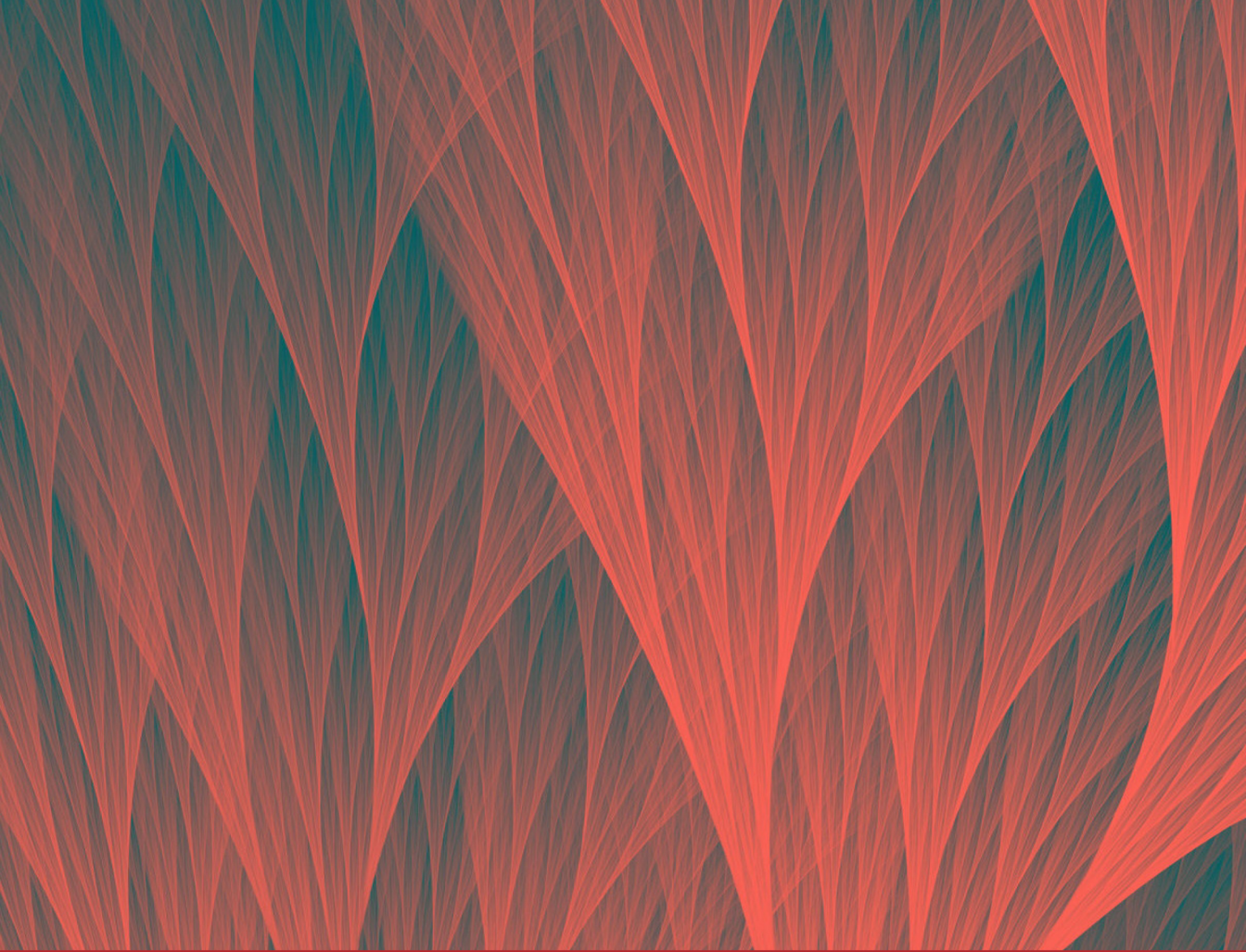




EDUCATIONAL PSYCHOLOGY HANDBOOK SERIES

HANDBOOK OF EDUCATIONAL PSYCHOLOGY AND STUDENTS WITH SPECIAL NEEDS

Edited by
ANDREW J. MARTIN, RAYNE A. SPERLING,
AND KRISTIE J. NEWTON



Handbook of Educational Psychology and Students with Special Needs

Handbook of Educational Psychology and Students with Special Needs provides educational and psychological researchers, practitioners, policy-makers, and graduate students with critical expertise on the factors and processes relevant to learning for students with special needs. This includes students with attention-deficit/hyperactivity disorder, other executive function difficulties, behavior and emotional disorders, autism spectrum disorder, intellectual disabilities, learning disabilities, dyslexia, language and communication difficulties, physical and sensory disabilities, and more. With the bulk of educational psychology focused on “mainstream” or “typically developing” learners, relatively little educational psychology theory, research, measurement, or practice has attended to students with “special needs.” As clearly demonstrated in this book, the factors and processes studied within educational psychology—motivation and engagement, cognition and neuroscience, social-emotional development, instruction, home and school environments, and more—are vital to all learners, especially those at risk or disabled.

Integrating guidance from the DSM-5 by the American Psychiatric Association and the International Classification of Diseases (ICD-10) by the World Health Organization, this book synthesizes and builds on existing interdisciplinary research to establish a comprehensive case for effective psycho-educational theory, research, and practice that address learners with special needs. Twenty-seven chapters by experts in the field are structured into three parts on diverse special needs categories, perspectives from major educational psychology theories, and constructs relevant to special needs learning, development, and knowledge building.

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1

INTRODUCTION

Educational Psychology and Students with Special Needs

Andrew J. Martin, Kristie J. Newton, Rayne A. Sperling

INTRODUCTION

Educational psychology is a discipline that attends to the factors and processes relevant to and implicated in learning. These factors and processes include motivation, engagement, and achievement—to name a few. It is fair to say that the bulk of educational psychology as a discipline has been focused and based on “mainstream” or “typically” developing learners. Relatively little educational psychology theory, research, measurement, or practice has attended to students with special needs. Because these students experience significant academic difficulties, this limited scholarly attention is a significant gap in educational psychology and also limits the potential for educational psychology to meaningfully contribute to other disciplinary areas that seek to assist students with special needs.

Addressing these limitations will provide researchers and practitioners with critical domain-specific expertise on the factors and processes relevant to learning for students with special needs. Indeed, addressing this gap is the driving purpose of this handbook. By synthesizing what has been learned in educational psychology and building on existing work in other educational and psychological disciplines, this handbook lays a broader base for effective theory, research, measurement, and practice as relevant to students with special needs.

Because educational psychology fundamentally focuses on learning factors and learning processes, it is in a unique position to understand and study students who are at academic risk wholly or partly because of a special need. Answers unearthed here will substantially augment current understanding of at-risk students among educational psychology researchers and practitioners. Importantly also, answers unearthed here can in turn contribute to other important channels of knowledge and practice in developmental psychology, school psychology, and counseling psychology—and also educational (e.g., special education) and medical (e.g., pediatric) disciplines. Thus,

we envisage this handbook can substantially guide the development, implementation, assessment, and refinement of successful multidisciplinary interventions to support and optimize these at-risk students' educational trajectories.

STUDENTS AT ACADEMIC RISK—THE STARTING POINT FOR THIS HANDBOOK

In our previous work in this space (Newton, Sperling, & Martin, 2017), we were drawn to conceptual frameworks that shed important light on at-risk children and young people (e.g., Coleman & Hagell, 2007). Harnessing such frameworks, we noted that students with special needs were at particular academic risk on a potentially frequent and ongoing basis and in a diversity of ways. These ideas were developed in a special issue of *Contemporary Educational Psychology* (Martin, Newton, & Sperling, 2017), guest-edited by us, focusing on students with learning disabilities, attention-deficit/hyperactivity disorder (ADHD), and executive function disorders. Focusing on these students, we identified various risk factors and risk behaviors that have significant relevance to these academically at-risk students more broadly, and especially those with special needs.

Risk Factors

Harnessing Coleman and Hagell's framework (Coleman & Hagell, 2007), risk factors were identified as factors increasing the probability of maladaptive outcomes, including illness, dysfunction, and disorder. Thus, for example, major conceptual models of ADHD and learning disabilities emphasize impairments to self-regulation and executive function that have adverse educational implications (Loe & Feldman, 2007; Nigg, 2001). Other models relevant to these disabilities emphasize cognitive, neuropsychological, neurological, and biochemical risk (Barkley, 2006; Brown, 2005; Chandler, 2010; Gray & McNaughton, 2003; Sergeant, 2005). Moreover, from a risk perspective, there are factors that interact with or compound existing challenges and their negative effects. For example, anxiety (a prevalent comorbidity for many students with special needs), can compound the academic risk experienced by students with learning disabilities, ADHD, and so on (Bauermeister et al., 2007; Cooray & Bakala, 2005; McGillivray & Baker, 2009). Taken together, a student's academic risk status has significant implications for major and salient educational outcomes that are the cornerstone of educational psychology. We intentionally extended risk factors in this volume to include students with maltreatment histories (Panlilio & Corr, Chapter 9), and Hall, Capin, Vaughn, and Cannon (Chapter 7) acknowledged the prevalence of risk factors in English-language learners within the United States.

Risk Behaviors

A second major dimension of risk relates to risk behaviors (Coleman & Hagell, 2007). Risk behaviors refer to challenging and potentially harmful behaviors and practices that can disrupt educational and developmental processes. Our special issue in *Contemporary Educational Psychology* also considered risk behaviors as relevant to students with learning disabilities, ADHD, and other executive function disorders.

We noted that, for each of these groups, there were maladaptive behaviors across a wide range of educational outcomes that threatened to disrupt their educational development (e.g., see Barkley, Murphy, & Kwasnik, 1996; DuPaul & Stoner, 2003; Martin, 2012). Among these students, for example, there are elevated levels of off-task behavior, problematic self-regulation, and poor task completion (Vile Junod, DuPaul, Jitendra, Volpe, & Cleary, 2006). The educational consequences of these risk behaviors included poor achievement, school exclusion, schoolwork non-completion, school refusal, and grade repetition, (DuPaul & Stoner, 2003; Martin, 2014a, 2014b; Pliszka, 2009; Purdie, Hattie, & Carroll, 2002). Again, then, a student's academic risk status has significant implications for major educational factors that are fundamental constructs and processes in educational psychology.

This handbook was inspired by the recent special issue in *Contemporary Educational Psychology* (Martin et al., 2017). However, that special issue focused on only a few aspects of special needs and at-risk status. We were thus mindful there remained an enormous range and diversity of conditions, disabilities, and disorders that can place a student at academic risk. We were also mindful of the many psycho-educational theories, processes, and factors that were not represented in its collection of empirical papers. Therefore, comprising a comprehensive range of psycho-educational perspectives, this handbook represents a major advancement in progressing current understanding of students with special needs.

SPECIAL NEEDS IN EDUCATIONAL PSYCHOLOGY—A QUIET SPACE REQUIRING MORE VOICES

As noted earlier, theory, research, measurement, and practice in educational psychology have been relatively quiet when it comes to students with special needs. The educational psychology research that has been conducted has tended to be sporadic and diffuse, at best. More voices in this area—and more consistently sounded—are needed in educational psychology. In fact, when considering the psychological and cognate disciplines that have attended to students with special needs, it seems as though school psychology, clinical psychology, and special education outlets have been more active than educational psychology. For instance, in a search of empirical studies in PsycINFO by Martin (2012), some 100 published articles were identified under one or both of the keywords “attention deficit with hyperactivity disorder” or “ADHD” between 1990 and 2010, in three major journals of school psychology (*Psychology in the Schools*, *Journal of School Psychology*, *School Psychology Quarterly*). In an update of this search, from 2011 to the time of writing (March 2019), there were 38 articles published in these school psychology outlets. In contrast, between the years 1990 and 2010, 7 articles derived from the same search parameters were published in three major journals of educational psychology (*Contemporary Educational Psychology*, *Journal of Educational Psychology*, *British Journal of Educational Psychology*). In an update of this search, from 2011 to the time of writing (March 2019), there were 19 articles published in these educational psychology outlets. This represented an improvement on 1990–2010 activity, but it hardly constitutes a major line of work in educational psychology—and 5 of the 19 articles were in our own special issue in *Contemporary Educational Psychology*. Although some special needs have received more attention in major educational psychology outlets, a similar pattern is present. For example,

Newton et al. (2017) reported that, in *Contemporary Educational Psychology*, 7 peer-reviewed articles published since 1990 were identified when PsychINFO was searched with “learning disabilities” as a keyword, and 38 peer-reviewed articles in the flagship outlet *Journal of Educational Psychology* were published during this time.

We hope this handbook inspires a great deal more scholarly activity in the educational psychology space than has been evident to date. We see this handbook as enabling opportunities for new conversations about students with special needs. We maintain that psycho-educational perspectives and voices will greatly strengthen current understanding of students with special needs. As highlighted in this handbook, there are tremendous and as-yet untapped opportunities and “green fields” of research among these students.

EDUCATIONAL PSYCHOLOGY INFORMING OUR KNOWLEDGE OF STUDENTS WITH SPECIAL NEEDS

This handbook is obviously concerned with how educational psychology can contribute to a better understanding of students with special needs—particularly as relevant to the factors and processes implicated in their learning. Thus, across the handbook, many theories of educational psychology are unpacked, with particular interest in how they can explain and inform the academic development of students with special needs. Major theories, such as expectancy-value theory (Wigfield & Ponnock, Chapter 17), self-worth theory (Martin, Chapter 16), achievement goal theory (Bergin & Prewett, Chapter 14), self-determination theory (Strnadová, Chapter 4; Wehmeyer & Shogren, Chapter 12), social cognitive theory (Cassady & Thomas, Chapter 3; Schunk & DiBenedetto, Chapter 11), control-value theory (Pekrun & Loderer, Chapter 18), self-regulation theory (Perry, Mazabel, & Yee, Chapter 13), and cognitive load theory (Tricot, Vandenbroucke, & Sweller, Chapter 15), are addressed in significant detail.

In each case, the authors have identified how major tenets under a respective theory align with the learning processes and principles for students with special needs, as they do for students without special needs. Thus, an important point made is that there is substantial congruence in the theoretical implications and applications of educational psychology for students with and without special needs. Importantly, however, as described below, many authors also identify some boundary conditions to major theory—and, in such cases, students with special needs play a major role in informing our knowledge of educational psychology.

When reading the chapters in this handbook, it became clear that major theories of educational psychology map onto distinct areas and aspects of special needs in ways that are difficult for other disciplinary theories to do. For example, with its clear and present focus on working and long-term memory, cognitive load theory is uniquely placed to shed significant light on how to improve reading for students with dyslexia (Tricot et al., Chapter 15) or with mathematics difficulties (Jordan, Barbieri, Dyson, & Devlin, Chapter 19). Similarly, engagement theories can help us understand and create interventions for students with attention difficulties or behavioral problems (O'Donnell & Reschly, Chapter 23), and findings related to academic self-concept have implications for supporting students with mild disabilities in inclusive classrooms (Tracey, Merom, Morin, & Maïano, Chapter 24). For students with ADHD and who experience significant academic failure, self-worth theory speaks specifically to some

of the maladaptive strategies they may engage in to protect their self-worth in the event of such failure (Martin, Chapter 16). And, balancing the need for guidance and autonomy, self-determination theory has much to say about autonomy-supportive structures and how to operationalize them for students with special needs (Strnadová, Chapter 4; Wehmeyer & Shogren, Chapter 12). In all such cases, major educational psychology perspectives uniquely target specific areas and aspects of special need, in ways that are distinct from what other disciplinary perspectives can offer.

STUDENTS WITH SPECIAL NEEDS INFORMING OUR KNOWLEDGE OF EDUCATIONAL PSYCHOLOGY

As the handbook developed, it was equally clear that there was much for educational psychology to learn from the focus on students with special needs. For example, by closely considering psycho-educational theories, some authors identified potential boundary conditions of these theories, or identified special considerations that researchers need to accommodate when conducting their investigations among special needs populations. As a case in point, the chapter on self-worth theory and ADHD (Martin, Chapter 16) recognized that an important assumption of self-worth theory is that students are sufficiently aware and reflective to know that they are at risk academically, as it is this awareness that leads to self-worth threat and then self-worth protection. Yet it is a capacity to self-reflect that may be diminished among students with ADHD. Thus, self-worth theory research conducted among students with special needs must in some way account for any potential confounding between aspects of the special need and fundamental tenets of the theory being applied.

Importantly, however, understanding of boundary conditions can also inform the generality or generalizability of psycho-educational theories, factors, and processes. As was observed above, there is substantial alignment between students with special needs and students without special needs in how psycho-educational theories, factors, and processes function. In a discipline that is dedicated to gaining reach across all students, generality and generalizability are critical elements. A test of this is how key educational psychology ideas and principles can explain learning among students with special needs. Indeed, because the bulk of psycho-educational ideas and principles have been developed on the basis of research among students without special needs, exploring generality among special needs populations is a very strong test of applicability. We think it is reasonable to assert that this handbook is a testament to the generality and applicability of educational psychology to students with special needs. To the extent this is the case, we further assert that educational psychology would be greatly assisted by a continued focus on these students.

The special needs space also presents unique challenges to educational psychology. The reality is that many at-risk students experience more than one disability, disorder, and so on (e.g., Cooray & Bakala, 2005; McGillivray & Baker, 2009). For example, it is not uncommon for anxious students and students with ADHD to also experience depression (e.g., Ostrander, Crystal, & August, 2006; Wigfield & Ponnock, Chapter 17), or for students with autism spectrum disorder to also experience anxiety (Gillies, Chapter 22). Similarly, Sigafos, Green, O'Reilly, and Lancioni (Chapter 8) shared the increased risks for anxiety, phobia, and obsessive-compulsive disorders among those with developmental disabilities. Further, underlying conditions such

as executive function deficits may result in co-occurring disabilities (e.g., Follmer & Sperling, Chapter 5). Dockrell and Lindsay (Chapter 6) also noted the co-occurrence of language impairments with a number of other developmental difficulties. This brings into consideration the need for multiple psycho-educational perspectives to effectively traverse the multiple challenges that students with special needs experience. Notably, a major strength of educational psychology is the wide range of theories, factors, and processes underpinning it that can be flexibly applied to a range of learner and learning conditions. As is evident across this handbook, there is remarkable applicability of educational psychology across a vast range of learner and learning conditions.

In other ways, students with special needs challenge educational psychology and stimulate further thinking about how students learn. For example, the reasoning skills of students with learning disabilities in mathematics may provide insight about important cognitive processes (Morsanyi, Chapter 21). Additionally, there is the relatively neglected issue of “twice exceptionality.” For example, some children are identified as gifted and are diagnosed with ADHD (Lee & Olenchak, 2015). Although care is required when diagnosing dual conditions such as this (see Mullet & Rinn, 2015), when explaining and supporting these students’ learning, educational psychology will need to meaningfully traverse two conditions that in some respects may reside at opposite ends of a learning continuum. This is a challenging undertaking, but those striving to do so will ultimately enrich educational psychology.

“SATELLITE” THEORIES IN EDUCATIONAL PSYCHOLOGY

When the range and applicability of salient and seminal educational psychology perspectives are considered, it is also evident there are numerous “satellite” theories that are highly effective in explaining and supporting the learning of students with special needs. We refer to these theories as “satellite” theories because they tend not to be typically considered as educational psychology theories; however, they are often invoked or harnessed in psycho-educational research. Thus, they may be major theories in other disciplinary channels, but are not central to educational psychology. One example is Bronfenbrenner’s ecological systems theory (Bronfenbrenner, 1992). We suggest this theory is not a psycho-educational theory per se, but is highly pertinent to the educational psychology discipline and is often harnessed in psycho-educational research.

An important revelation in this handbook is that, when dealing with the learning of students with special needs, some of these satellite theories become very central and powerful. Again, taking ecological systems theory as a case in point, the nature of special needs and the multitiered dimensions of need and support implicated in special needs render this theory almost indispensable to explanations of learning (Bronfenbrenner, 1988). Particularly for students with special needs, all layers of their ecology are critical for optimizing their learning outcomes (Dockrell & Lindsay, Chapter 6; Macfarlane, Macfarlane, & Mataiti, Chapter 25).

Another example is “theory of mind” (Premack & Woodruff, 1978). Typically, this would not likely receive a great deal of attention in educational psychology channels. However, in the context of learning among some groups with special needs, it becomes more salient. For example, students with autism spectrum disorder can have

difficulties engaging in reciprocal interactions, understanding others' perspectives, and recognizing others' emotional states—all factors critical for optimal functioning in a classroom. Theory of mind helps to explain the difficulties these students have in understanding others' thoughts, intentions, and feelings, and can guide social skills training to assist interpersonal relationships in the classroom (Gillies, Chapter 22; Hue, Chapter 10; see also Baron-Cohen, Leslie, & Frith, 1985).

Some chapters rely on established theoretical models coupled with satellite theories specific to content area or specific learners. For example, Hall et al. (Chapter 7) leveraged cognitive processing models but also required the use of interactive models of reading comprehension as an explanatory tool to best understand the challenges faced by English-language learners with special needs. The Reading Systems Framework, well known to educational psychologists, served in this role. Other scholars share models developed in their work that extend existing models for specific learners. Cassady and Thomas (Chapter 3), for example, share an emotional information-processing model as an explanatory tool for how learners with affective disorders may process internal and external cues. Panlilio and Corr (Chapter 9) explicate a conceptual framework that extends self-regulation theories to demonstrate influences of maltreatment and trauma on students' academic competence.

Taken together, the contents of this handbook challenge educational psychology theory, research, and practice to cast wider theoretical, empirical, and applied nets when considering learning among students with special needs. Theories that are considered “satellite” in the ordinary course of educational psychology among “mainstream” students may deserve more central positioning in future work among students with special needs.

INTERSECTIONS OF DIVERSE EXPERTISE

There is a vast amount of expertise represented in the handbook. As we invited authors and received chapters, it became evident that this expertise was demarcated in a variety of ways.

Disciplinary Homes

One major demarcation was in the authors' disciplinary homes. For example, some authors are well established in educational psychology, some are well established in special education, some are well established in cognate disciplines such as developmental psychology, and others are well established in sociological and sociocultural areas. The psychologically oriented authors were selected for their reach into one or more special needs area. The special educators were identified on the basis of their connections to educational psychology. Indeed, this handbook is about the vital and under-investigated nexus between psychology on the one hand and special needs on the other hand. It is this nexus that we challenged the authors to unpack and articulate.

As editors and as authors of our own chapters in this volume, we found that writing about educational psychology was something we were pretty comfortable with. We also found that writing about special needs was also reasonably doable. The tricky part was bringing the two together to explain and support the learning of students

with special needs. As we challenged ourselves and authors to expand in this space, we came to understand why so little work had been done to date. It is not easy work. It takes considerable scholarly energy to interpret and extrapolate to meaningfully contribute to this space. Dare we say, it also requires compassion and a belief in these students' capacity to strive to fulfill their academic potential. Dare we also say, the authors in this handbook delivered on all counts.

Theorists, Researchers, and Practitioners

Regardless of disciplinary home, another demarcation is evident in the various “hats” that authors wore in a given chapter. In each chapter, we sought solid and equal attention to theory, research, and practice. Perhaps not unexpectedly, authors with long research experience were sometimes challenged by the editors and reviewers to amplify implications for practice. Likewise, those with a strong track record of education and practice were sometimes challenged to amplify theoretical foregrounding and to make the evidence base clearer.

It was also evident that it was easier to draw on research in some areas and aspects of special needs than in other areas. In part, this reflects the different research traditions that have unfolded over the years and recognition (or identification) of new conditions and challenges in the special needs or disability field. For example, there has not been a lot of research to date into English-language learners with special needs. In contrast, there has been much more research into anxiety. In part, it may also reflect the fact that a particular special need is not categorized in formal classification schemes (e.g., DSM-5, American Psychiatric Association, 2013; ICD-10, World Health Organization, 2016) and thus does not attract as much attention in the research community. In part, it may also reflect the reality that empirical data (particularly quantitative data) are difficult to collect among some samples with special needs. For example, “classic” survey methodology and academic testing, which are mainstays in educational psychology, are not always appropriate for many students with special needs. In turn, a dearth of data leads to fewer empirical outputs on which to draw in the special needs area.

In similar vein, we believe it is important to be grounded in theoretical approaches to students with special needs. Because these students can present obvious and concrete challenges in the classroom, there can be a tendency for very applied research to be conducted among them. This is understandable—practitioners want to immediately help these students, and applied research makes a major contribution here. But, in this handbook, we wanted to showcase the important role theory can play in explaining and supporting learning for these students. We believe this is important for a few reasons. First, the nature of many special needs is such that they manifest in many different ways, depending on the student, their context, and so on. It is difficult to investigate all possible manifestations of special needs, and, even if we were to do so, it would be difficult for practitioners to be knowledgeable about all this research. However, when a practitioner has a good grounding in theory, this offers guiding principles that can direct intervention responses for many students in many contexts. Second, as noted above, there is a lack of educational psychology research in areas and aspects of special need or disability; theory can offer guidance for practice in the absence of specific research. Third, notwithstanding the

diversity of special needs, there is yield in implementing efficient interventions. For example, practitioners may be able to identify apparently different behaviors in terms of some common underlying dynamics. Theory is very helpful here. Taking self-determination theory as a case in point, it may be that implementing autonomy-supportive practices can actually address numerous aspects or manifestations of a special need or disability.

In this handbook, authors were also challenged to expand beyond “universal” intervention ideas that could apply to all children. Specifically, they were challenged to clearly articulate how their selected psycho-educational theory (or perspective/factor) would be operationalized in the academic lives of students with a particular special need. This too is not an easy task. It requires a careful and credible identification of key psycho-educational processes/mechanisms to be then applied to specific aspects of a particular special need. In so doing, we can optimize practice outcomes by providing guidance on well-directed psycho-educational strategies that target specific features of a specific special need.

OPERATIONALIZING SPECIAL NEEDS FOR THE HANDBOOK

For the purposes of the handbook, authors were asked to consider (at least as a starting point) special needs, disability, and at-risk status in terms of overarching categories and specific topics. Predominantly, these were drawn from the *Diagnostic and Statistical Manual of Mental Disorders*, version 5 (DSM-5; American Psychiatric Association, 2013), and the *International Classification of Diseases-10*, 2016 version (ICD-10; WHO, 2016). In total, there were five categories and numerous topics nested within each category. Authors were invited to select which one/s they felt their psycho-educational expertise could best inform. As the handbook demonstrates, there was some flexibility here. For example, some authors focused on one category and selected one or more topic(s) within that category. Others opted to focus on more than one category and a specific topic within each category.

The categories and topics presented to authors were as follows:

- Category 1: neurodevelopmental needs (example topics: intellectual disability, dyslexia, ADHD, etc.)
- Category 2: physical needs (example topics: sensory impairment, physical impairment, etc.)
- Category 3: emotional needs (example topics: anxiety, depression, etc.)
- Category 4: social and communication needs (example topics: autism spectrum disorder, language disorder, etc.)
- Category 5: behavioral needs (example topics: oppositional defiance disorder, conduct disorder, etc.)

Importantly, the categories and topics were not presented as prescriptive, definitive, or exhaustive. Other areas of at-risk status were identified by authors, and they elected to focus on these. Also, the topics listed within each category were deliberately incomplete to allow important topics to be proposed as a function of authors’ own expertise. Nevertheless, we did explicitly refer authors to the DSM-5 and the ICD-10 as starting points to ensure that these were part of their decision-making.

HANDBOOK STRUCTURE: A 360° APPROACH

We aimed for something of a 360° approach to educational psychology and students with special needs. In so doing, three major parts of the handbook were developed.

Part I is dedicated to “Students with Special Needs and Educational Psychology.” In this part, authors were asked to focus on a particular special needs area and explore diverse ways that educational psychology has or can progress knowledge, research, and practice in this area. Thus, the lens for Part I is a *specific special needs area*, with contributions from educational psychology identified. For example, Swanson has selected specific learning disability as the special needs area and examined this from a working memory perspective. In another chapter (Chapter 4), Strnadová has selected intellectual disability and examined this from a self-determination perspective. In all the chapters in this part, one or more special needs or disabilities are the focus and are then investigated through the lens of one or more educational psychology theory or perspective. The aim here is to highlight how students in each chapter’s designated special needs area can be assisted by psycho-educational researchers and practitioners harnessing these psycho-educational theories and perspectives.

Part II attends to “Perspectives from Major Educational Psychology Theories.” Authors in this part were asked to focus on major theories in educational psychology and explore diverse ways that they have contributed or can contribute to knowledge, research, and practice with regards to students with special needs. Thus, the lens for Part II was a *major educational psychology theory*, and what it offers the special needs field. Thus, for example, Schunk and DiBenedetto (Chapter 11) have selected social cognitive theory as the educational psychology lens to examine students with learning disabilities, reading disabilities, and ADHD. In another chapter (Chapter 17), Wigfield and Ponnock have selected expectancy value theory as the psycho-educational focus and used this as the lens to explore the educational development of students with depression and anxiety. In all the chapters in this part, one major educational psychology theory is the focus, harnessed as the lens to better understand an area of special need or at-risk condition. The aim here is to highlight how psycho-educational theory is applicable and helpful for educating children in diverse special needs areas.

Part III focuses on “Special Needs and Constructs Relevant to Psycho-Educational Development.” Here, authors were asked to focus on constructs and/or processes that are relevant to psycho-educational development and to harness these constructs/processes to explore diverse ways that they have contributed or can contribute to knowledge, research, and practice among students with special needs. Thus, the lens for Part III is a *specific construct or process* in educational psychology and what it offers the special needs field. Whereas Part II addresses major educational psychology theories, Part III addresses specific constructs, processes, or emerging ideas that have significant implications for students with special needs. These include themes such as interpersonal relationships, neuroscience, and technology, and also domain-specific processes such as writing and mathematics. Thus, for example, Graham and Harris (Chapter 20) have selected writing as a domain-specific activity and consider this among students with learning disabilities. In another chapter (Chapter 27), Byrnes and Eaton focus on neuroscience and consider this in terms of students with special needs such as those with autism spectrum disorder, conduct disorder, or

ADHD. Okolo and Ferretti (Chapter 26) explore ways that technology can support the cognitive and motivational needs of students with difficulties in reading. The aim here is to highlight how some specific and salient psycho-educational constructs/processes are applicable and helpful for educating children in diverse special needs areas.

In each chapter, we asked authors to address four elements as they connected educational psychology to their theories or areas of special need. These were: theory; research; implications for practitioners; and future directions for research, theory, and practice. We were also keen for authors' own expert voices to come through in this handbook. Thus, although we asked them to adhere to the four key elements (theory, research, etc.), we also welcomed inclusion of some summary or illustrative data they might have, as well as novel or cutting-edge models, concepts, methodologies, and directions based on their own expertise and experience in this field.

The reader will also notice that we (as Editors) engage more specifically with the chapters at the outset of each part. That is, we have not conducted the more traditional summary of chapters that often appears in opening chapters of handbooks such as this. Each editor was responsible for one part. Although the development of each part conformed to the overarching vision and mission of the handbook, each editor had a vision for their respective part. Indeed, each part evolved over the course of chapter revisions and interactions between the relevant part editor and authors. Essentially, the development of each part has its own story, in addition to the stories told by the authors themselves. We wanted each editor to tell this story, and so a more detailed summary of chapters (and their journeys) is presented at the appropriate points later in the handbook.

OUR AUDIENCE

Predominantly, there are three audiences we have sought to inform: researchers, graduate students, and practicing professionals.

Researchers

With regard to researchers, there is continued interest in comprehensive volumes that represent an integration of major fields in psychology and education, particularly when this integration occupies a unique space not previously addressed, as this volume does. We also believe the handbook should be of significant interest to researchers in aligned psychological disciplines such as developmental psychology, school psychology, and counseling psychology. Moreover, as the chapters in the handbook unfolded it became evident that they offered insights to researchers in cognate medical and other fields such as pediatrics and adolescent health.

Again, as noted above, there is very little educational psychology research attending to students with special needs. Because these students experience significant academic difficulties, this limited scholarly activity represents a significant gap in educational psychology. Addressing this gap provides educational and psychological researchers with critical domain-specific expertise on the factors and processes relevant to learning for students with special needs. This integration thus represents unique empirical space.

Students

In regard to students, the handbook is clearly relevant to many graduate students in educational psychology and (special) education disciplines. We also envisage that the handbook would be significant specialist support reading (e.g., to an undergraduate textbook) in undergraduate courses in educational psychology and special education. Most graduate education degrees in the USA, UK, Europe, and Asia-Pacific offer courses in the two subjects under focus in the handbook: educational psychology (or psychology of teaching and learning, learning theory and practice in the classroom, etc.) and special education (or teaching exceptional children, students with special needs, teaching in the inclusive classroom, etc.). Similarly, many psychology graduate degrees offer courses in educational psychology (or psychology of teaching and learning, psychology of education and teaching, learning theory and practice in the classroom, etc.). In regard to undergraduates, most teacher education degrees and some psychology degrees mandate study in the areas of educational psychology (or psychology of teaching and learning, learning theory and practice in the classroom, etc.) and special education (or teaching exceptional children, students with special needs, teaching in the inclusive classroom, etc.). We believe this handbook offers important perspectives to better inform graduate (and undergraduate) students in these courses and subjects.

Practicing Professionals

Authors of each chapter were asked to include significant material on implications for psycho-educational practice. Thus, although the volume has a strong research foundation, there is also credible and evidence-based practice directions identified in every chapter. Given this, the handbook has direct relevance to professionals, especially in the fields of educational psychology and special education. As we lamented earlier, it seems there have been more contributions to special needs and disability practice from school, developmental, and counseling psychology. No question, these contributions are vital, but we suggest that educational psychology illuminates critical learning factors and learning processes that underpin at-risk students' educational development. Educational psychology thus represents a major foundation for practitioners to optimize these students' educational development.

CONCLUSION

When considering students with special needs, prevalence rates for any given special need are not often high. However, we believe this is a misleading and problematic take on special needs that lacks ecological validity. We say this because, in any given class and school, there are many students with special needs or at risk of disability. The ecological reality is that they represent a critical mass of students. If we were to conduct an audit of special needs prevalence rates reported in this handbook's chapters, it would immediately be evident there are large numbers of students with special needs in absolute terms. We believe that, when a critical mass of students in a group is assisted, the group as a whole is assisted. To the extent this is the case, when students with special needs are assisted in their learning, their classrooms and schools are aca-

demically enriched as well. Because educational psychology is a discipline that attends to the factors and processes implicated in learning, it has much to contribute to these students and the classrooms and schools to which they belong.

REFERENCES

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders*, (DSM-5). Washington, DC: APA. doi:<https://doi.org/10.1176/appi.books.9780890425596>
- Barkley, R. A. (Ed.). (2006). *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment*. New York: Guilford Press.
- Barkley, R. A., Murphy, K., & Kwasnik, D. (1996). Psychological adjustment and adaptive impairments in young adults with ADHD. *Journal of Attention Disorders*, 1, 41–54. doi:<https://doi.org/10.1177/108705479600100104>
- Baron-Cohen, S., Leslie, A., & Frith, U. (1985). Does the autistic child have a theory of mind? *Cognition*, 21, 37–46. doi:[https://doi.org/10.1016/0010-0277\(85\)90022-8](https://doi.org/10.1016/0010-0277(85)90022-8)
- Bauermeister, J. J., Shrout, P. E., Ramírez, R., Bravo, M., Alegria, M., Martínez-Taboas, A., & Canino, G. (2007). ADHD correlates, comorbidity, and impairment in community and treated samples of children and adolescents. *Journal of Abnormal Child Psychology*, 35, 883–898. doi:<https://doi.org/10.1007/s10802-007-9141-4>
- Bronfenbrenner, U. (1988). Interacting systems in human development: Research paradigms: present and future. In N. Bolger, A. Caspi, G. Downey, & M. Moorehouse (Eds.), *Human development in cultural and historical contexts. Persons in context: Developmental processes* (pp. 25–49). New York: Cambridge University Press. doi:<https://doi.org/10.1017/CBO9780511663949.003>
- Bronfenbrenner, U. (1992). *Ecological systems theory*. London: Jessica Kingsley.
- Brown, T. E. (2005). *Attention deficit disorder: The unfocused mind in children and adults*. New Haven: Yale University Press.
- Chandler, C. (2010). *The science of ADHD*. Oxford: Wiley-Blackwell. <https://doi.org/10.1002/9781444328172>
- Coleman, J., & Hagell, A. (Eds.). (2007). *Adolescence, risk, and resilience*. London: John Wiley.
- Cooray, S. E., & Bakala, A. (2005). Anxiety disorders in people with learning disabilities. *Advances in Psychiatric Treatment*, 11, 355–361. doi:<https://doi.org/10.1192/apt.11.5.355>
- DuPaul, G. J., & Stoner, G. (2003). *ADHD in the schools: Assessment and intervention strategies* (2nd ed.). New York: Guilford Press.
- Gray, J. A., & McNaughton, N. (2003). *The neuropsychology of anxiety: An enquiry into the function of the septo-hippocampal system*. Oxford: Oxford University Press. doi:<https://doi.org/10.1093/acprof:oso/9780198522713.001.0001>
- Lee, K. M., & Olenchak, F. R. (2015). Individuals with a gifted/attention deficit/hyperactivity disorder diagnosis: Identification, performance, outcomes, and interventions. *Gifted Education International*, 31, 185–199. doi:<https://doi.org/10.1177/0261429414530712>
- Loe, I. M., & Feldman, H. M. (2007). Academic and educational outcomes of children with ADHD. *Journal of Pediatric Psychology*, 32, 643–654. doi:<https://doi.org/10.1093/jpepsy/jsl054>
- Martin, A. J. (2012). The role of personal best (PB) goals in the achievement and behavioral engagement of students with ADHD and students without ADHD. *Contemporary Educational Psychology*, 37, 91–105. doi:<https://doi.org/10.1016/j.cedpsych.2012.01.002>
- Martin, A. J. (2014a). Academic buoyancy and academic outcomes: Towards a further understanding of students with ADHD, students without ADHD, and academic buoyancy itself. *British Journal of Educational Psychology*, 84, 86–107. doi:<https://doi.org/10.1111/bjep.12007>
- Martin, A. J. (2014b). The role of ADHD in academic adversity: Disentangling ADHD effects from other personal and contextual factors. *School Psychology Quarterly*, 29, 395–408. doi:<https://doi.org/10.1037/spq0000069>
- Martin, A. J., Newton, K., & Sperling, R. (Eds.). (2017). Special Issue: Learning disabilities, ADHD, and executive functioning: Understanding academically at-risk students' learning, motivation, and engagement. *Contemporary Educational Psychology*, 50, 1–102. doi:<https://doi.org/10.1016/j.cedpsych.2016.12.003>
- McGillivray, J. A., & Baker, K. L. (2009). Effects of comorbid ADHD with learning disabilities on anxiety, depression, and aggression in adults. *Journal of Attention Disorders*, 12, 525–531. doi:<https://doi.org/10.1177/1087054708320438>

- Mullet, D. R., & Rinn, A. N. (2015). Giftedness and ADHD: Identification, misdiagnosis, and dual diagnosis. *Roeper Review*, 37, 195–207. doi:<https://doi.org/10.1080/02783193.2015.1077910>
- Newton, K. J., Sperling, R. A., & Martin, A. J. (2017). Learning disabilities, attention-deficit hyperactivity disorder, and executive functioning: Contributions from educational psychology in progressing theory, measurement, and practice. *Contemporary Educational Psychology*, 50, 1–3. doi:<https://doi.org/10.1016/j.cedpsych.2016.12.003>
- Nigg, J. T. (2001). Is ADHD an inhibitory disorder? *Psychological Bulletin*, 125, 571–596. doi:<https://doi.org/10.1037//0033-2909.127.5.571>
- Ostrander, R., Crystal, D. S., & August, G. (2006). Attention deficit-hyperactivity disorder, depression, and self- and other-assessments of social competence: A developmental study. *Journal of Abnormal Child Psychology*, 34, 773–787. doi:<https://doi.org/10.1007/s10802-006-9051-x>
- Pliszka, S. R. (2009). *Treating ADHD and comorbid disorders: Psychosocial and psychopharmacological interventions*. New York: Guilford Press.
- Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind?. *The Behavioral and Brain Sciences*, 4, 515–526. doi:<https://doi.org/10.1017/S0140525X00076512>
- Purdie, N., Hattie, J., & Carroll, A. (2002). A review of the research on interventions for attention deficit hyperactivity disorder: What works best?. *Review of Educational Research*, 72, 61–99. doi:<https://doi.org/10.3102/00346543072001061>
- Sergeant, J. A. (2005). Modeling attention-deficit/hyperactivity disorder: A critical appraisal of the cognitive-energetic model. *Biological Psychiatry*, 57, 1248–1255. doi:<https://doi.org/10.1016/j.biopsych.2004.09.010>
- Vile Junod, R. E., DuPaul, G. J., Jitendra, A. K., Volpe, R. J., & Cleary, K. S. (2006). Classroom observations of students with and without ADHD: Differences across types of engagement. *Journal of School Psychology*, 44, 87–104. doi:<https://doi.org/10.1016/j.jsp.2005.12.004>
- World Health Organization. (2016). *International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10)*. Geneva: WHO.

Part I

Students with Special Needs and Educational Psychology

Rayne A. Sperling

We tasked authors in Part I to focus on a particular disability or special needs area. In each chapter, these experts share information about the special need with recognition that many of the readers of the handbook may not be familiar with the prevalence, characteristics, etiology, implications for how the special need may present in the context of academic achievement, or likely co-occurring conditions of specific special needs. As they present these details, authors also reveal how psycho-educational researchers benefit from greater knowledge of each special need.

In this part, as across the handbook, we seek clear and specific links between the identified special need and educational psychology, and each chapter shares theory or theories, research, implications for practice, and future directions. Authors rose to the challenge, and, as a result, the contributions in this part provide solid foundation for moving educational psychology (and related fields such as special education) forward.

The awareness and conversations regarding students with specific special needs these chapters will spark are essential, if only owing to the number of students impacted. For, in the United States alone, the National Center for Educational Statistics (NCES) reports that, in 2017–2018, 7 million individuals aged 3–21 were receiving special education services (https://nces.ed.gov/programs/coe/indicator_cgg.asp). Importantly, not all students impacted are receiving services. The contributions in this part further elucidate the characteristics of these many learners.

The intersection of special needs and educational psychology is complex (see also Newton, Part III, this volume). There is not a one size, or one theory, fits all solution to the challenges presented by this intersection. The authors vary considerably in their approach to their contributions. This variance is in part a function of the varied expertise found among the authors. Many authors in this part are scholars known for their research in a specific area of special needs. This variance is also likely due, in part, to the uniqueness of the many special needs addressed, as well as by the complexities that emerge in research and practice with special needs populations.

Despite this variance and the unique contribution of each of the chapters, themes emerge across the part. Three of these themes include, first, that specific disabilities or needs are often not clearly nor consistently defined. Second, co-occurring conditions present additional challenges in delineating specific special needs. Third, no single educational psychology theory can be leveraged to explain specific needs or how research or practice can support learners with a specific need. Across the chapters in the part, it is also clear that additional research is necessary, and the authors provide essential suggestions for needed future research directions.

SPECIFIC DISABILITIES OR NEEDS ARE NOT CLEARLY OR CONSISTENTLY DEFINED

As the authors in Part I define and explain their area of specific special need, many note some vagueness in identifying the characteristics of these learners. In their chapter on developmental disability (Chapter 8), Sigafoos, Green, O'Reilly, and Lancioni note, for example, that at times different types of educational need categories may be included within the umbrella term “developmental disability.” When one casts the net widely, the term may include students with ADHD, epilepsy, and vision and hearing needs, for example. Similarly, Hue (Chapter 10) notes inconsistencies in how behavioral and emotional special needs are classified and defined and argues that what is included within the category of a behavioral disorder can be a function of an individual's unique context.

In addition to what may be included under the umbrella of a specific disability category, the names of the categories also lack consistency and evolve over time. The authors work to provide this context. Dockrell and Lindsay (Chapter 6), for example, share several terms that are used to describe persistent difficulties in language acquisition and use of language, such as specific language impairment (SLI), language disorder, and speech language and communication needs (SLCN). Strnadová (Chapter 4), similarly, reported different terms once used to capture what is now known as “intellectual disability.” The lack of clarity that results from vague definitions of special need categories is a concern discussed for decades that continues to present ongoing challenges for both research and practice, including in educational psychology.

CO-OCCURRING CONDITIONS PRESENT ADDITIONAL CHALLENGES IN DELINEATING SPECIFIC SPECIAL NEEDS

Co-occurrence is an area of targeted research within studies that examine special needs, and the co-occurrence of conditions also represents an important theme found across the chapters in this part. As some examples, Sigafoos and colleagues (Chapter 8) noted the marked increased risk of psychological problems for learners identified with developmental disabilities. Strnadová (Chapter 4) indicated some of the co-occurring needs often found with intellectual disability. Dockrell and Lindsay (Chapter 6), when discussing language impairments, shared conclusions found in the literature that co-occurring conditions in these learners were expected, and not finding co-occurring conditions was the exception.

Two chapters specifically examine co-occurrence. In Panlilio and Corr (Chapter 9), the roles of early adversity and maltreatment and potential co-occurring special needs

are explored, and, in Hall, Capin, Vaughn, and Cannon (Chapter 7), the challenges of understanding special needs within the context of English-language learning are tackled. Both of these chapters present cutting-edge thinking in emerging areas of scholarship. Co-occurrence of special needs increases challenge in generalizing findings from research and can constrain the ability to develop and test interventions for a targeted need.

NO SINGLE EDUCATIONAL PSYCHOLOGY THEORY FITS ALL

Across the chapters in Part I, authors leverage a variety of theories to explain specific needs and to discuss potential design and application of interventions (see also Martin, Newton, & Sperling, Chapter 28, this volume). For some of the authors, the connection to educational psychology theories is a challenge; for others, theory is foundational to their thinking about specific needs. Some of the authors employ theories that are well-established educational psychology theories, whereas others suggest known theories that are somewhat less commonly applied in educational psychology research. Both Swanson (Chapter 2), and Follmer and Sperling (Chapter 5), for example, rely on cognitive views of learning as they discuss the role of working memory and executive functions, respectively. Strnadová (Chapter 4) grounds her discussion of inclusion of students with intellectual disability in self-determination theory, a theory well referenced in educational psychology research. In their chapter (Chapter 7), which targets English learners who also demonstrate learning difficulties, Hall and colleagues attend to theoretical models specific to reading and reading development. Dockrell and Lindsay (Chapter 6) employ the Bronfenbrenner model to illuminate the multilevel complexities of language difficulties.

Both Cassady and Thomas (Chapter 3), and Panlilio and Corr (Chapter 9) forward models that extend existing educational psychology theories in order to explicate mediating and moderating variables that impact outcomes for students with academic anxieties and those with histories of maltreatment accordingly. Cassady and Thomas revisit the emotion information-processing framework, a model that extends models of both social information-processing and self-regulation. This framework affords the opportunity to specify person-level and contextual variables that play a role in academic anxieties. In a similar manner, Panlilio and Corr extend a self-regulated learning model to include potential factors that influence the path to academic competence for those learners who experience early risk such as maltreatment and/or disability.

MORE RESEARCH IS NECESSARY

In his 2017 commentary in *Contemporary Educational Psychology*, Volume 50, Special issue, Graham called for future research that examines educational psychology and special needs. Authors in Part I share some of the same themes in their calls for future research. These authors' numerous recommendations indicate that varied methodologies are necessary to address areas of additional research need. Authors implicate and suggest research that benefits understanding of individual students through inclusive research practices (e.g., Strnadová, Chapter 4), as well as qualitative and case study methods (e.g., Hue, Chapter 10), is warranted. Others suggest correlational research studies as one approach to better understanding constructs of study (e.g., Follmer &

Sperling, Chapter 5; Swanson, Chapter 2), as well as studies of varied methods to test existing and new models (e.g., Panlilio & Corr, Chapter 9). Many authors point to research designed to test the effectiveness of existing and potential interventions (e.g., Cassady & Thomas, Chapter 3; Dockrell & Lindsay, Chapter 6; Hall et al., Chapter 7). Of particular importance, and a theme found in the volume overall, Sigafoos and colleagues (Chapter 8) make explicit the need to focus on students' strengths and abilities rather than deficits in future research and practice. Overall, the authors' recommendations focus on the necessity of additional research that supports assessment, identification, and optimal environments, conditions, and instruction for students with special needs.

2

SPECIFIC LEARNING DISABILITIES AS A WORKING MEMORY DEFICIT

A Model Revisited¹

H. Lee Swanson

The chapter provides a review as well as an update on a model outlined by Swanson and Siegel (2001a, 2001b) that suggested that specific processes related to the phonological and executive system of working memory (WM) underlie specific learning disabilities in reading and/or math. We find (e.g., Swanson, 1992, 1993c; Swanson & Beebe-Frankenberger, 2004; Swanson & Fung, 2016; Swanson & Jerman, 2007), as do others, that children who have normal intelligence but suffer specific learning disabilities in reading (referred to as reading disabilities; RD) and/or math (referred to as math disabilities, MD) experience considerable difficulties on WM tasks (e.g., Attout & Majerus, 2015; Brandenburg et al., 2015; De Weerd, Desoete, & Roeyers, 2013; Passolunghi & Siegel, 2004; Peng, Congying, Beilei, & Sha, 2012; Wang & Gathercole, 2013). In this chapter, we review work that provides an empirical foundation for the view that specific learning disabilities in reading and/or math reflects a fundamental deficit in WM.

Before discussing the research linking learning disabilities in reading and/or math to WM, we review an operational definition of specific learning disabilities and WM. We then review the theoretical basis of our model as well as criticisms of application of the model to children with RD and/or MD. We next review syntheses of the literature linking WM to RD and/or MD and then review work from our own lab linking specific learning disabilities in reading and/or math to specific components of WM. We then bring the reader up to date on our intervention research that has focused on helping children with RD and/or MD compensate for their WM deficits.

DEFINITION OF TERMS

Learning disabilities: The concept of specific learning disabilities rests on two assumptions: (a) academic difficulties are *not* due to inadequate opportunity to learn, general intelligence, or physical or emotional disorders, but to basic disorders in specific psychological

processes; and (b) these specific processing deficits are a reflection of neurological, constitutional, and/or biological factors. Thus, to assess specific learning disabilities at the cognitive level, systematic efforts are made to detect: (a) normal psychometric intelligence; (b) below normal achievement in a specific academic skill; (c) below normal performance in a specific cognitive processes (i.e., phonological awareness, WM); (d) whether systematic opportunity to learn has occurred (documentation that optimal instruction has been presented, but deficits in isolated processes remain); and (e) that processing deficits are not directly caused by environmental factors or contingencies (e.g., SES, child rearing).

We operationally defined specific learning disabilities as occurring in those children and adults who have general intelligence scores on standardized tests above 85 and who have reading scores and/or math scores below the 25th percentile (90 standard score) on a standardized norm-referenced reading/and or mathematics achievement measure. In some studies, our criterion or cut-off point for defining low achievement is much lower than the 25th percentile (e.g., below the 11th percentile) and general IQ is higher (> 95). Our more recent classification studies that included measures of latent class and latent transition analysis suggest that a discrete class of children with RD and MD emerges consistent with our previous cut-off points (e.g., Swanson, Olide, & Kong, 2018). An IQ-achievement test score discrepancy is not used in our studies because it does not consistently discriminate in terms of processing difficulties between children with specific learning disabilities and slow learners (e.g., children with low intelligence and reading/math ability; see Hoskyn & Swanson, 2000, for a review).

No doubt, the degree to which children with RD and/or MD differ from their normal achieving counterparts on WM measures varies as a function of the cut-off points on achievement measures as well as environmental factors such as SES. However, in our sampling of children at risk for RD and/or MD from low SES (e.g., migrant families; e.g., Swanson, Sáez, Gerber, & Leafstedt, 2004) and high SES backgrounds (e.g., private schools; Swanson, 1993a) they have consistently shown significantly lower performance on WM measures when compared with their average achieving peers. In fact, some studies suggest that, when vocabulary is controlled in the analysis, SES plays a minor role in WM differences (e.g., Engel, Santos, & Gathercole, 2008; Maguire et al., 2018). For example, Engel et al. matched children of low and high SES families on age, gender, and nonverbal ability and compared them on vocabulary and WM measures. As expected, children from the low SES group obtained significantly lower scores on measures of expressive and receptive vocabulary than their higher-income peers, but no significant group differences were found on the WM measures. We would not argue from this study or others that WM abilities are impervious to substantial differences in socioeconomic background; however, our research suggests that our sampling of children at risk for RD and/or MD manifest WM deficits relative to their average achieving peers across SES groups.

Working memory: WM consists of a limited-capacity system of temporary stores and functions related to the preservation of information while other information and attention control related to these functions is simultaneously processed (e.g., Baddeley, 2012; Unsworth & Engle, 2007; see Swanson, 1999, 2017, for review). Cowan (2014) defines WM “as the small amount of information that can be held in the mind and used in the execution of cognitive tasks, in contrast with long-term memory (LTM), which is the vast amount of information saved in one’s life” (p. 197). WM or complex span tasks share the same processes (e.g., rehearsal, updating, controlled search) as short-term memory (STM) or simple span tasks. However simple tasks (e.g., recalling words or digits in the order of presentation) have a greater reliance on phonological processes

than WM or complex span tasks (e.g., recalling words or digits in the context of interference/distraction; see Unsworth & Engle, 2007, pp. 1045–1046, for a review). Simply stated, WM tasks assess an individual's ability to maintain task-relevant information in an active state and to regulate controlled processing. Individuals performing WM tasks must remember some task elements and ignore, or inhibit, other elements as they complete task-relevant operations (e.g., Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). In contrast, tasks that measure STM typically involve situations that do not vary from initial encoding (e.g., Unsworth & Engle, 2007). In elaborating the distinction between STM and WM, Cowan (1997) emphasized the role of attentional processes. WM is depicted as a subset of items of information stored in STM that are in turn submitted to limited attentional control processing (see also Engle, Tuholski, Laughlin, & Conway, 1999). This assumes that, when the contents of STM are separated from WM, what is left of WM is some form of controlled attention or processing related to the central executive system (also referred to as the central executive component of WM).

Theoretical Foundation

By far the most utilized framework for understanding the role of WM as it applies to learning disabilities is Baddeley's multiple-components model (Baddeley, 2012; Baddeley & Logie, 1999). In this model, WM consists of three components: visual-spatial sketchpad, phonological loop, and central executive. The visual-spatial sketchpad is for the temporary storage of visual and spatial information, and it is important for manipulation of mental images, such as symbols and shapes. The phonological loop is for the temporary storage of verbal information, and it is important for temporary storage of text and verbal information, such as the story within a text reading. The central executive coordinates activities between the two subsystems (i.e., visual-spatial sketchpad and phonological loop) and increases the amount of information that can be stored in the two subsystems. This model has been revised to include an episodic buffer (Baddeley, 2012), but support for the tripartite model has been found across various age groups of children (e.g., Alloway, Gathercole, Willis, & Adams, 2004; Gathercole, Pickering, Ambridge, & Wearing, 2004). For example, Gray et al. (2017) added measures of the episodic component (tasks that bind verbal and visual information) to a battery of WM measures in children and found weak support for the four-factor model when compared with Baddeley's earlier three-factor model (e.g., Baddeley & Logie, 1999). In addition, because the Baddeley and Logie model originally had three components, and a fourth component was added later, for the current purposes, this fourth component was not considered in our model of specific learning disabilities.

Within a multiple component model of WM and when compared with average achievers, our model views children with RD and/or MD as manifesting deficits related to the phonological loop, a component of WM that specializes in the retention of speech-based information. However, in situations that place high demands on processing, individuals with RD and/or MD have deficits related to the executive component of WM, primarily related to controlled attentional processes (e.g., updating and/or maintaining task-relevant information in the face of distraction or interference) that can operate independent of their problems in the phonological system. No doubt, this theoretical model seems counterintuitive when applied to specific learning disabilities, as WM, especially the executive component, has been associated with a number of

other domain-general processes, such as intelligence and attention. For example, how is it that children with specific problems in reading and/or math, but with normal intelligence, exhibit deficits in domain-general processes related to the executive system of WM? We will briefly consider four false assumptions and possible explanations as to why executive processing deficits in WM may underlie RD and/or MD.

Problems in WM Are Merely a Function of Intelligence

As stated, it seems counterintuitive that children with average intelligence can experience deficits related to tasks that tap the executive component of WM. This is because current studies show that the executive component of WM (updating, suppression of competing traces) is strongly correlated with fluid intelligence (e.g., Ackerman, Beier, & Boyle, 2002; Engle et al., 1999; Kyllonen & Christal, 1990; Swanson, 2008). Fluid intelligence is assessed on measures that tap reasoning, thinking, or the ability to acquire new knowledge (Carroll, 1993). Thus, it is rather unexpected that children with average intelligence, but with RD and/or MD, will have difficulties on WM tasks. This paradox can be addressed in three ways.

First, the relationship between the executive component of WM and fluid intelligence in children with RD and/or MD may be indirect. That is, a weak to moderate relation exists between WM and fluid intelligence (performance on the Raven Colored Progressive Matrices test) in children with reading and/or math problems. For example, Swanson and Alexander (1997) found that the magnitude of the correlations between the executive component of WM and fluid intelligence (Raven Colored Progressive Matrices Test) was significantly smaller in children with RD than in average readers (see Table 4 in Swanson & Alexander, 1997). This finding suggests evidence that fluid intelligence, although related to the executive system of WM, is not an exclusive manifestation of such a system.

Second, our work on problem-solving shows that children with RD and/or MD may use different routes or processes to problem solve, even though solution accuracy is comparable with chronological age (CA)-matched peers (Swanson, 1988, 1993a). Swanson (1988, 1993a) found that students with RD yield performance comparable with average readers on fluid measures of intelligence, but relied on different cognitive routes than average readers in problem-solving (tasks were Tower of Hanoi task, as well as two Piagetian problem-solving tasks [combinatorial, pendulum]). For example, on measures of fluid intelligence, problem-solving for children with RD was augmented by “emphasizing problem representation (defining the problem, identifying relevant information or facts given about the problem) rather than procedural knowledge or processes used to identify algorithms” (Swanson, 1993a, p. 864). In this context, procedural knowledge refers to focusing on the mental steps that led to problem solution. Thus, there is evidence suggesting that performance by individuals with RD on fluid measures of intelligence may involve compensatory processing. This compensation can partially overcome problems in executive processing (e.g., attention allocation) that, in turn, may allow them to perform in the normal range.

Finally, individuals with below average reading and math problems may achieve normal intelligence because the information they experience in their environment does not always place high demands on their WM. A standardized test of WM (S-CPT; Swanson, 1995) shows, for example, that the majority of children with average intelligence but with reading deficits scored in the 21st percentile on WM measures (scaled

scores across 11 subtests hovered around 8, or a standard score of 88; see Swanson, 1995, p. 167), suggesting they have weak but adequate WM ability to process information and then store information over the long term.

*Attributing RD and/MD to Executive Processing Is
Counterintuitive to the Notion of Specific Disabilities*

Another false assumption is that executive processing deficits represent only domain-general deficits and not specific deficits. That is, difficulties in executive processing are viewed as general processing activities and not related to specific operations. However, executive processing is made up of several parts (i.e., updating, inhibition, task switching) that reflect a number of different mental activities, each of which can represent a specific cognitive process and/or operation. For example, some of these operations can reflect a specific mental constraint in children with RD and/or MD related to (a) maintaining task-relevant information in the face of distraction or interference, (b) suppressing and inhibiting information irrelevant to the task if necessary, or (c) quickly accessing information from LTM, all which have been attributed to specific disabilities in reading and/or math (e.g., see Kudo, Lussier, & Swanson, 2015; Swanson & Jerman, 2006).

*Problems in the Executive System Are Secondary to
Deficits in the Phonological Storage System*

Some studies have argued that deficits in phonological processes for children at risk for RD and/or MD create a bottleneck in the processing of information within the executive system (e.g., Hecht, Torgesen, Wagner, & Rashotte, 2001; Peng et al., 2017; Shankweiler & Crain, 1986). Basic structural deficiencies in the storage of phonological input are assumed to impair higher-level processing, such as executive processing. This bottom-up processing approach views lower-level linguistic and cognitive analysis as subserving or influencing processing in an “upstream” manner. Therefore, performance differences on executive processing measures between children with RD and/or MD and average achievers would be eliminated once performance related to phonological processing was partialled out of the analysis.

Several of our regression studies have shown, however, that executive processing deficits within the WM system exist in children with RD and/or MD independent of their deficits in phonological processing (Swanson, 2004; Swanson & Ashbaker, 2000; Swanson & Berninger, 1995; Swanson & Sachse-Lee, 2001a, 2001b). In addition, problems in WM have been found to persist in children with RD and MD even after the influence of verbal articulation speed (e.g., Swanson & Ashbaker, 2000; Swanson & Beebe-Frankenberger, 2004), STM (e.g., Swanson, Ashbaker, & Lee, 1996), or IQ scores (e.g., Swanson & Sachse-Lee, 2001a, 2001b) is partialled out in various regression models.

*Executive Processing Problems in Children with RD and/or
MD Are Manifestations of Attention Disorders*

Because executive deficits are manifestations of monitoring attention, it is easy to attribute executive processing deficits that might arise in children with RD and/or MD

as manifestations of attention-deficit/hyperactivity disorder (ADHD). This is because RD and ADHD are frequently comorbid in epidemiological studies. However, a distinction can be made between executive processing deficits related to the self-monitoring of attention and constraints in attentional capacity. Studies that attribute executive deficits to ADHD primarily rely on measures related to various forms of planning, not measures of WM (e.g., Barkley, 1997). Some studies suggest that children with ADHD do not exhibit WM deficits (Willcutt et al., 2001). For example, Siegel and Ryan (1989) found that ADHD children's WM span scores were not significantly different from those of normal achievers. In addition, the literature is clear that WM problems exist in individuals with RD and/or MD who do not suffer from behavioral manifestations (e.g., inability to attend or focus for long periods, impulsivity) of attention deficits (Siegel & Ryan, 1989). Willcutt, Doyle, Nigg, Faraone, and Pennington's (2005) meta-analyses have examined executive processing tasks as a means of differentiating ADHD from other disabilities. The largest difference in favor of the control group emerged on measures of response inhibition, vigilance, planning, and WM, raising concerns as to whether deficits in executive functioning per se are a sufficient or necessary cause of ADHD (see Follmer & Sperling, Chapter 5, this volume, for discussion of executive functions and ADHD).

Regardless, the symptoms commonly attributed to ADHD children's poor attentional monitoring (impulsivity, distractibility, diminished persistence, diminished sensitivity to feedback, lack of planning and judgment) appear intact relative to ADHD children for children with RD and/or MD (see Kudo et al., 2015). In contrast to ADHD children, research with RD children has shown normal levels of planning and judgment on various problem-solving tasks (e.g., Tower of Hanoi; Swanson, 1993a), and signal detection measures (d') on vigilance tasks show comparable persistence (although less attentional capacity) with average achievers in their use of attentional resources across time (Swanson, 1981, 1983). These findings do not imply that children with RD and/or MD do not experience monitoring and planning difficulties on high-order tasks such as reading comprehension (e.g., Locascio, Mahone, Eason, & Cutting, 2010) and/or math problem-solving (e.g., Swanson, Lussier, & Orosco, 2015), but rather our results suggest that, on some tasks that require complex problem-solving, such children's procedural knowledge (e.g., steps to solve a problem) parallels that of average achievers.

RESEARCH ON WORKING MEMORY

Synthesis of Literature

Given this multicomponent view of WM, and prior to selectively reviewing some of our work, a quantitative overview of the literature on WM is necessary to provide a context for our findings. We briefly summarize quantitative syntheses of the published literature on RD, MD, and memory (e.g., Kudo et al., 2015; also see Johnson, Humphrey, Mellard, Woods, & Swanson, 2010; Peng & Fuchs, 2016; Swanson & Jerman, 2006). A common metric utilized in these meta-analyses is referred to as effect size (ES) and reported as a d -index. To make d s more interpretable, statisticians have adopted Cohen's (1988) system for classifying d s in terms of their size (i.e., .00–.19 is described as trivial; .20–.49, small; .50–.79, moderate; .80, high or large).

Working Memory and Short-Term Memory

A previous meta-analysis of the literature on children with RD (Swanson, Zheng, & Jerman, 2009) suggested that such children clearly vary from their average reading counterparts on means of STM and WM. As shown in Table 2.1, ESs across a broad age, reading, and IQ range yielded a mean ES across memory studies of $-.89$ ($SD = 1.03$) in favor of their chronologically matched average reading counterparts. The moderate range for STM measures consisted in 255 ESs ($M = -.61$, 95% confidence range from $-.65$ to $-.58$), and 320 ESs were in the moderate range for WM measures ($M = -.67$, 95% confidence range from $-.68$ to $-.64$). The synthesis clearly indicated that children with RD were distinctively disadvantaged compared with average readers on (a) STM measures requiring the recall of phonemes and digit sequences and (b) WM measures requiring the simultaneous processing and storage of digits and words within sentence sequences and final words from unrelated sentences. The results of this synthesis also indicated, via a meta-regression analysis, no significant moderating effects related to age, IQ, or reading level emerged when predicting memory ESs. In general, the findings indicated STM and WM differences

Table 2.1 Effect Size as a Function of Categorical Variables for Children with Reading Disabilities when Compared with Chronological Age and IQ Matched Children

Category	K	Weighted Effect Size	SE	95% CI for effect size	
				Lower	Upper
<i>Short-Term Memory</i>					
1. Phonological	22	-0.39*	0.05	-0.50	-0.29
2. Pictures	53	-0.57	0.04	-0.65	-0.49
3. Words	76	-0.55	0.03	-0.61	-0.48
4. Digits	55	-0.63	0.03	-0.69	-0.56
5. Letters	13	-1.10	0.07	-1.24	-0.95
<i>Divided Attention</i>					
6. Backwards	59	-0.69	0.03	-0.74	-0.63
7. Preload	7	-0.49	0.12	-0.73	-0.26
8. Sorting	30	-0.52	0.04	-0.60	-0.44
<i>Working Memory—D & C format</i>					
9. Counting	32	-0.78	0.03	-0.84	-0.73
10. Listen/Sentence	57	-0.84	0.03	-0.89	-0.79
11. Visual Matrix	72	-0.80	0.03	-0.86	-0.74
12. Complex Visual	20	-0.48	0.05	-0.57	-0.39
13. Semantic Assoc.	31	-0.37	0.04	-0.44	-0.30
14. Digit/Sentence	24	-0.58	0.05	-0.68	-0.48
15. Story Retelling	9	-0.37	0.07	-0.50	-0.24
16. Phonol./Rhyming	13	-0.61	0.06	-0.74	-0.49

Notes: Daneman and Carpenter task format, K = number of dependent measures; lower and upper = 95% level of confidence range; weighted = adjusted for sample size

*Positive ESs favor RD, and negative ESs favor comparison group

between ability groups persisted across age, suggesting that both a phonological system (STM) and components of the executive system (WM) underlie RD.

RD versus MD

Of interest is whether MD and RD share the same and/or different WM problems. To address this question, Swanson and Jerman (2006) performed a quantitative synthesis of the literature comparing the cognitive functioning of children with MD with (a) average achieving children, (b) children with RD, and (c) children with comorbid disabilities (RD + MD) on this issue. The ESs as a function of ability group, STM, and WM measures are shown in Table 2.2. When focusing on children with MD, approximately 194 ESs compared children with MD with average achievers ($M = -.52$, $SE = .01$), 58 ESs compared MD and children with RD ($M = -.10$, $SE = .03$), and 102 ESs compared children with MD with children with MD + RD ($M = .26$, $SE = .02$) on various cognitive measures. Overall, average achievers outperformed children with MD on measures of verbal problem-solving ($M = -.58$), naming speed ($M = -.70$), verbal WM ($M = -.70$), visual-spatial WM ($M = -.63$), and LTM ($M = -.72$). The magnitude

Table 2.2 Weighted Effect Sizes, Standard Error, Confidence Intervals, and Homogeneity of Categories for Comparisons between Math Disabled and Non-Math Disabled (MD/NMD), MD and Reading Disabled (MD/RD), and MD and RD + MD (CMOR; corrected for outliers)

Comparison	K	Weighted Effect Size	Standard Error	Lower	Upper
STM: Words					
MD/NMD	16	-.45*	.06	-.58	-.32
MD/RD	3	.16	.13	-.10	.42
MD/CMOR	4	.71	.12	.46	.96
STM: Digits/Numbers					
MD/NMD	11	-.26	.07	-.41	.10
MD/RD	4	.03	.14	-.24	.32
MD/CMOR	9	-.08	.11	-.30	.13
WM: Verbal					
MD/NMD	43	-.70	.04	-.79	-.61
MD/RD	19	-.07	.06	-.19	.04
MD/CMOR	20	.30	.06	.17	.42
WM: Visual Spatial					
MD/NMD	13	-.63	.07	-.77	-.48
MD/RD	13	-.30	.07	-.44	-.16
MD/CMOR	13	.23	.07	.08	.38

Notes: MD = math disabled only; NMD = non-math disabled average achiever; RD = reading disabled; CMOR = comorbid group with both low reading and low math; K = number of measures; lower and upper = 95% level of confidence range

*Positive ESs favor MD, and negative ESs favor comparison group

of these ESs was persistent across age and severity of the math disability. The results further indicated that children with MD outperformed children with comorbid disabilities (MD + RD) on measures of literacy ($M = .75$), visual-spatial problem-solving ($M = .51$), LTM ($M = .44$), STM for words ($M = .71$), and verbal WM ($M = .30$). Interestingly, a quantitative summary of the literature found that children with MD could only be differentiated (although weakly) from children with RD on measures of naming speed ($-.23$) and visual-spatial WM ($-.30$). More importantly, hierarchical linear modeling (HLM; Bryk & Raudenbush, 1992) of the data showed that the magnitude of ESs in overall cognitive functioning (criterion measure) between MD and average achievers was primarily related to WM deficits when the effects of all other variables (e.g., age, IQ, reading level, other domain categories) were partialled out of the analysis.

In general, the results of Swanson and Jerman's (2006) meta-analysis suggested there are no significant quantitative differences between children with RD and MD on STM and WM measures (also see Swanson, Jerman, & Zheng, 2009). Thus, one can infer children with MD share a common set of WM difficulties with children with RD. No doubt, this inference on the surface seems counterintuitive, given that not all children with reading problems exhibit math difficulties and vice versa. One explanation for this finding (sharing a common set of difficulties) is that RD and MD co-occur more frequently than expected by chance (e.g., Landerl & Moll, 2010; Swanson et al., 2018). Although a number of explanations emerge related to this comorbidity (e.g., sampling artifact, manifestations of a secondary disorder, alternative manifestations of the same etiology; see Willcutt et al., 2013, for a review), there is a high probability that children labelled as MD do not reflect a diagnostic category that is completely independent of reading difficulties (e.g., Cirino, Fuchs, Elias, Powell, & Schumacher, 2015).

Some studies suggest that the similarities in WM performance between MD and RD children become much more reliable with greater manipulations of phonological information (a position consistent with Hecht et al., 2001). Phonological STM is believed to be composed of rehearsal components and phonological skills that are consistently found to be deficient in children with MD and RD. Swanson and Jerman's (2006) meta-analysis supported this conclusion, showing that the two groups could not be differentiated on measures attributed to phonological memory (STM for digits and words).

In general, the takeaway message from these syntheses of the literature and our own studies (to be reviewed) is that the two groups (children with RD and/or MD) share common WM and STM problems, even though these problems may yield different manifestations on achievement measures. Thus, the question emerges: "how is it that both groups can share WM deficits, but manifest themselves as a reading or math deficits?" One possible explanation comes from fMRI studies.

fMRI Studies

An important findings is that several fMRI studies have indicated that math and reading processes tap several common areas of the brain (e.g., Evans, Flowers, Luetje, Napoliello, & Eden, 2016), and the manifestations of these deficits may

reflect an under-activation of these common areas of the brain. As RD and/or MD are assumed to have a neurological base to the learning problems (DSM-V), it is important to note there are correlates in the neuropsychological literature that complement the tripartite WM structure of Baddeley and Logie's (1999) model, suggesting that some functional independence exists among the systems (e.g., Acheson, Hamidi, Binder, & Postle, 2011; Bledowski, Kaiser, & Rahm, 2010; Chein & Fiez, 2010; Nee et al., 2013; Smith & Jonides, 1997, 1999). Neuropsychological evidence also suggests that children with RD and/or MD experience difficulties related to these structures (e.g., Beneventi, Tønnessen, & Ersland, 2009; Beneventi, Tønnessen, Ersland, & Hugdahl, 2010; Rosenberg-Lee, Lovett, & Anderson, 2009). For example, Kaufmann, Wood, Rubinsten, and Henik's (2011) meta-analysis of fMRI studies directed at children with MD (dyscalculia) showed observable *hypo-activation* (under-activation) differences in number processing in the prefrontal and occipital cortex when compared with children without MD. Likewise, Richlan, Kronbichler, and Wimmer's (2011) meta-analysis of fMRI studies that included children or adults with dyslexia suggested that the left occipital temporal and the temporoparietal regions showed a *hypoactivation* in adults with dyslexia, whereas a hypoactivation was observed only in the anterior portion of the left occipitotemporal cortex for dyslexic children. Richlan's (2012) reanalysis of the data also found little support for the assumption that standard neural anatomical models of developmental dyslexia are localized to problems primarily related to phonological decoding deficits in the left temporoparietal regions. Rather, Richlan found evidence that points to dysfunction in the left hemisphere in dyslexics reflecting a larger reading network that included the hypoactivation of the occipitotemporal, inferior frontal, and inferior parietal regions. In general, the sharing of common problems in STM and WM suggests that an under-activation may occur in common areas of the brain for children with RD and/or MD.

Given this overview of a multicomponent view of WM, we will now briefly review some of our findings linking RD and/or MD to specific components of WM. The links between various components of WM and various achievement measures have been reviewed previously (e.g., Swanson & Alloway, 2012; Swanson & Zheng, 2013) and, because of space limitations, are not reviewed here. Instead, some selective studies are reviewed that have included children with specific learning disabilities in reading and/or math under each WM component.

Executive System

The central executive monitors the control processes in WM. There have been a number of cognitive activities assigned to the central executive, including coordination of subsidiary memory systems, control of encoding and retrieval strategies, switching of attention in manipulation of material held related to the verbal and visual spatial systems, and the retrieval of information from LTM (e.g., Miyake et al., 2000). Although the executive function has separable operations (i.e., inhibition, updating, task switching), these operations share some underlying commonality (e.g., see Miyake et al., 2000, for a review). A crucial component of the central executive as it applies to children with RD and/or MD is controlled attention. The involvement of controlled attention difficulties in children with RD and/or MD is inferred from three

outcomes: (1) depressed performance across both verbal and visual-spatial tasks that require concurrent storage and processing, (2) poor performance on complex divided attention tasks (attention to relevant and irrelevant information), and (3) poor concurrent monitoring of attention on high-demand tasks.

Combined Processing and Storage Demands

The majority of our recent studies (Swanson, 2011a; Swanson & Jerman, 2007; Swanson, Jerman, & Zheng, 2008) on executive processing have included tasks that follow the format of Daneman and Carpenter's sentence span measure, a task strongly related to achievement measures (see Swanson & Alloway, 2012, for a review). This task is assumed to tap central executive processes related to "updating" (Miyake et al., 2000). Updating requires monitoring and coding information for relevance to the task at hand and then appropriately revising items held in WM. Thus, in our studies, WM tasks typically engage participants in at least two activities after initial encoding: (1) a response to a question or questions about the material or related material to be retrieved, and (2) a response to recall item information that increases in set size. The first part of the task is a distractor of initial encoding items, whereas the second part tests storage. An example of such a task is as follows: Participants in this listening span task are asked to recall the last word of several sentences and to answer a comprehension question about a sentence. The sentences are arranged randomly into sets of two, three, four, or five. An example of a series of sentences of which the last word is to be recalled is as follows:

- We waited in line for a *ticket*.
- Sally thinks we should give the bird its *food*.
- My mother said she would write a *letter*.

To ensure that participants comprehended the sentences (i.e., processed their meaning and did not merely try to remember the target word or treat the task as one of STM), they are required to answer a question after each group of sentences has been presented. For the three-sentence set, for example, the child is asked, "Where did we wait?" After each set of unrelated sentences is presented, the child answers a question about a sentence and then is asked to recall the last word of each sentence.

These laboratory tasks have an analog to everyday learning (Uppal & Swanson, 2016): for example, holding a person's address in mind while listening to instructions about how to get there, listening to a sequence of events in a story while trying to understand what the story means, locating a sequence of landmarks on a map while determining the correct route, listening to specific word features among several in one ear and suppressing the same features in the other ear, and so on. All these tasks have some aspects of interference (a competing memory trace that draws attention away from the targeted memory trace) and monitoring (decisions related to the allocation of attention to the stimulus that is under consideration together with the active consideration of several other stimuli whose current status is essential for successfully completing the task).

An example of the difficulties experienced by children and adults with RD on complex tasks can be found in an earlier cross-sectional study that compared participants

with and without RD across a broad age span (Swanson, 2003). The study compared four age groups (7, 10, 13, 20) on phonological, semantic, and visual-spatial WM measures administered under a variety of conditions (Swanson, 1992, 1996): initial (no probes or cues), gain (cues that bring performance to an asymptotic level), and maintenance conditions (asymptotic conditions without cues). The general findings of the Swanson (2003) study were that participants both with and without RD showed continuous growth in verbal and visual-spatial WM. The results clearly showed, however, that the children with RD were inferior to average readers on WM tasks across a range of age groups. Further, the study provided little evidence that participants with RD catch up in WM skills with average readers as they age, suggesting that a deficit model rather than a developmental lag model best captured such readers' age-related performance.

In terms of MD, a longitudinal study (Swanson et al., 2008) examined the influence of growth in WM on growth in mathematical problem solution accuracy in elementary school children with and without MD. A battery of tests was administered over a 3-year period to assess problem-solving, achievement, and cognitive processing (WM, inhibition, naming speed, phonological coding) in children in Grades 1, 2, and 3. The results showed that children identified as at risk for math problem-solving difficulties in Wave 1 showed less growth rate and lower levels of performance on WM measures than children not at risk in Wave 3 (3 years later). More importantly, the results indicated that WM contributed unique variance to problem-solving beyond what phonological processes (e.g., phonological knowledge), fluid intelligence, reading skill, inhibition, and processing speed contributed. Thus, there was clear evidence that WM contributed important variance to math performance 3 years later, beyond processes related to speed, phonological knowledge, fluid intelligence, and reading skill. Some studies (e.g., van der Sluis, van der Leij, & de Jong, 2005) have suggested that children with RD exhibit no problems in executive function, whereas children who show reading plus arithmetic difficulties have problems in executive processing. To address this issue, Swanson and Jerman (2007; also see Swanson, Howard, & Sáez, 2006) assessed whether growth in poor phonological memory and/or WM may underlie memory differences between children with RD and/or MD. They administered a battery of memory and achievement measures to children across three testing waves spaced 1 year apart. Three subgroups of children with RD were tested because some studies have suggested that children who have combined deficits in reading and math (referred to as the comorbid group in this study) reflect more generalized deficits related to the executive system than do RD-only children who have deficits only related to reading (e.g., van der Sluis et al., 2005). The study assessed whether (a) subgroups of children with RD (children with RD-only, children with both reading and arithmetic deficits, and low verbal IQ readers) and average readers varied in WM and STM growth, and (b) whether growth in an executive system and/or phonological storage system mediated growth in reading performance. Thus, this study examined whether children identified with only deficits in reading had isolated deficits in the development of phonological STM and children with comorbid deficits in both reading and math had deficits in both STM and WM. Overall, these analyses supported the notion that deficient growth in the executive component of WM was a common problem among all the subgroups of children with reading problems and/or math problems.

Complex Divided Attention Tasks

Our earlier research showed that children with RD can be distinguished from average achievers in how they handled attentional demands (Swanson, 1987, 1989). For example, Swanson (1989) compared central and incidental recall on WM tasks between children with RD, children with low verbal IQ, average achievers, and intellectually gifted children. In general, the results suggested that children with low verbal IQ and children with RD recalled less information as a function of encoding conditions than higher-ability groups on both central and incidental memory tasks. However, the results also indicated that lower-ability groups differed from higher-ability groups in executive processing (how they shared, discriminated, and selectively allocated resources between the central and secondary recall tasks). Children with low verbal IQ compensated for their executive processing deficiencies by maintaining a constant resource supply (recall was comparable between central and secondary tasks), whereas children with RD failed to effectively prioritize items (recall fluctuated between central and secondary tasks) despite having a higher verbal IQ.

Earlier studies during this time period investigated how limits in the allocation of attention resources were strategically handled (e.g., Swanson, 1989; Swanson & Cochran, 1991). For example, *selective attention* to word features within and across the cerebral hemispheres was explored in children with RD via a dichotic listening task. Swanson and Cochran (1991) compared 10-year-old children with LD with average achieving children matched on CA on a dichotic listening task. Participants were asked to recall words organized by semantic (e.g., red, black, green, orange), phonological (e.g., sit, pit, hit), and orthographic (e.g., sun, same, seal, soft) features presented to either the left or right ear. The study included two experiments. Experiment 1 compared free recall with different orienting instructions with the word lists. One orienting instruction told children about the organizational structure of the words, the other condition (non-orienting) did not. For the orienting condition, children were told to remember all words, “but to specifically remember words that go with ____ [e.g., colors],” “words that rhyme with ____ [e.g., it],” “words that start with the letter ____ [e.g., s],” or “words that go with certain categories [e.g., animals and furniture] or sounds [e.g., rhymes]”. For the non-orienting condition, children were told to remember all words, but no mention was made of the distinctive organizing features of words. Experiment 2 extended Experiment 1 by implementing a cued recall condition. In both experiments, children were told they would hear someone talking through the earphone in either the right or left ear. They would also hear words in the other ear. They were told that when they stopped hearing the information in the designated ear and the non-designated ear, they were to tell the experimenter all the words they could remember.

For both experiments, children without RD had higher levels of targeted recall and nontargeted recall than children with RD. More importantly, ability group differences emerged in “how specific word features” were selectively attended to. The selective attention index focused on the targeted words in comparison with the background words (targeted word recall minus background word recall) from other lists *within* the targeted ear, as well as background items in the contralateral ear. Regardless of word features, whether competing word features were presented within ear or across ear conditions, or whether retrieval conditions were non-cued or cued, selective attention scores for

children with RD were smaller (the difference score between targeted items and non-targeted items was closer to zero) than for children without RD. Taken together, the results of this study suggest that children with RD manifest processing deficits related to attention to targeted items, regardless of the types of word feature, retrieval conditions, or ear presentation.

General Monitoring Difficulties

In another one of our earlier experiments (Swanson, 1993b, Experiment 1), a concurrent memory task, adapted from Baddeley (Baddeley, Eldridge, Lewis, & Thomson, 1984), was administered to RD and average readers. The task required subjects to remember digit strings (e.g., 9, 4, 1, 7, 5, 2) while they concurrently sorted blank cards, cards with pictures of nonverbal shapes, or cards with pictures of items that fit into semantic categories (e.g., vehicles: car, bus, truck; clothing: dress, socks, belt). Demands on the central executive capacity system were manipulated through the level of difficulty (3- vs. 6-digit strings) and type of sorting required (e.g., nonverbal shapes, semantic categories, blank cards). Sorting activities that placed demands on the verbal storage (phonological system) included the categorization of pictures into semantic categories, whereas sorting activities that made demands on the visual store (i.e., visual-spatial sketch pad) included discrimination among complex nonverbal shapes. Baddeley et al. (1984) found that in such activities the main task difficulty (sorting) interacted with concurrent memory load, but only with a memory load of 6 digits. Performance for the 6-digit memory load condition placed processing demands on the central executive, thereby interfering with the main task. Swanson's (1993b) results indicated a clear effect for memory load. The results showed that children with RD can perform comparably to their CA-matched counterparts on verbal and visual-spatial sorting conditions that included 3-digit strings (low demands), and that only when the coordination of tasks becomes more difficult (6-digit strings) do ability group differences emerge. More importantly, the results for the high memory load condition (6-digit strings) showed that children with RD were inferior to the CA-matched readers (and reading-matched controls for ordered recall) in their ability to recall digits during both verbal and nonverbal sorting. Because recall performance for children with RD was not restricted to a particular storage system (i.e., verbal storage), compared with the performance of CA-matched average readers, one can infer that processes other than a language-specific system accounted for the results. More importantly, the results suggested that domain-general constraints in WM capacity (WMC) emerged for children with RD under high memory demand conditions (see Tricot, Vandenbroucke, and Sweller, Chapter 15, this volume, for discussion of cognitive load theory and RD).

Summary

We have selectively reviewed our studies suggesting that children with RD and/or MD manifest WM deficits that, depending on the task and information-processing demand, reflect problems related to an executive processing system. Although our research suggests that difficulties related to updating and the suppression of irrelevant information underlies RD and/or MD, we also want to emphasize that several activities that involve

executive processing are very much intact for children with RD/MD. Depending on the task, of course, some of these intact executive processes relate to planning (Swanson, Kehler, & Jerman, 2010). For example, although planning (such as mapping out a sequence of moves) is considered a component of the executive system (e.g., however, see Miyake et al., 2000, p. 91), we have not found overall solution differences between children with RD (and/or MD) and average achieving students on problem-solving tasks (see Swanson, 1988, 1993a; Swanson et al., 2010). Likewise, studies that have examined performance on complex executive-processing tasks, such as the Tower of Hanoi, have not produced reliable differences between children with and without RD. In an earlier study, Swanson (1993a) compared children with and without RD on the Tower of Hanoi task, as well as two Piagetian problem-solving tasks (combinatorial, pendulum). No significant differences in solution time or number of steps to solution were found between average achievers and RD children (children with reading scores below the 15th percentile) with comparable IQs on the three problem-solving measures. Thus, those components of the executive system that are relatively intact for children with RD on the aforementioned problem-solving tasks are related to “planning, self-regulation, or decision making” (e.g., Swanson, 1993a).

Although our studies specifically focus on the executive component of WM, we recognize that executive functioning reflects a broad category of processes, and, therefore, some clarification of how we use the term is necessary. Several studies suggest executive function focuses on higher-order cognitive functions associated with the frontal lobes, such as initiating, planning, cognitive flexibility, monitoring, decision-making, ability to solve novel problems, and, of course, WM (e.g., see Zelazo, Blair, & Willoughby, 2016). Thus, rather than examining executive functions as a single domain, several studies distinguish between “hot” and “cold” executive functions (e.g., Semenov & Zelazo, 2018; Zelazo et al., 2016). “Hot” executive functions involve emotion, desires, motivation, and rewards. A typical example of hot executive function is decision-making, where an individual makes strategy choices with potentially rewarding consequences. “Cold” executive functions are emotion-independent and logically based. A typical example of cold executive function is WM. Given these general distinctions, the area in which we find serious problems in children with RD and/or MD represents cold executive processes (e.g., Zelazo, Qu, & Müller, 2005).

A number of comprehensive reports have also reviewed the link between executive processes, such as WM, and achievement (e.g., Fuhs, Nesbitt, Farran, & Dong, 2014; Gerst, Cirino, Fletcher, & Yoshida, 2017; Swanson & Alloway, 2012). For example, Gerst et al. (2017) investigated the interrelations of executive function on measures of reading comprehension and math calculations. They found that, although the relations among measures within four executive function measures (WM, planning, inhibition, and shifting) were modest, the relations to academic domains were stronger. They found that WM was particularly important for reading comprehension, whereas cognitive measures from all executive function measures were important for math performance.

PHONOLOGICAL LOOP

In Baddeley and Logie’s model (1999), the phonological loop is specialized for the retention of verbal information over short periods of time. It is composed of both a

phonological store, which holds information in phonological form, and a rehearsal process, which serves to maintain representations in the phonological store (see Baddeley, Gathercole, & Papagno, 1998, for an extensive review). A cognitive process consistently implicated in RD is phonological awareness (e.g., Melby-Lervåg, Lyster, & Hulme, 2012). Phonological awareness is “the ability to attend explicitly to the phonological structure of spoken words” (Scarborough, 1998, p. 95). This difficulty in forming and accessing phonological representations impairs the ability to retrieve verbal information from STM. The ability to retain and access phonological representations has been associated with verbal STM, but more specifically the phonological loop. A substantial number of studies support the notion that children with RD experience deficits in phonological processing (e.g., see synthesis of Kudo et al., 2015), such as forming or accessing phonological representations of information. Interestingly, this phonological impairment does not appear to have broad effects on general intellectual ability apart from the developmental consequences on language-related functions. Several studies suggest that deficits in the phonological loop may lie at the root of new word learning problems in children with RD (e.g., see Scarborough, 1998, for review) and computation problems in children with MD (e.g., Hecht et al., 2001). These findings build on research that has shown that the manifestations of this phonological deficit are poor word recognition; poor performance on phonological awareness tasks, computation, and slow naming speed; and impaired verbal STM.

When attributing the component of WM to mathematical performance, studies with older children and adults have attributed arithmetic skill to the phonological loop (e.g., Logie, Gilhooly, & Wynn, 1994) or to a combination of both the phonological and executive systems (e.g., Fürst & Hitch, 2000). The research to date indicates that some children who are less proficient in math appear to rehearse less and perform more poorly on tasks requiring short-term retention of order information than children proficient in math, especially on measures of digits (Geary, 2011; Geary, Hoard, Nugent, & Bailey, 2012; McLean & Hitch, 1999; Siegel & Ryan, 1989), suggesting inefficient utilization of the phonological rehearsal process. Swanson and Kim (2007) found that both STM and WM tasks each uniquely predicted individual differences in mathematical performance. WM was independent of the contribution of STM and naming speed in predicting children’s mathematical performance. The results were interpreted as support for the notion that both the central executive system (controlled attention) and storage system of WM (i.e., phonological loop) predict children’s math performance. These findings are in line with the notion that the phonological loop is partly controlled by the central executive system (i.e., the executive system shares some variance with the phonological loop), and, therefore, individual differences in mathematics are related to the controlling functions of the central executive system itself.

A key finding in several of our studies is that the contribution of STM (phonological loop) and WM (storage + controlled attention) can contribute unique variance to achievement measures and, therefore, can operate independent of one another. Swanson and Ashbaker (2000) directly tested whether the operations related to STM and WM operated independently of one another. In this study, they compared children with and without RD and younger reading level-matched children on a battery of WM and STM tests to assess executive and phonological processing, respectively. Measures of the executive system were modeled after Daneman and Carpenter’s (1980) WM tasks, whereas measures of the phonological system included those that related to

articulation speed, digit span, and word span. The study yielded two important results. First, reading-group differences were pervasive across verbal and visual-spatial WM tasks, even when the influence of verbal STM was statistically removed, suggesting that reading-group differences are domain general. Second, WM tasks and verbal STM tasks contributed unique variance to word recognition and reading comprehension beyond articulation speed. Taken together, the results suggested that the executive component of WM predicted reading problems independent of problems related to the phonological component of WM.

VISUAL-SPATIAL SKETCH PAD

The visual-spatial sketchpad is specialized for the processing and storage of visual material, spatial material, or both, and for linguistic information that can be recoded into imaginable forms (see Baddeley, 2012, for a review). The literature linking RD to visual-spatial memory deficits is mixed. For example, when visual-spatial WM (combined storage and processing demands) performance is considered, some studies find that visual-spatial WM in students with RD is intact when compared with their same age counterparts (e.g., Swanson et al., 1996, Experiment 1), whereas others suggest problems in various visual-spatial tasks (e.g., Mammarella, Caviola, Giofrè, & Szűcs, 2017; Mammarella, Lucangeli, & Cornoldi, 2010; Swanson et al., 1996, Experiment 2). Most studies, however, suggest that, depending on the type of academic disability, greater problems in performance are more likely to occur on verbal than visual-spatial WM tasks for children with RD and/or MD (Peng et al., 2017; Swanson & Jerman, 2007). For example, several studies in the STM literature suggest RD children's visual STM is intact (see O'Shaughnessy & Swanson, 1998, for a comprehensive review). Likewise, our meta-analysis synthesizing research on the cognitive studies of MD (Swanson & Jerman, 2006) suggests that memory deficits are more apparent in the verbal than visual-spatial domain. Our studies suggest that the visual-spatial system of RD children is generally intact, but, when excessive demands are placed on the executive system, their visual-spatial performance is depressed compared with CA-matched average achievers (Swanson, 2000).

STORAGE VERSUS CAPACITY

Prior to our leaving our discussion of components of WM that may underlie RD and/or MD, a question emerges as to whether problems in WM performance are primarily related to item availability, accessibility, capacity, or all these processes? We have tested two hypotheses related to these issues (e.g., Swanson, 1993c; Swanson et al., 1996). One hypothesis, a retrieval efficiency hypothesis, predicts that WM differences between children with RD and/or MD and their average achieving counterparts are greater for tasks that require effortful reconstruction (i.e., non-cued recall conditions) than for those that do not (i.e., cued recall conditions). The magnitude of ability group differences is reduced on cued conditions because retrieval demands are lessened by the provision of contextual support. An extension of this hypothesis predicts that the benefits of contextual support (cues) are greater for children with RD and/or MD than for children who are average achievers. In contrast, if WM deficits of children with RD and/or MD are due to constraints in WMC, then procedures that facilitate access to

previously presented information would not bring them to the same level of performance as their normal achieving counterparts. We have conducted several studies to examine these two hypotheses, and find support for the second hypothesis.

In general, our studies have presented WM tasks under three conditions. These conditions include: (1) presentation of WM tasks without cues to assess initial performance (initial condition); (2) presentation of graduated cues to help participants access forgotten information from the initial condition and to continue the use of cues until span scores can no longer be improved upon (referred to as the gain or asymptotic condition); and (3) presentation of the highest span level achieved for the gain condition after a brief interlude, but without the support of cues (referred to as the maintenance condition). We reasoned that individual differences in WM performance under initial conditions reflect idiosyncratic processing as well as individual differences in accessing items in storage. To obtain an assessment of individual differences in item accessibility, cues are presented to help participants reinstate the memory trace and/or retrieve forgotten items. This condition, referred to as the gain condition, allows participants to use as many cues as necessary to access previously forgotten information. Because the number of probes (the terms probes and cues are used interchangeably) used to retrieve information provides an assessment of the status of information in memory, a finding of reading and/or math group differences on the gain condition supports the inference that a failure to activate new information in storage is an important determinant of WM development. The major limitation in interpreting gain performance, however, is that there is no basis for inferring constraints on storage capacity. Thus, it is necessary to reinstate the highest level achieved successfully under gain conditions, but without cues (referred to as the maintenance condition). A further rationale for these conditions will be presented later.

In general, what we have found is that WM performance in children with RD and/or MD has been consistently inferior to their average achieving counterparts on verbal and visual-spatial WM tasks. More importantly, these performance differences between ability groups are “increased” on gain and maintenance conditions when compared with the initial (non-cued) conditions. These findings support a general capacity explanation of poor WM performance of children with RD and/or MD. These differences in capacity reflect demands placed on both the accessing of new information (gain condition) and the maintenance of old information (maintenance condition).

Summary

When performance demands on various tasks directly tax the WMC of individuals with RD and/or MD, deficiencies related to the accessing of speech-based information and/or the monitoring of attentional processes emerge. Thus, these two areas of deficiencies are related to components of WM referred to in Baddely’s model (Baddeley & Logie, 1999) as the phonological loop and the executive system. Individuals with RD and/or MD do not exhibit deficits in all aspects of the phonological loop (e.g., they have relatively normal abilities in producing spontaneous speech and have few difficulties in oral language comprehension) or the executive system (e.g., they have relatively normal abilities in planning and sustaining attention across time). Those aspects of the phonological system that appear particularly

problematic for individuals with RD and/or MD relate to the accurate and speedy access of speech codes in STM, and those aspects of the executive system that appear faulty are related to the concurrent monitoring of processing and storage demands and the suppression of conflicting (e.g., irrelevant) information. Deficiencies in these operations influence performance in academic domains (reading comprehension, mathematics) that draw heavily upon these operations (Swanson & Siegel, 2001b).

Although we find that students with LD exhibit deficits unique to both the phonological loop and the executive system, we can only speculate on the problems related to the interchange of information between these two systems. We assume limitations in WMC underlie specific learning disabilities. These capacity constraints place limits on the coordination of two levels of processing. Children with RD and/or MD may be viewed as having difficulty accessing higher-level information and/or lower-order skills (phonological codes) or switching between the two levels of processing. Children with MD may be viewed as having difficulty accessing numerical information. For example, their executive systems may fail to compensate for a deficient lower-order specialized process. This lack of compensatory processing may be characterized by a WM system either not contributing enough information to a specialized system or failing to provide an adequate capacity of processing resources given their problems in a specialized system (see Swanson, 1993b, for a related discussion). It is also possible that the executive system indirectly accounts for low-order processing deficits (especially on language-related tasks) because of excessive processing demands. An individual difference variable related to executive processing is the ability to retrieve stored LTM knowledge relevant to the task and to manipulate and recombine that material with the novel stimuli when demands on the phonological and visual-spatial system are exceeded. However, regardless of whether or not the executive system has storage capability, this system fails, under certain conditions, to efficiently monitor the storage of information so that it can be used to support low-order systems in children and adults with RD and/or MD.

Implications for Practitioners

Although we attribute some of the problems in reading and math in children with RD and/or MD to WM components, we have also attempted to improve such children's WM performance directly through scaffolding procedures and/or directly teaching memory strategies. The approaches are briefly reviewed.

Scaffolding and Dynamic Testing

The purpose of this research program is to maximize children's WM performance in hopes of better assessing where the processing breakdown in academic performance occurs, as well as determining the WM conditions (cued vs. non-cued recall; gain vs. maintenance) that best predict such performance (Swanson, 1992, 2011a). One of the most common procedures we discussed earlier is to scaffold feedback (via cues or probes) on children's WM performance under cued conditions (referred to as dynamic testing in our studies) in order to enhance performance to the participant's maximum span length. Scaffold feedback is assumed to help the participant reinstate the memory trace and/or retrieve forgotten items. The scaffold feedback conditions

maximize processing efficiency by bringing an individual's WM performance to an asymptotic level. The number of cues (hints on items forgotten) needed to achieve an asymptotic level serves as an indirect measure of processing efficiency (i.e., fewer cues relate to greater efficiency). The WM tasks are also presented at the asymptotic level (the maximum span length established with cues), but without cues. This condition includes the *same* WM tasks that matched each participant's highest WM span level. Thus, each participant is presented items calibrated to their asymptotic level of WM performance. This calibration allows for the assessment of processing constraint beyond the learning of items. The ability to maintain a high level of performance without cues serves as an indirect index of demands on WMC.

To further illustrate the scaffolding (cuing) procedure, consider one of the WM tasks we administered: the digit-sentence span task. The purpose of this task is to assess the participant's ability to remember numerical information embedded in a short sentence.

The general instructions for introducing the task to the child are as follows:

I'm going to read you some sentences that have information I want you to remember. All the sentences have to do with remembering an address, but I would like you to pay attention to all the information in the sentence because I will ask you a question about the sentence. After I present this information, and before you recall it, I will ask you a question about the information

An example sentence the child is asked to remember is the location of the library that is on "2-4-6-3 Baker Street". The child is asked a process question (what is the name of the street?) and then to recall the digits in order. If the child forgets a number or the order of numbers, a series of probes (cues) are administered. Cues are provided sequentially based on the type of error and ranged from least obvious hint (Cue 1) to the next explicit hint that facilitated recall of the answer. If the cuing procedure does not elicit a correct response, the task is discontinued, and the next task is administered. If a correct response does occur, the next set of items of increased difficulty is presented.

Consider the cuing sequence for a child who forgot parts of the address "2-4-6-3 Baker Street" and responds "6-4 Baker Street":

1. The last number in the sequence was "3"; now can you tell me all the number in order?
2. The first number in the sequence was "2"; now can you tell me all the numbers in order?
3. The middle numbers in the sequence are "4" and "6"; now can you tell me all the numbers in order?
4. All the numbers in order are "2-4-6-3"; now can you tell me all the numbers?

For each set of items not recalled in the correct order, or for items left out or substituted, the experimenter provides a series of hints based on the error that is closest to Cue 1. That is, probes range from the least obvious hint (Cue 1) to the next explicit hint that facilitates recall of the answer. Once the appropriate hint has been identified, based on the location of the error, probes are presented in order until the correct sequence is given.

The logic for the conditions is as follows (also see Swanson, 1999, 2003, 2011a): The non-cued or initial condition reflects the baseline for each participant's self-initiated processes to access information. The cueing condition enhances the access to stored items by tailoring cues to help participants reinstate memory traces or to retrieve forgotten items from the initial (or baseline) conditions. Previous studies have shown that the cueing conditions improve performance by as much as 1 SD (Swanson, 1992, 2003). This occurs because the systematic cueing procedures emphasize sequential processing strategies and thereby reduce the number of competing strategies employed. If the locus of WM problems in children with LD is in the retrieval phase, one would expect a reduction in ability group differences (children with and without LD) for this condition when compared with the initial condition. The highest level achieved under the cueing condition is readministered (referred to as the maintenance condition) using the *same* materials, but without cues to support performance. Calibrating this condition allows us to capture processing differences between groups beyond the learning of items. Because each participant is presented items calibrated to their asymptotic level of WM span, a decrement in performance relative to the cued condition is related to constraints in processing capacity.

In one of our more recent studies (Swanson et al., 2010), WM performance on these aforementioned conditions was compared between children with and without RD as a function their selection of strategies. That is, after stimulus set presentation for the WM tasks, but prior to actual recall, participants were asked to select the strategy they believe will help their retrieval. For the verbal WM task used in this study, the strategy selections were rehearsal, clustering, association, and elaboration. For the visual spatial WM task, the strategy selections were sectional (focus on recalling sections of a matrix), elemental (focus on key items), global (focus on the gestalt of the task) and backward processing (work backwards in reconstructing the patterns) strategies, respectively.

There are three general findings in this line of intervention research. First, although children without RD outperformed children with RD across WM conditions, ESs related to WM improvement were comparable between groups on gain and maintenance conditions. Second, no differences emerged between groups in their knowledge of strategies assumed to improve WM performance. However, stable strategy choices, rather than unstable choices, were related to high and low WM span performance. Finally, the results suggested the locus of group differences was best predicted by measures that show demands on WMC (maintenance conditions) rather than measures of strategy stability or processing efficiency. More importantly, academic performance was best predicted by maintenance conditions.

Obviously, there are at least two limitations to this line of research when it comes to designing a further intervention. First, only declarative knowledge was compared between the two ability groups. Declarative knowledge was not linked to procedural knowledge. That is, children were asked to choose from a menu the strategies that they believed would best help them retrieve previously presented information, but there was no indication of the extent to which the strategies selected were actually employed. It may be that the measures of strategy selection provided in these tasks are not fine-tuned enough to access children's understanding of the use of a systematic approach to memory tasks.

Second, although the WM span of children with RD can be significantly improved upon (via the scaffolding of cues), there was minimal evidence that such procedures

substantially reduced the variance between ability groups. In fact, the mean ESs across the conditions were comparable between the ability groups. That is, a key assumption in assessing the positive effects of strategy training studies is that the variance between the two groups will be reduced. Such has not been the case in several of our studies.

Direct Strategy Training

Another approach to improving WM performance is to “directly train” WM strategies. Experiment 2 of Swanson et al. (2010) was a study we carried out in an attempt to train WM performance in children with RD. The hypothesis under investigation was whether children with RD (children with low WM spans) benefit more from strategy instruction than children without RD (children with high spans) because they are more likely to experience greater processing constraints on WM tasks than children without RD. For this study, children with RD were randomly assigned to clinical trials that involved rehearsal training or a control group. Rehearsal training was selected as the instructional condition because this can be easily taught, and some studies have found positive outcomes related to these strategies for children with RD. Rehearsal training was also selected because Swanson (1995) found in his standardization study (N = 968) on the digit-sentence task that participants who selected a rehearsal strategy (in contrast to clustering, association, and elaboration) yielded significantly higher span scores than those participants selecting other strategies. An operation span test assessed WM span by having participants solve simple math problems while remembering unrelated to-be-remembered (TBR) words that follow each math problem. After each simple addition or subtraction operation, a TBR word was visually and orally presented for later recall. All words were below children’s reading level by two grades.

Two important findings occurred. First, the results showed that rehearsal training significantly improved performance on the target (operation span) and a transfer measure (listening span) for both reading groups. Second, the correlations between reading and WM were comparable at both pretest and post-test within groups, and difference between groups was greater at post-test than pretest. Thus, the results did not support the hypothesis that strategy training reduced the variance (performance gap) between reading groups.

In summary, we have briefly reviewed two lines of intervention research designed to improve WM performance. Both lines of research showed that WM performance can be improved upon. Children with RD and/or MD benefited significantly in WM performance as a function of scaffolding (cued) instruction as well as direct strategy instruction (e.g., rehearsal). Despite the positive effects of strategy use on children’s WM performance, however, the results do not provide strong support for the assumption that the relationship between WM and RD/MD is related to direct instruction or strategy variables. Neither cued nor rehearsal training conditions allowed children with RD to improve their WM performance on a par with children without RD. In addition, measures of processing demands on WMC were more likely to capture the source of reading group differences on WM tasks than measures of processing efficiency and strategies. We now review our third line of research that focuses on WM as moderator between strategy instruction and treatment outcomes.

Embedding WM Demands within Curriculum

Our more recent intervention studies have been directed toward focusing on math word problem-solving strategies and including WM demands within these lesson plans (e.g., Swanson, 2014, 2016; Swanson et al., 2015; Swanson, Moran, Bocian, Lussier, & Zheng, 2013; Swanson, Moran, Lussier, & Fung, 2014). That is, we have been focusing on how strategies can enhance math problem-solving as a function of variations of both the WM demands within the curriculum and the WMC of the individual child. In terms of strategies, one approach we emphasized was the execution of action sequences to solve a problem (referred to as verbal strategies). That is, when confronted with a word problem, children are taught a general heuristic to identify what information is needed within the text, as well as what text information is irrelevant to solve the problem. This cuing of children's attention to text information, such as cues to underline the question sentence, is assumed to facilitate integrating information into a coherent problem representation (referred to in the literature as a situation model). These steps are not necessarily tied to specific types of problem, and, therefore, are assumed to have some generalizability. Another strategy emphasized visual-schematic representations. This approach teaches children to integrate solution-relevant text elements into a coherent visualization of the word problem. Such procedures draw upon retrieval, retention, and transformation of visual information within a spatial context. We also included additional strategies that involved combined elements of each approach. Strategies that combine visual and verbal information we assumed were effective in achievement outcomes, mainly because it is assumed the combination of strategies draws upon separate verbal and visual-spatial storage capacities, and, if these storage systems are combined, more information can be processed.

We have completed several studies that have investigated the role of strategy instruction and WMC on problem-solving solution accuracy in children with and without MD (Swanson, 2014, 2014; Swanson et al., 2013, 2013). For these studies, children with and without MD, drawn from Grade 3, were randomly assigned to one of five conditions: materials + verbal strategies (e.g., underlining the question); materials + verbal + visual strategies; materials + visual strategies (e.g., correctly placing numbers in diagrams); materials + no overt strategies; and an untreated control. The materials-only condition was implemented to test whether training related to increasing irrelevant propositions within the instructional materials had a unique contribution to solution accuracy independent of explicit strategy instruction. Treatment conditions involved systematic increases in the number of irrelevant sentences for solving word problems across 20 instructional sessions.

For these studies, training involved giving children explicit instructions regarding verbal strategies that direct children to identify (e.g., via underlining, circling) relevant or key propositions within the problems, visual strategies that require children to place numbers into diagrams, and a combined strategy condition that combines both verbal and visual strategies. The outcome measures included word problem-solving performance on norm-referenced measures. The cognitive intervention sessions focused on directing children's attention to the relevant propositions within word problems related to accessing numerical, relational, and question information, as well as accessing the appropriate operations and algorithms for obtaining a solution. Instructions to focus on relevant information for solution accuracy in the context of increasing numbers of

distractions-related, irrelevant propositions (sentences) within word problems were embedded within lessons.

Our studies are unique, however, in that we directed children's attention within the experimental conditions to the relevant propositions and irrelevant propositions within word problems. That is, instructions were embedded within each lesson that directed children's attention to relevant propositions within word problems while concurrently increasing the number of irrelevant propositions. Our approach is also based on research showing that a *key* mechanism that underlies low WMC is controlled attention—that is, an individual's ability to access and process relevant information in the context of interfering information (e.g., Engle et al., 1999).

In general, our studies have found that strategy outcomes are moderated by WMC such that children with high WMC outperform children with low WMC on all post-test measures. However, the results also indicated that the effectiveness of strategy conditions on post-test targeted (problem-solving), near transfer (calculation), and far transfer (operation span, fluid intelligence) were tied to the specific strategies embedded within the training curriculum (Swanson, 2016). The results suggested that, among children with MD, children with higher WMC outperformed those with lower WMC, implying that WMC serves as a bottleneck on both targeted and transfer measures. However, superior post-test performance for both WMC groups was a function of improving WM functions (allocation of attention) within the training materials.

SUMMARY

The previous review of our research shows the WM can be improved upon. However, the benefits of focusing on WM directly have not been as beneficial to child performance on academic measures as embedding WM demands within the academic curriculum has. Taken together, and depending on the task, there is evidence that children with RD and MD have problems in the WM system related to the phonological loop (storage) and the executive system (controlled attention) that can be improved upon.

Future directions

Our current research now focuses on the need to separate fundamental deficits in WM from fundamental deficits related to language acquisition. Our current research focuses on English-language learners (ELLs) with RD and MD whose first language is Spanish. We feel this line of work is important as children in the United States with Spanish as their first language have been found to yield low reading and mathematics scores when compared with other ELL groups on national assessments across several years (e.g., Institute of Education Sciences, National Center for Education Statistics, U.S. Department of Education, 1990–2015, 1992–2017; Perie, Moran, & Lutkus, 2005). Although closing the achievement gaps has been a goal in national and state education policies, the average reading and mathematics scores for non-ELL students in Grades 4 and 8 have been higher than the scores of ELL students whose first language is Spanish. No doubt, there are long-term implications related to this achievement gap. Difficulties in math in the elementary grades have been shown to have detrimental effects on high school performance (e.g., drop rates) as well as later employment (e.g., Grégoire & Desoete, 2009).

Our recent studies have focused on the role of WM in predicting children at risk for RD (Swanson, Orosco, & Kudo, 2017) and MD (Swanson, Kong, & Petcu, 2018) within English learning (EL) samples. Past and more recent studies (Lanfranchi & Swanson, 2005; Swanson, Orosco, & Lussier, 2015; Swanson, Orosco, Lussier, Gerber, & Guzman-Orth, 2011; Swanson, Sáez, & Gerber, 2006; Swanson et al., 2004) have attempted to determine (a) whether the memory processes implicated in reading and second language acquisition extend beyond the phonological domain, and (b) whether the cognitive processes that underlie difficulties in second language acquisition are the same as those that underlie difficulties in reading for monolingual students.

In one of our earlier studies (Swanson et al., 2004), elementary school bilingual and non-bilingual children were administered a battery of cognitive measures (STM, WM, rapid naming, random letter and number generation, vocabulary, and reading [real word and pseudo-word reading]) in both Spanish and English. The results showed that English word identification performance was best predicted by a general verbal WM latent factor (factor that reflected loading from both English and Spanish WM measures) and a Spanish STM factor, whereas English pseudo-word reading performance was best predicted by Spanish pseudo-word reading and a WM factor. The results also showed that WM and STM performance differentiated among EL children with and without RD (Swanson et al., 2004).

In terms of math, our recent study (Swanson et al., 2018) determined those components of WM that played a significant role in predicting math growth in children who are ELLs with MD. A battery of tests was administered in English and Spanish that assessed computation, reading, vocabulary, inhibition, and components of WM in Grade 1 children, with follow-up testing in Grades 2 and 3. The results indicated that growth in the executive component of WM was significantly related to growth in math performance, even when covariates (STM, vocabulary, reading, fluid intelligence) were entered into the latent growth models. Although comparable in math computation at Grade 1, proficient bilingual children (proficient in both Spanish and English vocabulary) with MD outperformed less proficient bilingual children with MD, on measures of math calculation, fluid intelligence, reading, and Spanish WM at Grade 3. These results, although tentative, support the notion that growth in the executive component of WM is significantly related to growth in math computation for EL children with MD. However, we also found a “bilingual effect.” Increased bilingual proficiency (increased vocabulary in both English and Spanish) across testing waves yielded positive gains in both math and cognitive performance in children with MD when compared with children with MD who were less bilingually proficient.

In summary, although our preliminary work with EL children has suggested that growth in reading and math is directly tied to the development of the executive WM system, we would not argue at this point that this system acts independent of cross-language skills across grades. No doubt, future research must focus on the interaction between executive components of WM within and across language systems during reading and math computation to disentangle alternative interpretations of the results.

Discussion

We conclude that WM deficits are fundamental problems of children with RD and/or MD. Students with RD and/or MD exhibit STM deficits related to the phonological

loop, a component of WM that specializes in the retention of speech-based information. We argue, however, that this subsystem is not the only aspect of WM that underlies RD and/or MD. We find that, in situations that place high demands on processing, which in turn place demands on controlled attentional processing (such as monitoring limited resources, suppressing conflicting information, updating information), children with RD and/or MD are at a clear disadvantage when compared with their chronologically aged counterparts. Further, these deficits are sustained when articulation speed, phonological processing, fluid intelligence, and verbal STM are partialed of the analysis. We believe that RD and/or MD students' executive system (and, more specifically, monitoring activities linked to their capacity for controlled sustained attention in the face of interference or distraction) is impaired. This impaired capability for controlled processing appears to manifest itself across visual-spatial and verbal WM tasks under high-demand conditions. These executive processing difficulties may include (a) maintaining (updating) task-relevant information in the face of distraction or interference, (b) situations involving suppressing and inhibiting information irrelevant to the task if necessary, and (c) accessing information from LTM. In general, our intervention studies have shown that WM can be improved upon. However, our studies have not convincingly shown that directly training WM influences performance on academic measures, such as reading and math. Some studies have found some generalization when WM demands are embedded in the curriculum materials (i.e., math word problems) to nontargeted related processes (visual WM training was related to recognizing visual spatial patterns), but WM training has not been shown at this point to make substantial improvement in important classroom tasks such as reading comprehension and/or math performance. We do find, however, that direct training on academic measures (problem-solving in this case) that include elements of WM function (inhibition of irrelevant information) yields positive outcomes related to calculation and WM tasks that were not part of the training (Swanson & McMurran, 2018). Our more recent focus suggests that WMC may be best viewed as a moderator of academic outcomes under instructional or training conditions. In the area of word problem-solving, for example, the results suggest that solution accuracy for children with MD, relative to the control condition, was substantially improved as a function of both verbal and visual strategy training for those with relatively higher WMC.

In summary, this review suggests that the WM system underlies some of the academic problems experienced by children with RD and/or MD. We generally conclude that, although children with RD and/or MD exhibit WM difficulties related to the phonological loop, they also exhibit difficulties in some of the executive components of WM. This analysis is consistent with that of several theorists who adopt a resource-interaction approach in which individual differences emerge when academic processes compete for a limited supply of WM resources. No doubt, there are gaping holes in our knowledge about how WM and learning problems are related, and, therefore, additional research is needed. For example, our classroom research has not identified all factors of WM amenable to particular manipulations, such as extended practice, specific instructions, and strategy use. Additional research needs to be directed toward explaining why WM tasks are good predictors of academic performance. Although, for example, it makes sense that controlled attention ability (e.g., the ability to switch attention between processing and storage requirements) may be particularly good for reading comprehension but not necessarily for simple sight word recognition, this

has not been tested experimentally. No doubt the complexity of the task determines whether general or domain-specific factors come into play. However, different capacity-limited factors may come into play in predicting achievement across elementary, junior high, and high school. Further, one can only speculate on how children with reading and math problems are able to attain normal levels of functioning in everyday cognition.

NOTE

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REFERENCES

- Acheson, D. J., Hamidi, M., Binder, J. R., & Postle, B. R. (2011). A common neural substrate for language production and verbal working memory. *Journal of Cognitive Neuroscience*, 23(6), 1358–1367. doi:10.1162/jocn.2010.21519
- Ackerman, P. L., Beier, M. E., & Boyle, M. O. (2002). Individual differences in working memory within anomalous network of cognitive and perceptual speed abilities. *Journal of Experimental Psychology: General*, 131, 567–589. doi:10.1037/0096-3445.131.4.567
- Allaway, T. P., Gathercole, S. E., Willis, C., & Adams, A. (2004). A structural analysis of working memory and related cognitive skills in young children. *Journal of Experimental Child Psychology*, 87, 85–106. doi:10.1016/j.jecp.2003.10.002
- Attout, L., & Majerus, S. (2015). Working memory deficits in developmental dyscalculia: The importance of serial order. *Child Neuropsychology*, 21(4), 432–450. doi:10.1080/09297049.2014.922170
- Baddeley, A., Gathercole, S., & Papagno, C. (1998). The phonological loop as a language-learning device. *Psychological Review*, 105, 158–173. doi:10.1037//0033-295X.105.1.158
- Baddeley, A. D. (2012). Working memory: Theories, models, and controversies. *Annual Review of Psychology*, 63, 1–29. doi:10.1146/annurev-psych-120710-100422
- Baddeley, A. D., Eldridge, M., Lewis, V., & Thomson, N. (1984). Attention and retrieval from long-term memory. *Journal of Experimental Psychology: General*, 113, 518–540.
- Baddeley, A. D., & Logie, R. H. (1999). The multiple-component model. In A. Miyake & P. Shah (Eds.), *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 28–61). Cambridge, U.K.: Cambridge University Press. doi:10.1017/CBO9781139174909.00
- Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin*, 121(1), 65–94. doi:10.1037/0033-2909.121.1.65
- Beneventi, H., Tønnessen, F. E., & Ersland, L. (2009). Dyslexic children show short-term memory deficits in phonological storage and serial rehearsal: An fMRI study. *International Journal of Neuroscience*, 119(11), 2017–2043. doi:10.1080/00207450903139671
- Beneventi, H., Tønnessen, F. E., Ersland, L., & Hugdahl, K. (2010). Executive working memory processes in dyslexia: Behavioral and fMRI evidence. *Scandinavian Journal of Psychology*, 51(3), 192–202. doi:10.1111/j.1467-9450.2010.00808.x
- Bledowski, C., Kaiser, J., & Rahm, B. (2010). Basic operations in working memory: Contributions from functional imaging studies. *Behavioural Brain Research*, 214(2), 172–179. doi:10.1016/j.bbr.2010.05.041
- Brandenburg, J., Kleszczewski, J., Fischbach, A., Schuchardt, K., Büttner, G., & Hasselhorn, M. (2015). Working memory in children with learning disabilities in reading versus spelling: Searching for overlapping and specific cognitive factors. *Journal of Learning Disabilities*, 48(6), 622–634. doi:10.1177/0022219414521665
- Bryk, A., & Raudenbush, S. (1992). *Hierarchical linear models for social and behavioral research. Applications and data analysis methods*. London: Sage.

- Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies* New York, NY: Cambridge University Press. Retrieved from <https://search.proquest.com/docview/618390556?accountid=14521> doi: 10.1017/CBO9780511571312
- Chein, J. M., & Fiez, J. A. (2010). Evaluating models of working memory through the effects of concurrent irrelevant information. *Journal of Experimental Psychology: General*, 139(1), 117–137. doi:10.1037/a0018200
- Cirino, P. T., Fuchs, L. S., Elias, J. T., Powell, S. R., & Schumacher, R. F. (2015). Cognitive and mathematical profiles for different forms of learning difficulties. *Journal of Learning Disabilities*, 48(2), 156–175. doi:10.1177/0022219413494239
- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Hillsdale, NJ: L. Erlbaum.
- Cowan, N. (1997). *The development of working memory* (pp. 163–199). (N. Cowan, Ed.). Hove, UK: Psychology Press/Erlbaum (UK) Taylor & Francis.
- Cowan, N. (2014). Working memory underpins cognitive development, learning, and education. *Educational Psychology Review*, 26(2), 197–223. doi:10.1007/s10648-013-9246-y
- Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior*, 19(4), 450–466. doi:10.1016/S0022-5371(80)90312-6
- De Weerd, F., Desoete, A., & Roeyers, H. (2013). Working memory in children with reading disabilities and/or mathematical disabilities. *Journal of Learning Disabilities*, 46(5), 461–472. doi:10.1177/0022219412455238
- Engel, P. M. J., Santos, F. H., & Gathercole, S. E. (2008). Are working memory measures free of socio-economic influence? *Journal of Speech, Language, and Hearing Research*, 51(6), 1580–1587. doi:10.1044/1092-4388(2008/07-0210)
- Engle, R. W., Tuholski, S. W., Laughlin, J. E., & Conway, A. R. (1999). Working memory, short-term memory, and general fluid intelligence: A latent variable approach. *Journal of Experimental Psychology: General*, 128, 309–331. doi:10.1037/0096-3445.128.3.309
- Evans, T. M., Flowers, D. L., Luetje, M. M., Napoliello, E., & Eden, G. F. (2016). Functional neuroanatomy of arithmetic and word reading and its relationship to age. *NeuroImage*, 143, 304–315. doi:10.1016/j.neuroimage.2016.08.048
- Fuhs, M. W., Nesbitt, K. T., Farran, D. C., & Dong, N. (2014). Longitudinal associations between executive functioning and academic skills across content areas. *Developmental Psychology*, 50(6), 1698–1709. doi:10.1037/a0036633
- Fürst, A. J., & Hitch, G. J. (2000). Separate roles for executive and phonological components of working memory in mental arithmetic. *Memory & Cognition*, 28(5), 774–782. doi:10.3758/BF03198412
- Gathercole, S. E., Pickering, S. J., Ambridge, B., & Wearing, H. (2004). The structure of working memory from 4 to 15 years of age. *Developmental Psychology*, 40, 177–190. doi:10.1037/0012-1649.40.2.177
- Geary, D. C. (2011). Cognitive predictors of achievement growth in mathematics: A 5-year longitudinal study. *Developmental Psychology*, 47(6), 1539–1552. doi:10.1037/a0025510
- Geary, D. C., Hoard, M. K., Nugent, L., & Bailey, D. H. (2012). Mathematical cognition deficits in children with learning disabilities and persistent low achievement: A five-year prospective study. *Journal of Educational Psychology*, 104(1), 206–223. doi:10.1037/a0025398
- Gerst, E. H., Cirino, P. T., Fletcher, J. M., & Yoshida, H. (2017). Cognitive and behavioral rating measures of executive function as predictors of academic outcomes in children. *Child Neuropsychology*, 23(4), 381–407. doi:10.1080/09297049.2015.1120860
- Gray, S., Green, S., Alt, M., Hogan, T., Kuo, T., Brinkley, S., & Cowan, N. (2017). The structure of working memory in young children and its relation to intelligence. *Journal of Memory and Language*, 92, 183–201. doi:10.1016/j.jml.2016.06.004
- Grégoire, J., & Desoete, A. (2009). Mathematical disabilities—An underestimated topic?. *Journal of Psychoeducational Assessment*, 27(3), 171–174.
- Hecht, S. A., Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (2001). The relations between phonological processing abilities and emerging individual differences in mathematical computational skills: A longitudinal study from second to fifth grades. *Journal of Experimental Child Psychology*, 79(2), 192–227. doi:10.1006/jecp.2000.2586
- Hoskyn, M., & Swanson, H. L. (2000). Cognitive processing of low achievers and children with reading disabilities: A selective meta-analytic review of the published literature. *School Psychology Review*, 29(1), 102–119. Retrieved from: <https://search.proquest.com/docview/619454541?accountid=14521>
- Institute of Education Sciences, National Center for Education Statistics, U.S. Department of Education. (1990–2015). National Assessment of Educational Progress (NAEP), Reading Assessments, NAEP Data Explorer.

- Institute of Education Sciences, National Center for Education Statistics, U.S. Department of Education. (1992–2017). National Assessment of Educational Progress (NAEP), Reading Assessments, NAEP Data Explorer.
- Johnson, E. S., Humphrey, M., Mellard, D. F., Woods, K., & Swanson, H. L. (2010). Cognitive processing deficits and students with specific learning disabilities: A selective meta-analysis of the literature. *Learning Disability Quarterly*, 33(1), 3–18. doi:10.1177/073194871003300101
- Kaufmann, L., Wood, G., Rubinsten, O., & Henik, A. (2011). Meta-analyses of developmental fMRI studies investigating typical and atypical trajectories of number processing and calculation. *Developmental Neuropsychology*, 36(6), 763–787. doi:10.1080/87565641.2010.549884
- Kudo, M. F., Lussier, C. M., & Swanson, H. L. (2015). Reading disabilities in children: A selective meta-analysis of the cognitive literature. *Research in Developmental Disabilities*, 40, 51–62. doi:10.1016/j.ridd.2015.01.002
- Kyllonen, P. C., & Christal, R. E. (1990). Reasoning ability is (little more than) working-memory capacity? *Intelligence*, 14, 389–433. doi:10.1016/S0160-2896(05)80012-1
- Landerl, K., & Moll, K. (2010). Comorbidity of learning disorders: Prevalence and familial transmission. *Journal of Child Psychology and Psychiatry*, 51(3), 287–294. doi:10.1111/j.1469-7610.2009.02164.x
- Lanfranchi, S., & Swanson, H. L. (2005). Short-term memory and working memory in children as a function of language-specific knowledge in English and Spanish. *Learning and Individual Differences*, 15(4), 299–319. doi:10.1016/j.lindif.2005.05.003
- Locascio, G., Mahone, E. M., Eason, S. H., & Cutting, L. E. (2010). Executive dysfunction among children with reading comprehension deficits. *Journal of Learning Disabilities*, 43(5), 441–454. doi:10.1177/0022219409355476
- Logie, R. H., Gilhooly, K. J., & Wynn, V. (1994). Counting on working memory in arithmetic problem solving. *Memory & Cognition*, 22(4), 395–410.
- Maguire, M. J., Schneider, J. M., Middleton, A. E., Ralph, Y., Lopez, M., Ackerman, R. A., & Abel, A. D. (2018). Vocabulary knowledge mediates the link between socioeconomic status and word learning in grade school. *Journal of Experimental Child Psychology*, 166, 679–695. doi:10.1016/j.jecp.2017.10.003
- Mammarella, I. C., Caviola, S., Giofrè, D., & Szűcs, D. (2017). The underlying structure of visuospatial working memory in children with mathematical learning disability. *British Journal of Developmental Psychology*, doi:10.1111/bjdp.12202
- Mammarella, I. C., Lucangeli, D., & Cornoldi, C. (2010). Spatial working memory and arithmetic deficits in children with nonverbal learning difficulties. *Journal of Learning Disabilities*, 43(5), 455–468. doi:10.1177/0022219409355482
- McLean, J. F., & Hitch, G. J. (1999). Working memory impairments in children with specific arithmetic learning difficulties. *Journal of Experimental Child Psychology*, 74(3), 240–260. doi:10.1006/jecp.1999.2516
- Melby-Lervåg, M., Lyster, S. H., & Hulme, C. (2012). Phonological skills and their role in learning to read: A meta-analytic review. *Psychological Bulletin*, 138(2), 322–352. doi:10.1037/a0026744
- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., & Howerter, A. (2000). The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. *Cognitive Psychology*, 41, 49–100. doi:10.1006/cogp.1999.0734
- Nee, D. E., Brown, J. W., Askren, M. K., Berman, M. G., Demiralp, E., Krawitz, A., & Jonides, J. (2013). A meta-analysis of executive components of working memory. *Cerebral Cortex*, 23(2), 264–282. doi:10.1093/cercor/bhs007
- O’Shaughnessy, T. E., & Swanson, H. L. (1998). Do immediate memory deficits in students with learning disabilities in reading reflect a developmental lag or deficit? A selective meta-analysis of the literature. *Learning Disability Quarterly*, 21(2), 123–148. doi:10.2307/1511341
- Passolunghi, M. C., & Siegel, L. S. (2004). Working memory and access to numerical information in children with disability in mathematics. *Journal of Experimental Child Psychology*, 88(4), 348–367. doi:10.1016/j.jecp.2004.04.002
- Peng, P., Barnes, M., Wang, C., Wang, W., Li, S., Swanson, H. L., & Tao, S. (2017). A meta-analysis on the relation between reading and working memory. *Psychological Bulletin*, doi:10.1037/bul0000124
- Peng, P., Congying, S., Beilei, L., & Sha, T. (2012). Phonological storage and executive function deficits in children with mathematics difficulties. *Journal of Experimental Child Psychology*, 112(4), 452–466. doi:10.1016/j.jecp.2012.04.004
- Peng, P., & Fuchs, D. (2016). A meta-analysis of working memory deficits in children with learning difficulties: Is there a difference between verbal domain and numerical domain? *Journal of Learning Disabilities*, 49(1), 3–20. doi:10.1177/0022219414521667

- Perie, M., Moran, R., & Lutkus, A.D. (2005). *NAEP 2004 Trends in Academic Progress: Three Decades of Student Performance in Reading and Mathematics (NCES 2005-464)*. U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. Washington, DC: Government Printing Office.
- Richlan, F. (2012). Developmental dyslexia: Dysfunction of a left hemisphere reading network. *Frontiers in Human Neuroscience*, 6. doi:10.3389/fnhum.2012.00120
- Richlan, F., Kronbichler, M., & Wimmer, H. (2011). Meta-analyzing brain dysfunctions in dyslexic children and adults. *NeuroImage*, 56(3), 1735–1742. doi:10.1016/j.neuroimage.2011.02.040
- Rosenberg-Lee, M., Lovett, M. C., & Anderson, J. R. (2009). Neural correlates of arithmetic calculation strategies. *Cognitive, Affective & Behavioral Neuroscience*, 9(3), 270–285. doi:10.3758/CABN.9.3.270
- Scarborough, H. S. (1998). Early identification of children at risk for reading disabilities: Phonological awareness and some other promising predictors. In B. Shapiro, P. Accardo, & A. Capute (Eds.), *Specific reading disability: A view of the spectrum* (pp. 75–119). Timonium, MD: York Press.
- Semenov, A. D., & Zelazo, P. D. (2018). The development of hot and cool executive function: A foundation for learning in the preschool years. In L. Meltzer (Ed.), *Executive function in education: From theory to practice* (2nd ed., pp. 82–104). Chapter xix, 396 pages New York, NY: Guilford Press.
- Shankweiler, D., & Crain, S. (1986). Language mechanisms and reading disorder. *Cognition*, 24, 139–168.
- Siegel, L. S., & Ryan, E. B. (1989). The development of working memory in normally achieving and subtypes of learning disabled children. *Child Development*, 60(4), 973–980. doi:10.2307/1131037
- Smith, E. E., & Jonides, J. (1997). Working memory: A view from neuroimaging. *Cognitive Psychology*, 33(1), 5–42. doi:10.1006/cogp.1997.0658
- Smith, E. E., & Jonides, J. (1999). Storage and executive processes in the frontal lobes. *Science*, 283(5408), 1657–1661. doi:10.1126/science.283.5408.1657
- Swanson, H. L. (1983). A developmental study of vigilance in learning-disabled and nondisabled children. *Journal of Abnormal Child Psychology*, 11(3), 415–429. doi:10.1007/BF00914249
- Swanson, H. L. (1987). What learning-disabled readers fail to retrieve on verbal dichotic tests: A problem of encoding, retrieval, or storage? *Journal of Abnormal Child Psychology*, 15(3), 339–360. doi:10.1007/BF00916454
- Swanson, H. L. (1988). Learning disabled children's problem solving: Identifying mental processes underlying intelligent performance. *Intelligence*, 12(3), 261–278. doi:10.1016/0160-2896(88)90026-8
- Swanson, H. L. (1989). The effects of central processing strategies on learning disabled, mildly retarded, average, and gifted children's elaborative encoding abilities. *Journal of Experimental Child Psychology*, 47(3), 370–397. doi:10.1016/0022-0965(89)90020-9
- Swanson, H. L. (1992). Generality and modifiability of working memory among skilled and less skilled readers. *Journal of Educational Psychology*, 84(4), 473–488. doi:10.1037/0022-0663.84.4.473
- Swanson, H. L. (1993a). An information processing analysis of learning disabled children's problem solving. *American Educational Research Journal*, 30(4), 861–893. doi:10.2307/1163207
- Swanson, H. L. (1993b). Executive processing in learning-disabled readers. *Intelligence*, 17(2), 117–149. doi:10.1016/0160-2896(93)90024-Y
- Swanson, H. L. (1993c). Working memory in learning disability subgroups. *Journal of Experimental Child Psychology*, 56(1), 87–114. doi:10.1006/jecp.1993.1027
- Swanson, H. L. (1995). *S-Cognitive processing test (S-CPT): A dynamic assessment measure*. Austin, TX: PRO-ED.
- Swanson, H. L. (1996). Individual and age-related differences in children's working memory. *Memory & Cognition*, 24, 70–82. doi:10.3758/BF03197273
- Swanson, H. L. (1999). What develops in working memory? A life span perspective. *Developmental Psychology*, 35(4), 986–1000. doi:10.1037/0012-1649.35.4.986
- Swanson, H. L. (2000). Are working memory deficits in readers with learning disabilities hard to change? *Journal of Learning Disabilities*, 33(6), 551–566. doi:10.1177/002221940003300604
- Swanson, H. L. (2003). Age-related differences in learning disabled and skilled readers' working memory. *Journal of Experimental Child Psychology*, 85(1), 1–31. doi:10.1016/S0022-0965(03)00043-2
- Swanson, H. L. (2004). Working memory and phonological processing as predictors of children's mathematical problem solving at different ages. *Memory & Cognition*, 32(4), 648–661. doi:10.3758/BF03195856
- Swanson, H. L. (2008). Working memory and intelligence in children: What develops? *Journal of Educational Psychology*, 100(3), 581–602. doi:10.1037/0022-0663.100.3.581
- Swanson, H. L. (2011a). Dynamic testing, working memory, and reading comprehension growth in children with reading disabilities. *Journal of Learning Disabilities*, 44(4), 358–371. doi:10.1177/0022219411407866

- Swanson, H. L. (2011b). Intellectual growth in children as a function of domain specific and domain general working memory subgroups. *Intelligence*, 39(6), 481–492. doi:10.1016/j.intell.2011.10.001
- Swanson, H. L. (2014). Does cognitive strategy training on word problems compensate for working memory capacity in children with math difficulties? *Journal of Educational Psychology*, 106(3), 831–848. doi:10.1037/a0035838
- Swanson, H. L. (2016). Word problem solving, working memory and serious math difficulties: Do cognitive strategies really make a difference? *Journal of Applied Research in Memory and Cognition*, 5(4), 368–383. doi:10.1016/j.jarmac.2016.04.012
- Swanson, H. L. (2017). Verbal and visual-spatial working memory: What develops over a life span? *Developmental Psychology*, 53(5), 971–995. doi:10.1037/dev0000291
- Swanson, H. L., & Alexander, J. E. (1997). Cognitive processes as predictors of word recognition and reading comprehension in learning-disabled and skilled readers: Revisiting the specificity hypothesis. *Journal of Educational Psychology*, 89(1), 128–158. doi:10.1037/0022-0663.89.1.128
- Swanson, H. L., & Alloway, T. P. (2012). Working memory, learning, and academic achievement. In Karen R. Harris, Steve Graham, Tim Urdan, Christine B. McCormick, Gale M. Sinatra, & John Sweller (Eds.), *APA Educational Psychology Handbook, vol 1: Theories, constructs, and critical issues* (pp. 327–366). Washington, DC: American Psychological Association. doi:10.1037/13273-012
- Swanson, H. L., & Ashbaker, M. H. (2000). Working memory, short-term memory, speech rate, word recognition and reading comprehension in learning disabled readers: Does the executive system have a role? *Intelligence*, 28(1), 1–30. doi:10.1016/S0160-2896(99)00025-2
- Swanson, H. L., Ashbaker, M. H., & Lee, C. (1996). Learning-disabled readers' working memory as a function of processing demands. *Journal of Experimental Child Psychology*, 61(3), 242–275. doi:10.1006/jecp.1996.0016
- Swanson, H. L., & Beebe-Frankenberger, M. (2004). The relationship between working memory and mathematical problem solving in children at risk and not a risk for serious math difficulties. *Journal of Educational Psychology*, 96, 471–491. doi:10.1037/0022-0663.96.3.471
- Swanson, H. L., & Berninger, V. (1995). The role of working memory in skilled and less skilled readers' comprehension. *Intelligence*, 21(1), 83–108. doi:10.1016/0160-2896(95)90040-3
- Swanson, H. L., & Cochran, K. F. (1991). Learning disabilities, distinctive encoding, and hemispheric resources. *Brain and Language*, 40(2), 202–230. doi:10.1016/0093-934X(91)90125-K
- Swanson, H. L., & Fung, W. (2016). Working memory components and problem-solving accuracy: Are there multiple pathways? *Journal of Educational Psychology*, 108(8), 1153–1177. doi:10.1037/edu0000116
- Swanson, H. L., Howard, C. B., & Sáez, L. (2006). Do different components of working memory underlie different subgroups of reading disabilities? *Journal of Learning Disabilities*, 39(3), 252–269. doi:10.1177/0022194060390030501
- Swanson, H. L., & Jerman, O. (2006). Math disabilities: A selective meta-analysis of the literature. *Review of Educational Research*, 76(2), 249–274. doi:10.3102/00346543076002249
- Swanson, H. L., & Jerman, O. (2007). The influence of working memory on reading growth in subgroups of children with reading disabilities. *Journal of Experimental Child Psychology*, 96(4), 249–283. doi:10.1016/j.jecp.2006.12.004
- Swanson, H. L., Jerman, O., & Zheng, X. (2008). Growth in working memory and mathematical problem solving in children at risk and not at risk for serious math difficulties. *Journal of Educational Psychology*, 100(2), 343–379. doi:10.1037/0022-0663.100.2.343
- Swanson, H. L., Jerman, O., & Zheng, X. (2009). Math disabilities and reading disabilities: Can they be separated? *Journal of Psychoeducational Assessment*, 27(3), 175–196. doi:10.1177/0734282908330578
- Swanson, H. L., Kehler, P., & Jerman, O. (2010). Working memory, strategy knowledge, and strategy instruction in children with reading disabilities. *Journal of Learning Disabilities*, 43(1), 24–47. doi:10.1177/0022219409338743
- Swanson, H. L., Kong, J., & Petcu, S. (2018). Math difficulties and working memory in ELL children: Does bilingual proficiency play a significant role? *Language, Speech, and Hearing Services in Schools*, 49, 379–394.
- Swanson, H. L., Lussier, C. M., & Orosco, M. J. (2015). Cognitive strategies, working memory, and growth in word problem solving in children with math difficulties. *Journal of Learning Disabilities*, 48(4), 339–358. doi:10.1177/0022219413498771
- Swanson, H. L., & McMurran, M. (2018). The impact of working memory training on near and far transfer measures: Is it all about fluid intelligence? *Child Neuropsychology*, 24(3), 370–395. doi:10.1080/09297049.2017.1280142

- Swanson, H. L., Moran, A., Lussier, C., & Fung, W. (2014). The effect of explicit and direct generative strategy training and working memory on word problem-solving accuracy in children at risk for math difficulties. *Learning Disability Quarterly*, 37(2), 111–122. doi:10.1177/0731948713507264
- Swanson, H. L., Moran, A. S., Bocian, K., Lussier, C., & Zheng, X. (2013). Generative strategies, working memory, and word problem solving accuracy in children at risk for math disabilities. *Learning Disability Quarterly*, 36(4), 203–214. doi:10.1177/0731948712464034
- Swanson, H. L., Olide, A. F., & Kong, J. E. (2018). Latent class analysis of children with math difficulties and/or math learning disabilities: Are there cognitive differences? *Journal of Educational Psychology*, doi:10.1037/edu0000252
- Swanson, H. L., Orosco, M. J., & Kudo, M. (2017). Does growth in the executive system of working memory underlie growth in literacy for bilingual children with and without reading disabilities? *Journal of Learning Disabilities*, 50(4), 386–407. doi:10.1177/0022219415618499
- Swanson, H. L., Orosco, M. J., & Lussier, C. M. (2015). Growth in literacy, cognition, and working memory in English language learners. *Journal of Experimental Child Psychology*, 132, 155–188. doi:10.1016/j.jecp.2015.01.001
- Swanson, H. L., Orosco, M. J., Lussier, C. M., Gerber, M. M., & Guzman-Orth, D. (2011). The influence of working memory and phonological processing on English language learner children's bilingual reading and language acquisition. *Journal of Educational Psychology*, 103(4), 838–856. doi:10.1177/0022219415618499
- Swanson, H. L., & Sachse-Lee, C. (2001a). A subgroup analysis of working memory in children with reading disabilities: Domain-general or domain-specific deficiency? *Journal of Learning Disabilities*, 34(3), 249–263. doi:10.1177/002221940103400305
- Swanson, H. L., & Sachse-Lee, C. (2001b). Mathematical problem solving and working memory in children with learning disabilities: Both executive and phonological processes are important. *Journal of Experimental Child Psychology*, 79(3), 294–321. doi:10.1006/jecp.2000.2587
- Swanson, H. L., Sáez, L., & Gerber, M. (2006). Growth in literacy and cognition in bilingual children at risk or not at risk for reading disabilities. *Journal of Educational Psychology*, 98(2), 247–264. doi:10.1037/0022-0663.98.2.247
- Swanson, H. L., Sáez, L., Gerber, M., & Leafstedt, J. (2004). Literacy and cognitive functioning in bilingual and nonbilingual children at or not at risk for reading disabilities. *Journal of Educational Psychology*, 96(1), 3–18. doi:10.1037/0022-0663.96.1.3
- Swanson, H. L., & Siegel, L. (2001a). Elaborating on working memory and learning disabilities: A reply to commentators. *Issues in Education: Contributions from Educational Psychology*, 7, 107–129.
- Swanson, H. L., & Siegel, L. (2001b). Learning disabilities as a working memory deficit. *Issues in Education: Contributions from Educational Psychology*, 7, 1–48.
- Swanson, H. L., & Zheng, X. (2013). Memory difficulties in children and adults with learning disabilities. In H. L. Swanson, K. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* (2nd ed., pp. 214–238). New York, NY: Guilford Press.
- Swanson, H. L., Zheng, X., & Jerman, O. (2009). Working memory, short-term memory, and reading disabilities: A selective meta-analysis of the literature. *Journal of Learning Disabilities*, 42(3), 260–287. doi:10.1177/0022219409331958
- Swanson, L. (1981). Vigilance deficit in learning disabled children: A signal detection analysis. *Child Psychology & Psychiatry & Allied Disciplines*, 22(4), 393–399. doi:10.1111/j.1469-7610.1981.tb00563.x
- Swanson, L., & Kim, K. (2007). Working memory, short-term memory, and naming speed as predictors of children's mathematical performance. *Intelligence*, 35(2), 151–168. doi:10.1016/j.intell.2006.07.001
- Unsworth, N., & Engle, R. W. (2007). On the division of short-term and working memory: An examination of simple and complex span and their relation to higher order abilities. *Psychological Bulletin*, 133(6), 1038–1066. doi:10.1037/0033-2909.133.6.1038
- van der Sluis, S., van der Leij, A., & de Jong, P. F. (2005). Working memory in Dutch children with reading- and arithmetic-related LD. *Journal of Learning Disabilities*, 38, 207–221.
- Wang, S., & Gathercole, S. E. (2013). Working memory deficits in children with reading difficulties: Memory span and dual task coordination. *Journal of Experimental Child Psychology*, 115(1), 188–197. doi:10.1016/j.jecp.2012.11.015
- Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., & Pennington, B. F. (2005). Validity of the executive function theory of attention-deficit/hyperactivity disorder: A meta-analytic review. *Biological Psychiatry*, 57(11), 1336–1346. doi:10.1016/j.biopsych.2005.02.006

- Willcutt, E. G., Pennington, B. F., Boada, R., Ogline, J. S., Tunick, R. A., Chhabildas, N. A., & Olson, R. K. (2001). A comparison of the cognitive deficits in reading disability and attention-deficit/hyperactivity disorder. *Journal of Abnormal Psychology, 110*(1), 157–172. doi:10.1037/0021-843X.110.1.157
- Willcutt, E. G., Petrill, S. A., Wu, S., Boada, R., DeFries, J. C., Olson, R. K., & Pennington, B. F. (2013). Comorbidity between reading disability and math disability: Concurrent psychopathology, functional impairment, and neuropsychological functioning. *Journal of Learning Disabilities, 46*(6), 500–516. doi:10.1177/0022219413477476
- Zelazo, P. D., Blair, C. B., & Willoughby, M. T. (2016). Executive function: Implications for education (NCER 2017-2000) Washington, DC: National Center for Education Research, Institute of Education Sciences, U.S. Department of Education. This report is available on the Institute website at <http://ies.ed.gov/>
- Zelazo, P. D., Qu, L., & Müller, U. (2005). Hot and cool aspects of executive function: Relations in early development. In W. Schneider, R. Schumann-Hengsteler, & B. Sodian (Eds.), *Young children's cognitive development: Interrelationships among executive functioning, working memory, verbal ability, and theory of mind* (pp. 71–93). Mahwah, NJ: Lawrence Erlbaum.

3

IDENTIFYING AND SUPPORTING STUDENTS WITH AFFECTIVE DISORDERS IN SCHOOLS

Academic Anxieties and Emotional Information Processing

Jerrell C. Cassady and Christopher L. Thomas

The overarching professional mission of school leaders, teachers, and support staff is to develop and maintain environments and learning events supportive of long-term academic success for students with differing levels of ability and unique challenges. Despite their best efforts, students' abilities to thrive in standard educational settings are routinely disrupted by negative affective experiences triggered by stressors within or beyond the academic environment (Pekrun, 2006; Putwain, 2007; Thomas, Cassady, & Heller, 2017). Available data suggest that anywhere between 20 and 45% of students will experience debilitating anxiety, depression, or a similar emotional disorder at some point during their academic career – with incidence rates increasing along the developmental trajectory (Greenberg, Domitrovich, & Bumbarger, 1999; Kessler, Berglund, Demler, Jin, & Walters, 2005). To assist learners at risk for maladaptive affective responses, schools must make use of methods supporting the accurate and timely detection of such students who would benefit from targeted intervention, reasonable accommodations, or course modifications. In the sections that follow, we outline the current state of screening methods for students with emotional and behavioral disorders, discuss how current diagnostic frameworks often fail to meet the changing and diverse needs of learners, and articulate a model that can be used by school personnel to detect and support students who struggle to effectively navigate emotionally laden and potentially challenging academic settings.

CHARACTERISTICS OF EMOTIONAL DISTURBANCE

The detection of students with emotional and behavioral disorders in the United States education system is guided by definitions and guidelines detailed in the U.S. Individuals with Disabilities Act (Individuals with Disabilities Education Act, 2004).

According to the Individuals with Disabilities Education Act (2004), emotional disturbance is defined as:

a condition exhibiting one or more of the following characteristics over a long period of time and to a marked degree that adversely affects a child's educational performance: (1) an inability to learn that cannot be explained by intellectual, sensory, or health factors, (2) an inability to build or maintain satisfactory interpersonal relationships with peers and teachers, (3) inappropriate types of behavior or feelings under normal circumstances, (4) a general pervasive mood of unhappiness or depression, and/or (5) a tendency to develop physical symptoms or fears associated with personal or school problems.

(<https://sites.ed.gov/idea/regs/b/a/300.8/c/4>)

Although the Individuals with Disabilities Education Act (2004) was developed to ensure students with emotional and behavioral disorders are not denied access to quality educational opportunities, educators and special needs support staff have expressed frustration over the definition of emotional disturbance, arguing the vague and subjective nature of the characteristics listed often interfere with the effective detection of at-risk students (Walker, Nishioka, Zeller, Severson, & Feil, 2000).

The ambiguity surrounding the defining characteristics of emotional disturbance is exacerbated upon consideration of cross-cultural comparisons of the practices that are used to identify students struggling with emotional and behavioral issues. For instance, in response to international calls to guarantee students' rights to inclusive education services, many European countries have worked to refine the diagnostic criteria used to identify students with special education needs to ensure the allocation of the resources to students at considerable risk for academic difficulties (Banks & McCoy, 2011; Chakraborti-Ghosh, Mofield, & Orellana, 2010). Despite these reform efforts, most Western countries have failed to generate an agreed upon definition of emotional disturbance – also referred to as severe emotional disability (ED), emotional difficulties, or emotionally disturbed within commonly used classification schemes – and some countries have failed to recognize students with emotional disturbance as a unique subtype of students with special education needs (Chakraborti-Ghosh et al., 2010). Further complicating discussions of definitional guidelines is evidence suggesting that efforts to establish clear definitions of emotional and behavior disturbance within many non-Western countries are still in their infancy (Chakraborti-Ghosh, 2008; Chakraborti-Ghosh et al., 2010; Mazurek & Winzer, 1994).

Despite ambiguity with the operational definition provided by the U.S. Individuals with Disabilities Education Act (2004) and classification schemes used by educators within other Western and non-Western countries, researchers and practitioners have come to a general consensus that manifestations of emotional disturbance can be parsed into two qualitatively distinct categories: internalizing and externalizing (Merrell & Walker, 2004). Students with externalizing forms of emotional disturbance routinely engage in overt behavioral patterns that disrupt the classroom environment and interfere with effective instruction (i.e., aggression, noncompliance, and delinquent behaviors; Stouthamer-Loeber & Loeber, 2002; Walker, Ramsey, & Gresham,

2004), whereas students with internalizing forms of emotional disturbance typically exhibit inwardly focused cognitions and behaviors that contribute to academic deficits (i.e., major depressive disorder, generalized anxiety, obsessive compulsive tendencies, somatic complaints, eating disorders; Gresham & Kern, 2004; Morris, Shah, & Morris, 2002). Hue (Chapter 10, this volume) provides additional discussion of internalizing and externalizing behaviors. Given the clear impact that externalizing disorders have on learning environments and the relative ease of observation for external behaviors, there has historically been greater attention to this form of emotional disturbance. However, there is a growing and pressing level of research being devoted to internalizing disorders, prompted largely by the rising rates of identification of anxiety, depression, and related emotional disorders. The internalizing domain is where the bulk of our focus lies, but it is imperative to recognize that externalizing disorders frequently co-occur or point to more covert internalized emotional difficulties and should not be overlooked during the identification and intervention efforts (Bubier & Drabick, 2009; Martín, Granero, Domènech, & Ezpeleta, 2017).

The association between emotional disturbance and maladaptive outcomes is well established within literature focusing on the contribution of non-cognitive factors to academic success. Across their academic lives, students with emotional disturbance often struggle to master fundamental skills that are required for success (i.e., reading comprehension, written expression, mathematical reasoning; Reid, Gonzalez, Nordness, Trout, & Epstein, 210, 004; Wagner & Cameto, 2004; Wagner & Davis, 2006), receive lower grade point averages (Newman et al., 2011), fail courses at higher rates (Newman et al., 2011), and are more likely to withdraw from school prior to completion (Kaufman, Alt, & Chapman, 2004). Unfortunately, the experience of maladaptive outcomes among this population of learners is not confined to the school years and persists into adulthood. Results of large-scale, longitudinal examinations investigating students' transitions to adulthood indicate learners with emotional disturbance experience more negative employment outcomes (i.e., unemployment, underemployment, and job instability; Bullis & Cheney, 1999; Carter & Wehby, 2003; Wood & Cronin, 1999), attend college at a lower rate (Wagner & Cameto, 2004), are more likely to come into contact with the criminal justice system (U.S. Department of Health and Human Services, 1999), and engage with the community at lower rates than their non-emotionally disturbed peers (Armstrong, Dedrick, & Greenbaum, 2003).

FACTORS INTERFERING WITH THE IDENTIFICATION OF STUDENTS WITH EMOTIONAL DISTURBANCE

Given the sizable population of students at risk for persistent maladaptive outcomes associated with emotional disturbances, it is critical that educators can identify at-risk learners early enough to secure formal and informal support services (e.g., academic, social, emotional). However, research repeatedly demonstrates school personnel struggle to effectively identify and support students with emotional disturbances, as illustrated by the extremely small percentage of K–12 students (< 5%) who are currently receiving special education services (McFarland et al., 2017).

Low Diagnostic Training

One likely source leading to the discrepancy between the number of children served and the number likely in need of service rests with traditional identification procedures in schools. The first step to developing an individualized educational support plan for students with emotional disorders typically relies on teacher referral to experts in special education, school psychology, or school counseling. The widespread use of teacher referral places educators in the role of gatekeepers to specialized academic diagnostic and intervention services. Unfortunately, the evidence clearly demonstrates that teachers generally have not received sufficient training to recognize and support students with internalizing emotional disorders (Hoagwood, Burns, Kiser, Ringeisen, & Schoenwald, 2001). Although teacher reports and referrals provide useful information about student behavior (e.g., frequency of behavior, location of problematic behaviors, potential environmental antecedents), experts recognize that teachers have difficulty identifying students who: (a) meet the diagnostic criteria for serious externalizing and internalizing disorders, (b) are not exhibiting current academic or behavioral problems but exhibit more covert indicators or cues that diagnosticians may identify as precursors to maladaptive outcomes, and (c) are experiencing mild or moderate impairments (Beare & Lynch, 1986). As such, we agree that teachers should be a critical part of the data collection process for identifying learners with emotional disturbances, but more systematic reviews of indicators are recommended to ensure more success in identifying students with need.

Imbalanced Identification of Internalized and Externalized Disorders

Although it is clear that educators (and parents) have difficulty effectively identifying students who should be referred for assessment, the barrier is more pronounced when considering learners at risk for internalized disorders (Achenbach, McConaughy, & Howell, 1987; Bradshaw, Buckley, & Ialongo, 2008; Glaser, Calhoun, Bradshaw, Bates, & Socherman, 2001). Explanations for the lower likelihood of referral for internalized disorders generally center on the accessibility of the indicators of the disorders (i.e., externalized aggression is easier to identify than internalized depression). This inability to identify internal disorders can be attributed to both the covert nature of the symptoms and the potential that students may mask or hide their emotional difficulties for fear of stigmatization (Amstadter, 2008; Mennin, Heimberg, Turk, & Fresco, 2002). Moreover, in a daily context, internalizing behaviors pose less immediate threat to classroom management and effective instruction (Lane, 2007). Externalized behavior disturbances also have been reliably and durably tied to academic performance, attracting the attention of educators, interventionists, and administrators alike (Nelson, Benner, Lane, & Smith, 2004). Finally, some experts hypothesize that schools place less emphasis on internalizing disorders simply because they are not equipped to serve those needs (Cheney, Flower, & Templeton, 2008; Kern, Hilt-Panahon, & Mukherjee, 2013).

Current versus Projective Identification

Finally, in-depth reviews of emotional and behavioral screening practices confirm that educators are most likely to refer students who are *currently* experiencing significant

academic, behavioral, or emotional difficulties – and are unable to reliably identify students most likely to experience difficulties in the future (Bruhn, Woods-Groves, & Huddle, 2014; Donovan & Cross, 2002). Although this is not surprising, the ability to identify individuals with initial indicators of emotional distress would aid a more proactive approach to supporting learners before problems become exacerbated and problematic (Atkinson & Hornby, 2002).

THE USE OF UNIVERSAL SCREENING TO SUPPORT THE IDENTIFICATION OF STUDENTS WITH EMOTIONAL DISTURBANCE

Given the obvious limitations of these traditional “wait to fail” approaches, advocates have called for the adoption of universal screening methods to support the detection of emotional disorders and disturbances alongside cognitive deficiencies. Universal emotional and behavioral screening is a proactive approach that tests all students within particular educational settings (e.g., classrooms, schools, school systems) throughout critical time points (Bruhn et al., 2014; Glover & Albers, 2007). Those data are analyzed to identify the students who may need intensive and structured support or more limited supportive efforts to thrive academically (Marquez, Yeaton, & Vincent, 2014). A variety of benefits associated with the use of universal screening practices have been articulated in the literature, including greater precision in identifying need, timely response to provide support for those at risk, and the ability to more effectively observe changes over time within students.

Foremost in this list of benefits is that validated assessment measures enhance the likelihood of identifying students at risk for emotional disturbance who would benefit from additional academic, social, or emotional support. Related to this, universal screening improves the timeliness of identification. The importance of early identification cannot be overstated given the plethora of empirical evidence suggesting a large percentage of students with emotional disturbance are often identified too late for supports to meaningfully impact student outcomes (Walker et al., 2004). Finally, the collection of data at multiple points during the academic year allows educators to observe both progressive and rapid changes in level of risk that may prove critical in detecting student needs (Lane, Menzies, Oakes, & Kalberg, 2012).

The development and adoption of universal screening methodologies are generally most effective when incorporated into a “multitiered” program of academic support emphasizing the integration of identification and support strategies to assist struggling learners. Multitiered intervention frameworks are consistent with the logic of the response-to-intervention approach (Brown-Chidsey & Steege, 2010; Walker et al., 1996) which strives to support learners by implementing a continuum of evidence-based academic and behavioral interventions matched to the severity of the presenting behavior. The lowest tier of support (Tier 1) involves exposing all students in an educational setting to programming promoting core social and emotional competencies to prevent the development of problematic internalizing and externalizing behaviors (i.e., conflict resolution skills, classroom behavioral expectations, anger management strategies; Horner, Sugai, & Anderson, 2010; Seeley, Severson, & Fixsen, 2010; Walker et al., 1996). Students who demonstrate persisting deficits in functioning following exposure to Tier 1 programming are referred to receive additional support (Fletcher &

Vaughn, 2009; Walker & Severson, 1992). The Tier 2 interventions are more intensive and tailored to meet the needs of clusters of at-risk students demonstrating behaviors that interfere with effective instruction and learning (e.g., social skills lessons, identification and management of emotional states; Horner et al., 2010; Walker et al., 1996). Finally, students who exhibit multiple risk factors for ED as well as learners who are not responsive to Tier 1 and 2 supports are exposed to Tier 3 interventions, which are highly structured, individualized interventions designed to reduce the intensity and frequency of severe externalizing and internalizing behaviors (Sugai & Horner, 2009). Because of their individualized nature and intensity, Tier 3 programs require coordination among a team of individuals (i.e., educators, administrators, school psychologists, counselors, behavioral specialists) to develop and implement them effectively (Horner et al., 2010; Seeley et al., 2010).

BENEFITS OF UNIVERSAL SCREENING METHODS

Universal screening and multitiered frameworks represent a relatively new approach in the field of behavioral and emotional disabilities screening (Brown-Chidsey & Steege, 2010), but their impact on student outcomes is promising. Studies of implementations of school-wide screening practices that emphasize both preventative practices and targeted support after identification through screening practices have shown significant improvements in academic performance (i.e., improved vocabulary, course grades, standardized test scores), classroom behavior, and mental health outcomes (i.e., improved emotional perception, emotional management, reductions in internalizing behavior; Hoagwood et al., 2007; Vidair, Sauro, Blocher, Scudellari, & Hoagwood, 2014).

Unfortunately, schools in the United States and many other Westernized countries have been slow to incorporate universal screening and multitier support into their emotional and behavioral screening procedures (Bruhn et al., 2014; Volpe et al., 2018). For instance, one recent nationwide investigation of the prevalence of emotional and behavioral screening methods used in K–12 educational settings in the United States indicated the majority of surveyed school systems (87%) do not use universal screening and multitier frameworks to identify at-risk students (Bruhn et al., 2014). Common barriers to implementation cited by educational professionals include limited access to screening materials, budgetary concerns, and mere lack of awareness (Bruhn et al., 2014). Although these barriers were identified by educators in the United States, available evidence suggests educators interested in adopting multitiered support systems in European countries also cite limited access to screening tools as the primary barrier preventing the adoption of universal screening practices (Grosche, & Volpe, 2013; Volpe et al., 2018).

We see promise and advocate for broader use of universal screening and multitier intervention supports based on the value of early identification and intervention in promoting academic and emotional thriving for more students, as well as the financial benefits schools experience when adopting proactive rather than reactive policies. However, until universal screening becomes commonplace, schools must rely upon “frontline” educators to initially identify students with needs. One strategy to support this is to provide teachers and other school professionals with parsimonious and functional approaches to recognizing the signs demonstrated by students struggling to manage emotional stressors in educational settings.

EDUCATIONAL PSYCHOLOGY PERSPECTIVES ON EMOTIONAL DISTURBANCES

A variety of theoretical perspectives are relevant when examining the impact of emotional disturbances on optimal student functioning in schools (e.g., Pekrun & Loderer, Chapter 18, and Wigfield & Ponnock, Chapter 17, this volume). From a broad perspective, our work on explaining and intervening with students who present with internalized emotional difficulties is predominantly informed by social-cognitive and cognitive perspectives. This is not to minimize the clear utility of behavioral and cognitive-behavioral strategies to support learners with both internalized and externalized emotional difficulties. That literature is well established, and we recognize the utility of effective behavior management supports. However, we believe incorporating the social-cognitive and cognitive perspectives provides added value in helping educators recognize relevant factors that can support learners' representations of academic settings and events to promote optimal functioning. Collectively, our views are explained by a model referred to as the emotional information processing framework (EIP; Cassady & Boseck, 2008). The EIP attempts to support the understanding of learners' abilities to successfully navigate challenging events by recognizing the influences of (a) individuals' perceptions of internal and external cues and (b) self-regulated learning and emotion regulation strategies (e.g., Crick & Dodge, 1994; Lazarus & Folkman, 1984, 1987; Pekrun, 2006; Schunk & Zimmerman, 2003). In short, the EIP model (see Figure 3.1) recognizes an iterative process for encoding and interpreting internal and external cues, developing and evaluating goals to

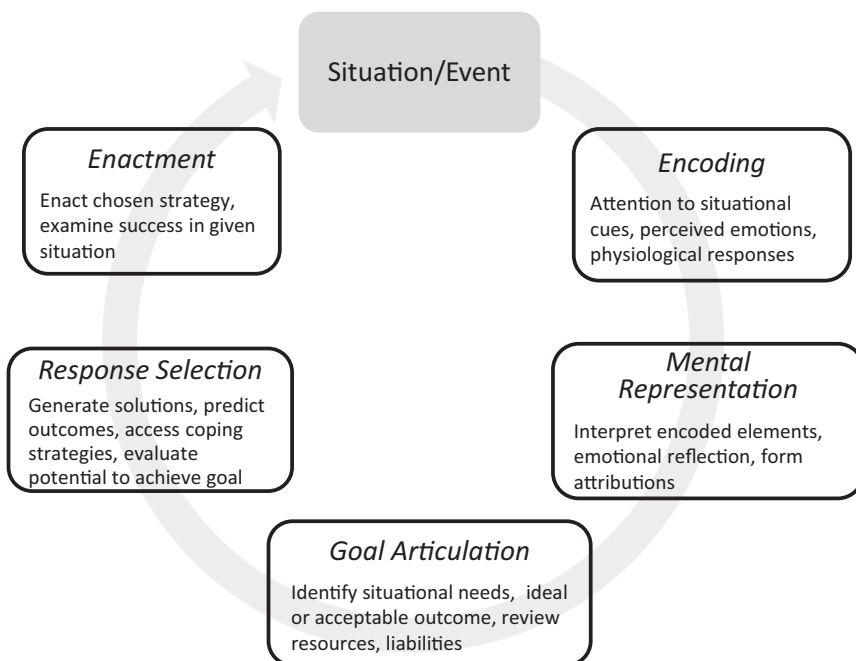


Figure 3.1 Emotional Information Processing Model

respond to the perceived situation, and implementing solutions to meet these goals (relying on personal experiences to determine the most viable solutions for the task at hand; see Cassady & Boseck, 2008).

Perceptions of Threat and Self-Efficacy

One of the core suppositions of the EIP is built on the work demonstrating significant variation in the interpretation of both internal and external cues among individuals. From a basic social-cognitive or constructivist framework, the EIP recognizes that each unique situation provides us with a set of environmental stimuli that are interpreted through the lens of our own histories. Crick and Dodge (1994) demonstrated that, in social situations, the selection of external cues to attend to and the interpretation of those cues were dramatically different among individuals with varied levels of social skills. Their social information processing model was instrumental in demonstrating that the progressive failures of children with high levels of aggression could be traced back through an information processing pathway that relied on their attention to environmental and personal factors, and this commonly led to these children presuming a hostile situation in contexts that non-aggressive children interpreted quite differently. Zentall, Cassady, and Javorsky (2001) used this framework while working with children with high levels of inattention and hyperactivity, demonstrating that their attentional biases in reviewing social contexts reliably led to less effective social problem-solving. In that study, refocusing the child to attend to more contextual cues mitigated the negative social outcomes for those children with hyperactivity, suggesting that reframing the situational interpretation may serve to support learners with difficulty in social or educational settings (Zentall et al., 2001).

In addition to environmental and contextual cues, the EIP model recognizes the critical role of learners' internal representation of their ability. Building from Lazarus and Folkman's (1984) coping model and Bandura's (2005) representation for the utility of self-efficacy in learning situations, the EIP suggests that it is the comparative analysis of the perceived event, stressor, or challenge and the learner's interpretation of their own abilities to successfully manage the task at hand that determine the interpretation of the event as a manageable challenge, stressor, or even threat to self. To illustrate, consistent with the classic representation of stress and performance (i.e., Yerkes & Dodson, 1908), we agree that limited levels of environmental stress can have a positive or motivating influence (Alpert & Haber, 1960; Couch, Garber, & Turner, 1983; Glass & Singer, 1972; Keeley, Zayac, & Correia, 2008; Raffety, Smith, & Ptacek, 1997). In line with that, low levels of academic stress may have a facilitative influence by initiating learners' behaviors toward addressing the task. However, when learners perceive stressors to exceed their level of ability or competence, the event or context is interpreted as a threat to academic success, social standing, or the self (Lazarus & Folkman, 1984, 1987). When the individual perceives an environmental stressor to be threatening rather than challenging, anxiety arises and can exert a debilitating influence on the situation (i.e., maladaptive anxiety), impeding learning efficiency and performance or sparking neurotic thoughts and behaviors (Keeley et al., 2008).

Self-Regulation and Emotion Regulation

Once the academic task or situation in question has been mentally represented by an individual, the set of processes referred to in the EIP are consistent with social-cognitive orientations toward self-regulated learning (SRL). (See Perry, Mazabel, & Yee, Chapter 13, this volume, for additional discussion of SRL to support learners with special needs in classrooms.) Dominant representations of SRL recognize the roles of planning, self-monitoring, self-regulation, and control processes in determining the success of learners in meeting quality achievement goals (e.g., Schunk & Zimmerman, 2003). Pintrich (2004) recognized that, in addition to regulating cognition, more complete representations of effective SRL functioning recognize that effective learners demonstrate the ability to regulate not only their cognitive processes, but also affect (or emotions), behavior, and the context within which they are operating. Gross's (1998, 2015) process model for emotion regulation provides a strong analogue to the EIP model, proposing that attention, cognitive change, and response modulation are key features in identifying how people may either change their emotional set or modify the severity of an emotional response. Gross's (2015) distinction between emotion regulation and coping draws a compelling line between the general management of emotional cues (i.e., emotion regulation) and response to stressors (i.e., coping). The EIP makes no explicit distinction between these two affective regulation strategies; however, Gross's representation for this distinction is a useful method for clarifying distinctions in the utility of emotion-focused and adaptive coping. That is, research on coping has frequently struggled to reconcile the overall utility of emotion-focused coping in academic settings (e.g., Thomas et al., 2017) but recognizes that, in specific cases, where the goal is to moderate or mitigate the influence of emotional influences on a situation, the adoption of emotion-focused coping may have an adaptive (or proactive function). In step with Gross, the EIP recognizes that the utility of a coping (or emotion regulation) strategy is predominately reliant on the goal that has been established. If the goal is to reduce emotional reactivity, manage emotional intensity, or separate from overwhelming emotional response, then emotion regulation is an effective coping strategy (cf. Gross, 2015). However, in cases where the primary goal is to advance understanding of content or improve performance on a task, emotion regulation strategies alone may not have the adaptive utility of other coping strategies.

The EIP recognizes these critical skills in planning, monitoring, and regulating cognitions, emotions, and behavior during the goal articulation, response selection, and enactment phases (see Figure 3.1; Cassady & Boseck, 2008). Key aspects of SRL theory articulated in the EIP include recognizing that effective goals are proximal, specific, and measurable (Schunk & Zimmerman, 2003); SRL strategies can be taught, modeled, and practiced (Bandura, 2005; Martynowicz & Cassady, 2018); accurately identifying, monitoring, and managing emotional influences on the context are inherently entwined with cognitive and behavioral operations (Gross, 2015; Pintrich, 2004); and, as the repository of effective strategies at a learner's disposal increases, their potential for successfully overcoming challenges also improves (Bjork, Dunlosky, & Kornell, 2013).

The primary value of effective SRL and emotion regulation strategies employed by learners is the long-term benefit of a recursive process of continued skill acquisition in establishing quality goals, employing effective strategies, and reflecting on those

successes over time (e.g., Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013; Kitsantas & Zimmerman, 2009). As such, learners who employ effective self-regulation processes simultaneously experience gains in learning strategy use, self-efficacy, and achievement motivation outcomes (Bjork et al., 2013; Schunk & Zimmerman, 2003). As the level of success increases (either qualitatively or quantitatively), learners become more likely to view future events as manageable (or less threatening), as their appraisal of their ability to meet the cognitive or emotional demands of the contextual challenge increases, promoting a sense of agency that influences each phase of the EIP (Bandura, 2005; Cassady & Boseck, 2008; Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986).

EMOTIONAL INFORMATION PROCESSING FRAMEWORK AND AFFECTIVE DISORDERS IN SCHOOLS

Building on the brief overview of theory, this section is intended to provide a bridge between theory and practice, with an attempt to illustrate how educators may gain insight into identifying and subsequently supporting individuals with affective disorders (i.e., emotional disturbances) in academic contexts. The wide range of specific emotional and affective disruptions learners encounter in schools precludes a full detailing of all conditions. Given our own experience, we use academic anxieties to illustrate what we see as the functional potential of the EIP. However, the model is intended to function effectively in explaining a wide array of negative and positive emotional representations and behavioral outcomes that follow from those experiences.

Anxiety in Schools

Within the educational domain, many representations of anxiety have been articulated, ranging from clinical diagnoses of generalized anxiety disorder, social anxiety disorder, and specific phobias – including “school phobia” (American Psychiatric Association, 2013) – to experiences of anxiety that are not clinically identified, but maintain influence on learners’ experiences. Our use of the term “academic anxieties” is an attempt to generalize the findings from research exploring anxieties learners cope with in academic settings (e.g., test anxiety, reading anxiety, math anxiety; Cassady, Pierson, & Starling, 2019). These various forms of anxiety in schools often share many features regarding manifestation and potential interventions, with the primary variation among these domains of anxiety resting with the specific stressor(s) underlying the anxiety (cf. Cassady, 2010a). To clarify our position, we represent academic anxiety as a response to perceived environmental stressors by the learner. These representations of stressors are formed in a constructive and individually specific process, whereby environmental stimuli (e.g., challenges, stressors, expectations) interact with personal factors (e.g., perceived ability, prior experiences), leading to a final appraisal of the level of threat imposed by the stressor and, eventually, the interpretation of personal ability to meet that challenge (see Bandura, 2005; Cassady & Boseck, 2008; Lazarus, 1993; Lazarus & Folkman, 1984, 1987). Our research also supports the notion of a “nested” representation of academic anxieties, demonstrating that academic anxieties serve as more specific or hierarchically subordinate forms of anxiety compared

with generalized anxiety disorders (i.e., individuals with high levels of anxiety have a higher likelihood of experiencing these more contextually focused forms of anxiety; Cassady et al., 2019).

Because most learners who experience anxiety in an academic setting will not rise to a level of clinical diagnosis requiring formalized support, there is growing attention to help educators identify the rates of incidence of these academic anxieties, as well as illustrating the range of negative outcomes that are associated (Putwain, 2007; Putwain & Daly, 2014; von der Embse & Hasson, 2012; von der Embse, Mata, Segool, & Scott, 2014). Estimations of the prevalence of test anxiety in schools suggest that 40–60% of students encounter some degree of test anxiety, and roughly 10–15% may encounter severe levels (Ergene, 2003; Putwain & Daly, 2014; von der Embse, Kilgus, Segool, & Putwain, 2013). This approach to detecting academic anxieties has broader utility, as research clearly demonstrates comorbidity of anxiety and other emotional conditions such as depression (Anderson & Hope, 2008; Cassady et al., 2019). Students identified with both anxiety and depression are of particular concern, because they experience lower overall psychological health, are more resistant to treatment efforts, and are linked to higher rates of suicide attempts (Garber & Weersing, 2010; Rhebergen et al., 2011).

VARIATIONS IN EMOTIONAL DIFFICULTIES IN SCHOOLS

A primary misconception we observe in our work with current and future educators is the belief there is uniformity in the experiences students with special needs or disabilities encounter. That is, many novice educators in particular suggest that characteristics of emotional disturbances will be universally demonstrated by all students experiencing that disorder. Obviously, this is an error of overgeneralization that is not limited to educating learners with emotional difficulties, but it is imperative to start all identification and intervention efforts with a reaffirmation that wide variability underlies individual experience. In the case of test anxiety, for instance, there is a long history of research demonstrating that there are at least two primary factors of test anxiety (i.e., cognitive/worry and affective/emotional; Cassady & Johnson, 2002; Liebert & Morris, 1967; Zeidner, 1998), with recent research suggesting a third factor emphasizing the role of socially focused concerns (i.e., fear of letting down important social others) in the experience of test anxiety (Friedman & Bendas-Jacob, 1997; Kavanagh, Harvey, & Mesagno, 2017; Lowe et al., 2008).

Another key point related to classic misperceptions of test anxiety is that the condition is not a transient experience that arises and dissipates within an evaluative session. To the contrary, test anxiety has been identified as present in three phases of the “learning–testing cycle” (Cassady, 2004; Schwarzer & Jerusalem, 1992). This recursive cycle represents the test preparation, test performance, and test reflection phases. Review of each phase has demonstrated that learners with test anxiety show differing forms of anxious responses during the three phases. During the test preparation phase, common responses include procrastination, withdrawal, or selection of relatively ineffective study strategies when preparation for the test does begin (Cassady, 2004; Kalechstein, Hocesvar, Zimmer, & Kalechstein, 1989; Zeidner & Matthews, 2005). During the performance phase, the traditional representations of distracting thoughts, physiological hyperarousal, and fear of negative consequences

of the test are commonly reported, hampering performance (Zeidner, 1998). Finally, during test reflection, learners with test anxiety are more likely to adopt learned helplessness perspectives and attributional stances that perpetuate negative appraisals for future testing events (Cassady, 2004, 2010).

Such variations in learners' experiences with test anxiety led to Zeidner and Matthews' (2005) proposed classification of six types of test anxiety: (a) study or testing skills deficits; (b) anxiety blockage or retrieval failure; (c) failure-acceptance, where anxiety promotes learned helplessness and low motivation; (d) failure-avoidance, where the learner actively withdraws from or avoids perceived stressors; (e) self-handicapping, which involves self-imposed barriers to success that ultimately provide ego-preserving explanations for eventual performance failures; and (f) perfectionism, with a predominately "maladaptive" style that involves socially prescribed and overly high expectations for performance. We believe that the development of diagnostic protocols (including assessment instruments, behavioral data, and recommendations from educators) in schools will help schools more effectively identify (a) primary sources of the anxiety; (b) immediate cognitive, behavioral, or emotional responses to those stressors; and (c) the academic, emotional, and social impacts that follow. When these diverse elements are reviewed for each individual case, there is a greater potential to identify both the causes and solutions for more effectively managing emotional difficulties in the classroom (see von der Embse, Barterian, & Segool, 2013).

ASSISTING STUDENTS WITH ACADEMIC ANXIETY AND RELATED EMOTIONAL DIFFICULTIES

The utility of the EIP can only be realized when put into operation. This section is meant to articulate exemplar strategies educators can employ to identify, explain, and help remediate students' emotional disturbances. Collectively, we reiterate that the optimal condition to support such an effort would rest within a universal screening and tiered intervention model, but believe that, in the absence of such a formalized structure, diagnostic observation and prescriptive intervention can still be realized. Whereas the full model of the EIP addresses five primary phases or steps, for simplicity we address two broad aspects of cognitive and emotional processing: (a) attention, perception, and interpretation of external and internal cues and (b) self-regulation and emotion regulation strategies that focus on setting effective goals and monitoring progress in meeting those goals. Below, we articulate both the model perspective on the importance of these two broad domains of EIP as well as provide exemplar strategies that may support optimal outcomes for learners.

Managing Learners' Perceptions of Environmental and Internal Cues

As presented in the EIP (Figure 3.1; Cassady & Boseck, 2008), the interpretation of an emotional situation starts with the encoding of internal and external cues or stimuli. In a recursive – often self-fulfilling – nature, individuals with a history of emotional difficulty have a predisposition to orient attention toward those cues or stimuli that tend to validate their prior experiences (e.g., stereotype threat; Schmader & Beilock, 2012; Schmader & Johns, 2003). To more effectively identify sources of aversive emotional reactions, it is critical to identify the environmental and internal stimuli *as*

interpreted by the learner. In this way, we liken the use of EIP to a functional behavior analysis, seeking to identify and address factors that may underlie and help to explain how learners operate in emotionally charged academic settings (Cassady & Boseck, 2008; Zentall et al., 2001). Although the cues learners attend to are critical in determining their emotion regulation, it is the interpretation of these cues – or the mental representation they form – that matters the most to professionals attempting to identify the sources and potential solutions of consistent emotional difficulties (Cassady & Boseck, 2008). As learners encode the cues, they reference their personal experiences with similar scenarios, building an appraisal of the situation that determines whether the situation poses a manageable challenge or a debilitating threat (Lazarus, 1993).

Zeidner and Matthews' (2005) self-referent executive function model of emotional distress also asserts that it is this development of negative self-appraisals that activates anxiety and leads to continued ineffectual coping and performance owing to diminished cognitive and behavioral efficiency. In addition to self-reference judgments, learners with predispositions to anxiety may develop attributional biases that place the locus of projected failure on themselves, promoting views of helplessness or hopelessness. Investigations of effective cue encoding have demonstrated increases in emotional reactivity (e.g., anxiety) interfere with optimal allocation of attentional resources, limiting the ability to identify relevant features in academic or social contexts (Broadbent, 1971; Easterbrook, 1959). More recent conceptualizations of these limitations in processing efficiency for learners with anxiety have identified that anxiety impairs basic cognitive operations related to attentional control (Eysenck, Derakshan, Santos, & Calvo, 2007). In addition, overall processing efficiency drops, perhaps owing to the increase in cognitive load brought about by the learner engaging in both the task at hand and managing the distracting stimuli sparked by anxiety or related emotional responses (Chen & Chang, 2009).

In the case of academic anxieties, external stressors that may spark these negative self-appraisals and cognitive distractions include teachers' comments about upcoming evaluations, perceived social pressures from peers and parents, public or private recriminations for failure to meet established standards, or the prototypical high-stakes assessments that permeate all dimensions of education in our current society (e.g., von der Embse & Witmer, 2014). Internal stressors include biological or physiological triggers (e.g., increased heart rate, shortness of breath) that are often interpreted as evidence of threat (Hembree, 1988), as well as emotional and cognitive ruminations that may orient toward self-deprecation (e.g., De Raedt & Koster, 2010; Sarason, 1986).

Strategies to Reduce Environmental Stressors in Academic Settings

Helping learners with academic anxiety and related emotional difficulties adjust their attentional focus and initial interpretations of personal and environmental stressors encompasses the two pivotal steps in the EIP. To start, practitioners and support personnel can help by limiting the presence of threat indicators in academic settings (minimizing the number of triggering cues that may be encountered). This can be accomplished by minimizing threat appraisals when discussing upcoming evaluation events (Segool, Carlson, Goforth, von der Embse, & Barterian, 2013), managing the environment to be a more calm and secure space for learners (Hughes & Coplan,

2018), and advocating for a mastery-oriented classroom goal structure (limiting the competitive nature in academic settings; Meece, Anderman, & Anderman, 2006; Putwain, Woods, & Symes, 2010). In a more direct and transferable approach to training learners to manage their environment, educators can incorporate relaxation-based interventions such as mindfulness meditation, progressive relaxation, and breathing techniques that have repeatedly been identified as effective strategies in helping reduce the impact of situational stressors on performance (Hartman, Wasieleski, Whatley, 2016; Hembree, 1988; Holzel et al., 2011; von der Embse, 2018).

Strategies to Improve Mental Representations

In addition to limiting triggering cues in the environment, educators can support learners by helping them (a) reinterpret ambiguous cues that previously were viewed as threatening by priming competence cues (Lang & Lang, 2010; Van Yperen, 2007); (b) recognize positive cues that are initially overlooked (e.g., through active recall of the event; Zentall et al., 2001); or (c) recall prior successes, referencing peer models who have achieved similar tasks, and referencing academic or social support mechanisms that may support success in the given task (see Fletcher & Cassady, 2010). The general focus of these strategies is to adjust the perception of the stressors to be identified as less threatening or more manageable, which in turn leads to establishing mastery-oriented goals and selecting active coping strategies. As demonstrated in work by Serrano Pintado and Escolar Llamazares (2014), identification of strategies to mitigate the impact of stress on coping in academic settings and identification of the sources of anxiety are critical in selecting cognitive restructuring and skills development interventions, emotional management through relaxation techniques, or both.

Supporting Quality Goals and Coping Strategies

Once a mental representation for the academic event has been formed, situational goals based on personal interest and perceived control are established (Lazarus, 1993; Pekrun, 2006). Consistent with social-cognitive views of achievement motivation, we agree that learners develop goals in response to their interpretation of the academic and emotional setting, but those goals are also influenced by internal motivational impulses (e.g., mastery or performance goal tendencies; Shim & Ryan, 2005). When learners with emotional difficulties (e.g., academic anxieties) perceive high levels of threat in academic settings, it is common for them to select performance-avoidance goals that focus on relief from the perceived stressor rather than achievement-oriented goals focused on completing the task at hand (e.g., Zeidner & Matthews, 2005). These goals lead to task avoidance or ego-defense behaviors such as procrastination, academic self-handicapping, or withdrawal from the academic settings (Thomas et al., 2017). The adoption of avoidance goals clearly does not support optimal performance – it merely relieves, temporarily, the emotional distress owing to separation from the stressor.

Once the goal is established, coping strategies or action plans for reaching the goal in the setting are reviewed and selected. Various classification models for these coping strategies have been proposed (e.g., problem-based vs. emotion-focused, adaptive vs.

maladaptive, active vs. passive; Carver, Scheier, & Weintraub, 1989), but they tend to share a basic orientation toward recognizing that the functional utility of coping strategies rests in the ability of the chosen strategy to reduce the discrepancy between the individual's appraisal of the current state and the goal state. Once again, prior experience of the learner is critical – when a learner has no repository of adaptive coping strategies to draw upon, or has a history of failure in similar settings, the probability of selecting and implementing a viable solution drops appreciably (Cassady & Boseck, 2008; Zentall et al., 2001).

Strategies to Promote Goal Setting and Strategy Selection

To support learners with emotional difficulties, educators can help students focus on mastery-focused or approach-oriented goals (Järvelä et al., 2015; Quoidbach, Mikolajczak, & Gross, 2015), paying attention to ensuring learners develop goals that are specific, proximal, and measurable (Schunk & Zimmerman, 2003). For instance, students with test anxiety are better served with a goal directed toward specific learning activities prior to an exam (e.g., attend tutoring sessions, read and take notes on each chapter) than goals focused on outcomes (e.g., “get an A”) or avoidance goals designed to escape the stressor (Thomas et al., 2017). Helping learners establish goals that directly combat the source of their emotional reactivity or academic difficulty in particular is an implicit aim of using this framework. This may include setting a goal to engage in relaxation activities before starting to study or take the exam, completing a programmed set of study activities prior to the exam, or engaging in expressive writing, exercise, or artistic expression as a means to release anxiety (e.g., Ramirez & Beilock, 2011; Serrano Pintado & Escolar Llamazares, 2014). However, it is also possible that promoting attention to emotion regulation goals may have positive utility as well (Gross, 2015). Differentiating between these approaches (approach-oriented adaptive coping strategies and emotion regulation efforts) largely rests in the established goal (see Figure 3.1). In a situation where the goal is to reduce negative affective experience, emotion regulation strategies (e.g., cognitive reframing, temporary disengagement) may be successful in meeting the goal. However, overall success in academic performance is more likely to be realized when emotion-focused goals are paired with mastery-oriented goals. This supports the potential that learners will adopt both emotion regulation strategies and SRL strategies that increase the likely outcome on academic tasks (Gross, 2015; Thomas et al., 2017).

Strategies to Bolster Expectations of Success

Additional success for learners in establishing quality goals may be realized by promoting their judgments of efficacy and resilience (Schunk & Zimmerman, 2003). Interventions that demonstrate to learners they have the necessary competence to meet the challenge (e.g., illustrating prior successes) mitigate the influence of cognitive test anxiety on performance (Lang & Lang, 2010). Support for learners with emotional difficulties needs to also include bolstering their predictions for success in using the adaptive coping strategies, which can be achieved with efficacy-based motivational manipulations (i.e., providing peer testimonials identifying the utility of specific coping strategies; Martynowicz & Cassady, 2018). Initial failure-accepting

predictions, driven by past experience, lower self-efficacy, or general negative affect can lead to learned helplessness (Cassady, 2004; Zeidner & Matthews, 2005). However, when an intervention strategy is identified that the learner recognizes as likely effective, self-efficacy can be improved (Bandura, 2005), and greater levels of confidence in performance and persistence in task perseverance can be realized, leading to higher potential for success in the academic task (Schunk & Zimmerman, 2003).

FUTURE RESEARCH

Our brief overview of several converging lines of research demonstrates the field of educational psychology is actively pursuing solutions to support learners with emotional disturbances on a variety of applied and theoretical fronts. From our perspective, the theoretical constructs have been sufficiently articulated and supported, and it is time for applied research studies to take a lead in the discipline. We see two primary areas of promising research that are centered on applications of the theories articulated in this chapter. First, recognition of the shared characteristics of subclinical forms of anxiety in educational contexts (e.g., academic anxieties such as math or test anxiety) is critical to support learners with negative affective responses to educational settings. Broadening the attention of educators to the variety of anxiety responses that commonly arise in educational settings may provide a more focused identification of learners who struggle to perform at optimal levels owing to the deleterious effects of anxiety. As more educators begin to recognize the common forms of evaluation-related anxiety learners experience in all phases of educational activity (not just “during tests”), the potential to support treatment in large groups, small groups, or individual counseling will be improved.

The second broad area of burgeoning research in the field of anxiety in school settings is focused on identifying the efficacy of specific interventions that will promote success for individuals experiencing distinct manifestations of academic anxiety (e.g., study skills limitations, cognitive distractions, emotional reactivity; Cassady, 2004; Zeidner & Matthews, 2005). As more precise identification of the component features of school-based anxieties (and related emotional difficulties) are identified (e.g., von der Embse, Kilgus, et al., 2013), provision of precision interventions is anticipated to be more effective, overcoming prior barriers in research demonstrating success for specific strategies of test anxiety (e.g., Hembree, 1988) because the interventions were not specifically focused on the primary areas of need.

In support of this next phase of work, in our own labs we are currently exploring the utility of real-time indicators of elevated anxiety (e.g., wearable heart rate monitors on smart watches) to help learners and educators identify periods of time when their anxiety is increased. Connected to this, using data from specific assessments to identify the sources of academic stress, we are working to provide prescriptive interventions that focus on emotional control strategies (e.g., relaxation techniques, improving views of self) and SRL strategies (e.g., study skills, cognitive monitoring) to overcome those uniquely identified challenges. We see great potential in connecting these lines of inquiry, ideally using integrated technology applications that help learners diagnose, plan, monitor, and engage in positive emotional and cognitive strategies to support their success.

CONCLUSION

As the incidence of affective disorders such as academic anxieties continues to rise, the field is in need of systemic research and practical solutions to support learners to reach their academic potential as well general subjective well-being. Overall, our review of this condition leads to the recommendations that schools will better serve their learners with the adoption of universal screening practices that will identify students in emotional distress, as well as those who are demonstrating precursors to distress. Taken in conjunction with a tiered support system to promote adaptive and positive emotional coping strategies, we believe considerable success can be achieved in breaking the negative cyclical trends observed in learners with maladaptive emotional responses to academic stressors. Even without these formal structures, educators can support students with predispositions toward negative emotional appraisals in academic settings by reviewing supportive strategies using a model such as the EIP. Starting with a clear understanding of the interpretation of the perceived threats in the academic setting, as well as learners' beliefs in their ability to successfully meet the challenge, will help educators better understand the social-cognitive representation that has been formed by their learners. Helping students reframe threats as challenges that can be overcome, identifying support mechanisms to achieve that task, and establishing effective coping strategies and goals are all well-validated strategies that can support students with emotional disturbances and support optimal functioning.

The functional utility of examining these primary dimensions of emotional distress and reactivity rests in the ability to identify and modify primary perceived threats as well as guide the learners toward goal structures and academic behaviors that will scaffold their progressive success. That is, the pathways on which learners reach a given academic outcome vary dramatically, and, by extension, the methods for supporting the learners should also be strategically adopted and applied. For instance, one immediate impact of academic anxiety is inefficient cognitive processing (e.g., attention, organization, retrieval) during the test preparation and test performance phases (Cassady, 2004; Eysenck et al., 2007). This outcome of test anxiety is more commonly experienced by learners whose source of negative self-appraisal rests in deficient study skills or habits (e.g., Naveh-Benjamin, 1991) or limitations in attentional control, working memory, or SRL skills (e.g., Deffenbacher, 1980; Sarason, 1986). Successful interventions for this source and manifestation of test anxiety tend to orient toward training in SRL strategies or study skills interventions (Segool et al., 2013). However, these interventions would be less prescriptive for students whose source of anxiety is rooted in "emotional reactivity" and may have the necessary cognitive skills and study strategies to be successful. For these students, it is more promising to employ emotion regulation strategies that help them reduce the misattributions of threat through behavior or cognitive-behavioral therapies focused on de-escalating the anxiety symptoms (e.g., Serrano Pintado & Escolar Llamazares, 2014). The key to ensuring that more students achieve greater success in overcoming the deleterious effects of anxiety is to provide individually specific intervention strategies to first identify the primary contributing factors that spark the development of anxiety, then provide an intervention strategy that meets their needs directly. In so doing, researchers and educators are in a stronger position to enhance the academic journey of students who would otherwise experience a problematic passage through school – and beyond.

REFERENCES

- Achenbach, T. M., McConaughy, S. H., & Howell, C. T. (1987). Child/adolescent behavioral and emotional problems: Implications of cross-informant correlations for situational specificity. *Psychological Bulletin*, 101(2), 213. doi:10.1037/0033-2909.101.2.213
- Alpert, R., & Haber, R. N. (1960). Anxiety in academic achievement situations. *Journal of Abnormal and Social Psychology*, 61(2), 207–215. doi:10.1037/h0045464
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.
- Amstadter, A. (2008). Emotion regulation and anxiety disorders. *Journal of Anxiety Disorders*, 22(2), 211–221.
- Anderson, E. R., & Hope, D. A. (2008). A review of the tripartite model for understanding the link between anxiety and depression in youth. *Clinical Psychology Review*, 28(2), 275–287. doi:10.1016/j.cpr.2007.05.004
- Armstrong, K. H., Dedrick, R. F., & Greenbaum, P. E. (2003). Factors associated with community adjustment of young adults with serious emotional disturbance: A longitudinal analysis. *Journal of Emotional and Behavioral Disorders*, 11(2), 66–76. doi:10.1177/106342660301100201
- Atkinson, M., & Hornby, G. (2002). *Mental health handbook for schools*. New York, NY: Routledge.
- Bandura, A. (2005). The evolution of social cognitive theory. In K. Smith, & M. A. Hitt (Eds.), *Great minds in management: The process of theory development* (pp. 9–35). New York: Oxford University Press.
- Banks, J., & McCoy, S. (2011). *A study on the prevalence of special educational needs*. Dublin: NCSE.
- Beare, P. L., & Lynch, E. C. (1986). Underidentification of preschool children at risk for behavioral disorders. *Behavioral Disorders*, 11(3), 177–183.
- Bjork, R. A., Dunlosky, J., & Kornell, N. (2013). Self-regulated learning: Beliefs, techniques, and illusions. *Annual Review of Psychology*, 64, 417–444.
- Bradshaw, C. P., Buckley, J. A., & Ialongo, N. S. (2008). School-based service utilization among urban children with early onset educational and mental health problems: The squeaky wheel phenomenon. *School Psychology Quarterly*, 23(2), 169–186. doi:10.1037/1045-3830.23.2.169
- Broadbent, D. E. (1971). *Decision and stress*. New York, NY: Academic Press.
- Brown-Chidsey, R., & Steege, M. W. (2010). *Response to intervention: Principles and methods for effective practice* (2nd ed.). New York, NY: Guilford Press.
- Bruhn, A. L., Woods-Groves, S., & Huddle, S. (2014). A preliminary investigation of emotional and behavioral screening practices in K-12 schools. *Education and Treatment of Children*, 37(4), 611–634. doi:10.1353/etc.2014.0039
- Bubier, J. L., & Drabick, D. A. (2009). Co-occurring anxiety and disruptive behavior disorders: The roles of anxious symptoms, reactive aggression, and shared risk processes. *Clinical Psychology Review*, 29(7), 658–669. doi:10.1016/j.cpr.2009.08.005
- Bullis, M., & Cheney, D. (1999). Vocational and transition interventions for adolescents and young adults with emotional or behavioral disorders. *Focus on Exceptional Children*, 31(7), 1–24.
- Carter, E. W., & Wehby, J. H. (2003). Job performance of transition-age youth with emotional and behavioral disorders. *Exceptional Children*, 69(4), 449–465. doi:https://doi.org/10.1177/001440290306900404
- Carver, C. S., Scheier, M. F., & Weintraub, J. K. (1989). Assessing coping strategies: A theoretically based approach. *Journal of Personality and Social Psychology*, 56(2), 267.
- Cassady, J. C. (2004). The influence of cognitive test anxiety across the learning–testing cycle. *Learning and Instruction*, 14(6), 569–592. doi:10.1016/j.learninstruc.2004.09.002
- Cassady, J. C. (2010). Test anxiety: Contemporary theories and implications for learning. In J. C. Cassady (Ed.), *Anxiety in schools: The causes, consequences, and solutions for academic anxieties* (pp. 5–26). New York, NY: Peter Lang.
- Cassady, J. C. (Ed.). (2010a). *Anxiety in schools: The causes, consequences and solutions for academic anxieties*. New York, NY: Peter Lang.
- Cassady, J. C., & Boseck, J. J. (2008). Educational psychology and emotional intelligence: Toward a functional model for emotional information processing in schools. In J. C. Cassady & M. A. Eissa (Eds.), *Emotional intelligence: Perspectives of educational and positive psychology* (pp. 3–24). New York, NY: Peter Lang.
- Cassady, J. C., & Johnson, R. E. (2002). Cognitive test anxiety and academic performance. *Contemporary Educational Psychology*, 27(2), 270–295.
- Cassady, J. C., Pierson, E. E., & Starling, J. M. (2019). Predicting student depression with measures of general and academic anxieties. *Frontiers in Education*, 4(11). doi.org/10.3389/educ.2019.00011

- Chakraborti-Ghosh, S. (2008). Understanding behavior disorders: Their perception, acceptance, and treatment: A cross-cultural comparison between India and the United States. *International Journal of Special Education*, 23(1), 136–146.
- Chakraborti-Ghosh, S., Mofield, E., & Orellana, K. (2010). Cross-cultural comparisons and implications for students with EBD: A decade of understanding. *International Journal of Special Education*, 25(2), 162–170.
- Chen, I. J., & Chang, C. I. (2009). Cognitive load theory: An empirical study of anxiety and task performance in language learning. *Electronic Journal of Research in Educational Psychology*, 7(2), 729–746.
- Cheney, D., Flower, A., & Templeton, T. (2008). Applying response to intervention metrics in the social domain for students at risk of developing emotional or behavioral disorders. *The Journal of Special Education*, 42(2), 108–126. doi:10.1177/0022466907313349
- Couch, J. V., Garber, T. B., & Turner, W. E. (1983). Facilitating and debilitating test anxiety and academic achievement. *The Psychological Record*, 33(2), 237–244.
- Crick, N. R., & Dodge, K. A. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin*, 115(1), 74–101. doi:10.1037/0033-2909.115.1.74
- De Raedt, R., & Koster, E. H. (2010). Understanding vulnerability for depression from a cognitive neuroscience perspective: A reappraisal of attentional factors and a new conceptual framework. *Cognitive, Affective, & Behavioral Neuroscience*, 10(1), 50–70. doi:10.3758/CABN.10.1.50
- Deffenbacher, J. L. (1980). Worry and emotionality in test anxiety. In I. G. Sarason (Ed.), *Test anxiety: Theory, research, and applications* (pp. 111–128). Hillsdale, NJ: Lawrence Erlbaum.
- Donovan, M. S., & Cross, C. T. (2002). *Minority students in special and gifted education*. Washington, DC: National Academies Press.
- Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, 14, 4–58. doi:10.1177/1529100612453266
- Easterbrook, J. A. (1959). The effect of emotion on cue utilization and the organization of behavior. *Psychological Review*, 66(3), 183–201. doi:10.1037/h0047707
- Ergene, T. (2003). Effective interventions on test anxiety reduction: A meta-analysis. *School Psychology International*, 24(3), 313–328. doi:10.1177/01430343030243004
- Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. *European Journal of Personality*, 6, 177–198. doi:10.1037/1528-3542.7.2.336
- Fletcher, J. M., & Vaughn, S. (2009). Response to intervention: Preventing and remediating academic difficulties. *Child Development Perspectives*, 3(1), 30–37. doi:10.1111/j.1750-8606.2008.00072.x
- Fletcher, K. L., & Cassady, J. C. (2010). Overcoming academic anxieties: Promoting effective coping and self-regulation strategies. In J. C. Cassady (Ed.), *Anxiety in schools: The causes, consequences, and solutions for academic anxieties* (pp. 177–200). New York, NY: Peter Lang.
- Folkman, S., Lazarus, R. S., Dunkel-Schetter, C., DeLongis, A., & Gruen, R. J. (1986). Dynamics of a stressful encounter: Cognitive appraisal, coping, and encounter outcomes. *Journal of Personality and Social Psychology*, 50(5), 992.
- Friedman, I. A., & Bendas-Jacob, O. (1997). Measuring perceived test anxiety in adolescents: A self-report scale. *Educational and Psychological Measurement*, 57(6), 1035–1046.
- Garber, J., & Weersing, V. R. (2010). Comorbidity of anxiety and depression in youth: Implications for treatment and prevention. *Clinical Psychology: Science and Practice*, 17(4), 293–306.
- Glaser, B. A., Calhoun, G. B., Bradshaw, C. P., Bates, J. M., & Socherman, R. E. (2001). Multi-observer assessment of problem behavior in adjudicated youths: Patterns of discrepancies. *Child & Family Behavior Therapy*, 23(2), 33–45. doi:10.1300/J019v23n02_03
- Glass, D. C., & Singer, J. E. (1972). *Urban stress: Experiments on noise and social stressors*. New York, NY: Academic Press.
- Glover, T. A., & Albers, C. A. (2007). Considerations for evaluating universal screening assessments. *Journal of School Psychology*, 45(2), 117–135. doi:10.1016/j.jsp.2006.05.005
- Greenberg, M. T., Domitrovich, C., & Bumbarger, B. (1999). *Preventing mental disorders in school-aged children: A review of the effectiveness of prevention programs*. University Park, PA: Prevention Research Center for the Promotion of Human Development, Pennsylvania State University.
- Gresham, F. M., & Kern, L. (2004). Internalizing behavior problems in children and adolescents. In R. B. Rutherford, Jr, M. M. Quinn, & S. R. Mathur (Eds.), *Handbook of research in emotional and behavioral disorders* (pp. 262–281). New York, NY: Guilford Press.

- Grosche, M., & Volpe, R. J. (2013). Response-to-intervention (RTI) as a model to facilitate inclusion for students with learning and behaviour problems. *European Journal of Special Needs Education*, 28, 254–269. doi:http://dx.doi.org/10.1080/08856257.2013.768452
- Gross, J. J. (1998). The emerging field of emotion regulation: An integrative review. *Review of General Psychology*, 2, 271–299.
- Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological Inquiry*, 26, 1–15.
- Hartman, S., Wasieleski, D. T., & Whatley, M. A. (2016). Just breathe: The effects of emotional dysregulation and test anxiety on GPA. *College Student Journal*, 51(1), 142–150.
- Hembree, R. (1988). Correlates, causes, effects, and treatment of test anxiety. *Review of Educational Research*, 58(1), 47–77. doi:10.3102/00346543058001047
- Hoagwood, K., Burns, B. J., Kiser, L., Ringeisen, H., & Schoenwald, S. K. (2001). Evidence-based practice in child and adolescent mental health services. *Psychiatric Services*, 52(9), 1179–1189. doi:10.1176/appi.ps.52.9.1179
- Hoagwood, K. E., Serene Olin, S., Kerker, B. D., Kratochwill, T. R., Crowe, M., & Saka, N. (2007). Empirically based school interventions targeted at academic and mental health functioning. *Journal of Emotional and Behavioral Disorders*, 15(2), 66–92. doi:10.1177/10634266070150020301
- Holzel, B. K., Lazar, S. W., Gard, T., Schuman-Olivier, Z., Vago, D. R., & Ott, U. (2011). How does mindfulness meditation work? Proposing mechanisms of action from a conceptual and neural perspective. *Perspectives on Psychological Science*, 6, 537–559. doi:10.1177/1745691611419671
- Horner, R. H., Sugai, G., & Anderson, C. M. (2010). Examining the evidence base for school-wide positive behavior support. *Focus on Exceptional Children*, 42(8), 1–14.
- Hughes, K., & Coplan, R. J. (2018). Why classroom climate matters for children high in anxious solitude: A study of differential susceptibility. *School Psychology Quarterly*, 33(1), 94–102. doi:10.1037/spq0000201
- Individuals with Disabilities Education Act, 20 U.S.C §§ 1401 (2004).
- Järvelä, S., Kirschner, P. A., Panadero, E., Malmberg, J., Phielix, C., Jaspers, J., ... Järvenoja, H. (2015). Enhancing socially shared regulation in collaborative learning groups: Designing for CSCL regulation tools. *Educational Technology Research and Development*, 63(1), 125–142. doi:10.1007/s11423-014-9358-1
- Kalechstein, P., Hocevar, D., Zimmer, J. W., & Kalechstein, M. (1989). Procrastination over test preparation and test anxiety. In R. Schwarzer, H. M. van der Ploeg, & G. D. Spiel-Berger (Eds.), *Advances in test anxiety research* (Vol. 6, pp. 63–76). Lisse, The Netherlands: Swets & Zeitlinger.
- Kaufman, P., Alt, M. N., & Chapman, C. D. (2004). Dropout rates in the United States: 2001. Statistical Analysis Report NCES 2005-046. *US Department of Education*.
- Kavanagh, B. E., Harvey, J. T., & Mesagno, C. (2017). Social anxiety mediates the relationship between social connectedness and test anxiety: An exploratory investigation. *Journal of Theoretical Social Psychology*, 1(2), 60–69.
- Keeley, J., Zayac, R., & Correia, C. (2008). Curvilinear relationships between statistics anxiety and performance among undergraduate students: Evidence for optimal anxiety. *Statistics Education Research Journal*, 7(1), 4–15.
- Kern, L., Hilt-Panahon, A., & Mukherjee, A. A. (2013). Strategies to address internalizing behavior problems. In B. Cook & M. Tankersley (Eds.), *Research-based practices in special education* (pp. 178–191). Upper Saddle River, NJ: Pearson.
- Kessler, R. C., Berglund, P. A., Demler, O., Jin, R., & Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication (NSC-R). *Archives of General Psychiatry*, 62(6), 593–602. doi:10.1001/archpsyc.62.6.593
- Kitsantas, A., & Zimmerman, B. J. (2009). College students' homework and academic achievement: The mediating role of self-regulatory beliefs. *Metacognition and Learning*, 4, 97–110. doi:10.1007/s11409-008-9028-y
- Lane, K., Menzies, W., Oakes, W., & Kalberg, J. (2012). *Systematic screenings of behavior to support instruction: From preschool to high school*. New York, NY: Guilford Press.
- Lane, K. L. (2007). Identifying and supporting students at risk for emotional and behavioral disorders within multi-level models: Data driven approaches to conducting secondary interventions with an academic emphasis. *Education and Treatment of Children*, 30(4), 135–164. doi:10.1353/etc.2007.0026
- Lang, J. W. B., & Lang, J. (2010). Priming competence diminishes the link between cognitive test anxiety and test performance: Implications for the interpretation of test scores. *Psychological Science*, 21(6), 811–819. doi:10.1177/0956797610369492
- Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. New York, NY: Springer.

- Lazarus, R., & Folkman, S. (1987). Transactional theory and research on emotions and coping. *European Journal of Personality*, 1(3), 141–169. doi:10.1002/per.2410010304
- Lazarus, R. S. (1993). From psychological stress to the emotions: A history of changing outlooks. *Annual Review of Psychology*, 44, 1–21. doi:10.1146/annurev.ps.44.020193.000245
- Liebert, R. M., & Morris, L. W. (1967). Cognitive and emotional components of test anxiety: A distinction and some initial data. *Psychological Reports*, 20(3), 977–978. doi:10.2466/pr0.1967.20.3.975
- Lowe, P. A., Lee, S. W., Witteborg, K. M., Prichard, K. W., Luhr, M. E., Cullinan, C. M., ... Janik, M. (2008). The Test Anxiety Inventory for Children and Adolescents (TAICA) examination of the psychometric properties of a new multidimensional measure of test anxiety among elementary and secondary school students. *Journal of Psychoeducational Assessment*, 26(3), 215–230.
- Marquez, B., Yeaton, P., & Vincent, C. (2014). Behavioral universal screening and progress monitoring with web-based technology. In H. M. Walker & F. M. Gresham (Eds.), *Handbook of evidence-based practices for emotional and behavioral disorders: Applications in schools* (pp. 192–210). New York, NY: Guilford Press.
- Martín, V., Granero, R., Domènech, J. M., & Ezpeleta, L. (2017). Factors related to the comorbidity between oppositional defiant disorder and anxiety disorders in preschool children. *Anxiety, Stress, & Coping*, 30(2), 228–242. doi:10.1080/10615806.2016.1228897
- Martynowicz, M. J., & Cassady, J. C. (2018). Impacting study behaviors, self-efficacy, satisfaction, and performance: Collective outcomes of strategy instruction and efficacy-based motivational messages. Presented at the 2018 Annual Conference for the Society for the Teaching of Psychology, Phoenix, AZ.
- Mazurek, K., & Winzer, M. A. (Eds.). (1994). *Comparative studies in special education*. Washington, DC: Gallaudet University Press.
- McFarland, J., Hussar, B., de Brey, C., Snyder, T., Wang, X., Wilkinson-Flicker, S., ... Bullock Mann, F. (2017). *The condition of education 2017*. NCES 2017-144. Washington, DC: National Center for Education Statistics.
- Meece, J. L., Anderman, E. M., & Anderman, L. H. (2006). Classroom goal structure, student motivation, and academic achievement. *Annual Review of Psychology*, 57(1), 487–503. doi:10.1146/annurev.psych.56.091103.070258
- Mennin, D. S., Heimberg, R. G., Turk, C. L., & Fresco, D. M. (2002). Applying an emotion regulation framework to integrative approaches to generalized anxiety disorder. *Clinical Psychology: Science and Practice*, 9, 85–90.
- Merrell, K. W., & Walker, H. M. (2004). Deconstructing a definition: Social maladjustment versus emotional disturbance and moving the EBD field forward. *Psychology in the Schools*, 41(8), 899–910. doi:10.1002/pits.20046
- Morris, R. J., Shah, K., & Morris, Y. P. (2002). Internalizing behavior disorders. In K. Lane, F. Gresham, & T. O'Shaughnessy (Eds.), *Interventions for children with or at risk for emotional and behavioral disorders* (pp. 223–241). Boston, MA: Allyn & Bacon.
- Naveh-Benjamin, M., McKeachie, W. J., & Lin, Y. (1987). Two types of test-anxious students: Support for an information processing model. *Journal of Educational Psychology*, 79(2), 131–136. doi:10.1037/0022-0663.79.2.131
- Naveh-Benjamin, M. (1991). A comparison of training programs intended for different types of test-anxious students: Further support for an information-processing model. *Journal of Educational Psychology*, 83(1), 134–139.
- Nelson, J. R., Benner, G. J., Lane, K., & Smith, B. W. (2004). An investigation of the academic achievement of K-12 students with emotional and behavioral disorders in public school settings. *Exceptional Children*, 71, 59–73. doi:10.1177/001440290407100104
- Newman, L., Wagner, M., Huang, T., Shaver, D., Knokey, A. M., Yu, J., ... Cameto, R. (2011). *Secondary school programs and performance of students with disabilities: A special topic report of findings from the National Longitudinal Transition Study-2 (NLTS2)*. NCSE 2012-3000. Washington, DC: National Center for Special Education Research.
- Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review*, 18, 315–341. doi:10.1007/s10648-006-9029-9
- Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review*, 16, 385–407. doi:10.1007/s10648-004-0006-x

- Putwain, D., & Daly, A. L. (2014). Test anxiety prevalence and gender differences in a sample of English secondary school students. *Educational Studies*, 40(5), 554–570. doi:10.1080/03055698.2014.953914
- Putwain, D. W. (2007). Test anxiety in UK schoolchildren: Prevalence and demographic patterns. *British Journal of Educational Psychology*, 77(3), 579–593. doi:10.1348/000709906X161704
- Putwain, D. W., Woods, K. A., & Symes, W. (2010). Personal and situational predictors of test anxiety of students in post-compulsory education. *British Journal of Educational Psychology*, 80(1), 137–160.
- Quoidbach, J., Mikolajczak, M., & Gross, J. J. (2015). Positive interventions: An emotion regulation perspective. *Psychological Bulletin*, 141(3), 655–693. doi:10.1037/a0038648
- Raffety, B. D., Smith, R. E., & Ptacek, J. T. (1997). Facilitating and debilitating trait anxiety, situational anxiety, and coping with an anticipated stressor: A process analysis. *Journal of Personality and Social Psychology*, 72(4), 892. doi:10.1037/0022-3514.72.4.892
- Ramirez, G., & Beilock, S. L. (2011). Writing about testing worries boosts exam performance in the classroom. *Science*, 331, 211–213. doi:10.1126/science.1199427
- Reid, R., Gonzalez, J. E., Nordness, P. D., Trout, A., & Epstein, M. H. (2004). A meta-analysis of the academic status of students with emotional/behavioral disturbance. *The Journal of Special Education*, 38(3), 130–143. doi:10.1177/00224669040380030101
- Rhebergen, D., Batelaan, N. M., deGraaf, R., Nolen, W. A., Spijker, J., Beekman, A. T. F., & Penninx, B. W. J. H. (2011). The 7-year course of depression and anxiety in the general population. *Acta Psychiatr Scand*, 123, 297–306.
- Sarason, I. G. (1986). Test anxiety, worry, and cognitive interference. In R. Schwarzer (Ed.), *Self-related cognitions in anxiety and motivation* (pp. 19–34). Hillsdale, NJ: LEA.
- Schmader, T., & Beilock, S. (2012). An integration of processes that underlie stereotype threat. In M. Inzlicht & T. Schmader (Eds.), *Stereotype threat: Theory, process, and application* (pp. 34–50). New York, NY: Oxford University Press.
- Schmader, T., & Johns, M. (2003). Converging evidence that stereotype threat reduces working memory capacity. *Journal of Personality and Social Psychology*, 85(3), 440–452. doi:10.1037/0022-3514.85.3.440
- Schunk, D. H., & Zimmerman, B. J. (2003). Self-regulation and learning. In W. M. Reynolds & G. E. Miller (Eds.), *Handbook of psychology* (Vol. 7, pp. 59–78). Hoboken, NJ: Wiley.
- Schwarzer, R., & Jerusalem, M. (1992). Advances in anxiety theory: A cognitive process approach. In K. A. Hagtvet & T. B. Johnsen (Eds.), *Advances in test anxiety research* (Vol. 7, pp. 2–31). Lisse, The Netherlands: Swets & Zeitlinger.
- Seeley, J. R., Severson, H. H., & Fixsen, A. A. M. (2010). Empirically based targeted preventions approaches for addressing externalizing and internalizing behavior disorders. In H. M. Walker & F. M. Gresham (Eds.), *Handbook of evidence-based practices for emotional and behavioral disorders: Applications in schools* (pp. 307–323). New York, NY: Guilford Press.
- Segool, N., Carlson, J., Goforth, A., von der Embse, N., & Barterian, J. (2013). Heightened test anxiety among young children: Elementary school students' anxious responses to high-stakes testing. *Psychology in the Schools*, 50(5), 489–499. doi:10.1002/pits.21689
- Serrano Pintado, I., & Escolar Llamazares, M. C. (2014). Description of the general procedure of a stress inoculation program to cope with test anxiety. *Psychology*, 5, 956–965. doi:10.4236/psych.2014.58106
- Shim, S., & Ryan, A. (2005). Changes in self-efficacy, challenge avoidance, and intrinsic value in response to grades: The role of achievement goals. *The Journal of Experimental Education*, 73(4), 333–349. doi:10.3200/JEXE.73.4.333-349
- Stouthamer-Loeber, M., & Loeber, R. (2002). Lost opportunities for intervention: Undetected markers for the development of serious juvenile delinquency. *Criminal Behaviour and Mental Health*, 12(1), 69–82. doi:10.1002/cbm.487
- Sugai, G., & Horner, R. H. (2009). Responsiveness-to-intervention and school-wide positive behavior supports: Integration of multi-tiered system approaches. *Exceptionality*, 17(4), 223–237. doi:10.15241/jzd.6.3.220
- Thomas, C. L., Cassidy, J. C., & Heller, M. L. (2017). The influence of emotional intelligence, cognitive test anxiety, and coping strategies on undergraduate academic performance. *Learning and Individual Differences*, 55, 40–48. doi:10.1016/j.lindif.2017.03.001
- U.S. Department of Health and Human Services. (1999). *Mental health: A report of the Surgeon General*. Washington, DC: Author.
- Van Yperen, N. W. (2007). Performing well in an evaluative situation: The roles of perceived competence and task-irrelevant interfering thoughts. *Anxiety, Stress, & Coping*, 20(4), 409–419. doi:10.1080/106158000701628876

- Vidair, H. B., Sauro, D., Blocher, J. B., Scudellari, L. A., & Hoagwood, K. E. (2014). Empirically supported school-based mental health programs targeting academic and mental health functioning: An update. In H. M. Walker & F. M. Gresham (Eds.), *Handbook of evidence-based practices for emotional and behavioral disorders* (pp. 15–53). New York, NY: Guilford Press.
- Volpe, R. J., Casale, G., Mohiyeddini, C., Grosche, M., Hennemann, T., Briesch, A. M., & Daniels, B. (2018). A universal behavioral screener linked to personalized classroom interventions: Psychometric characteristics in a large sample of German schoolchildren. *Journal of School Psychology, 66*, 25–40. doi:10.1016/j.jsp.2017.11.003
- von der Embse, N., Barterian, J., & Segool, N. (2013). Test anxiety interventions for children and adolescents: A systematic review of treatment studies from 2000–2010. *Psychology in the Schools, 50*(1), 57–71. doi:10.1002/pits.21660
- von der Embse, N., & Hasson, R. (2012). Test anxiety and high-stakes test performance between school settings: Implications for educators. *Preventing School Failure: Alternative Education for Children and Youth, 56*(3), 180–187. doi:10.1080/1045988X.2011.633285
- von der Embse, N., Jester, D., Roy, D., & Post, J. (2018). Test anxiety effects, predictors, and correlates: A 30-year meta-analytic review. *Journal of Affective Disorders, 227*, 483–493. doi:10.1016/j.jad.2017.11.048
- von der Embse, N. P., Kilgus, S. P., Segool, N., & Putwain, D. (2013). Identification and validation of a brief test anxiety screening tool. *International Journal of School and Educational Psychology, 1*, 246–258.
- von der Embse, N. P., Mata, A. D., Segool, N., & Scott, E. C. (2014). Latent profile analyses of test anxiety: A pilot study. *Journal of Psychoeducational Assessment, 32*(2), 165–172. doi:10.1177/0734282913504541
- von der Embse, N. P., & Witmer, S. E. (2014). High-stakes accountability: Student anxiety and large-scale testing. *Journal of Applied School Psychology, 30*(2), 132–156. doi:10.1080/15377903.2014.888529
- Wagner, M., & Cameto, R. (2004). The characteristics, experiences, and outcomes of youth with emotional disturbances [Report from the National Longitudinal Transition Study–2]. *NLTS2 Data Brief, 3*(2). Retrieved from <http://www.ncset.org/publications/>.
- Wagner, M., & Davis, M. (2006). How are we preparing students with emotional disturbances for the transition to young adulthood? Findings from the National Longitudinal Transition Study-2. *Journal of Emotional and Behavioral Disorders, 14*(2), 86–98. doi:10.1177/10634266060140020501
- Walker, H. M., Horner, R. H., Sugai, G., Bullis, M., Sprague, J. R., Bricker, D., & Kaufman, M. J. (1996). Integrated approaches to preventing antisocial behavior patterns among school-age children and youth. *Journal of Emotional and Behavioral Disorders, 4*(4), 194–209.
- Walker, H. M., Nishioka, V. M., Zeller, R., Severson, H. H., & Feil, E. G. (2000). Causal factors and potential solutions for the persistent underidentification of students having emotional or behavioral disorders in the context of schooling. *Assessment for Effective Intervention, 26*(1), 29–39. doi:10.1177/073724770002600105
- Walker, H. M., Ramsey, E., & Gresham, F. M. (2004). *Antisocial behavior in school: Evidence-based practices*. Belmont, CA: Wadsworth.
- Walker, H. M., & Severson, H. (1992). *Systematic screening for behavior disorders: Technical manual*. Longmont, CO: Sopris West.
- Wood, S. J., & Cronin, M. E. (1999). Students with emotional/behavioral disorders and transition planning: What the follow-up studies tell us. *Psychology in Schools, 36*, 327–345. doi:10.1002/(SICI)1520-6807(199907)36:4<327::AID-PITS6>3.0.CO;2-P
- Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit-formation. *Journal of Comparative Neurology and Psychology, 18*(5), 459–482.
- Zeidner, M. (1998). *Test anxiety: The state of the art*. New York, NY: Plenum Press.
- Zeidner, M., & Matthews, G. (2005). Evaluation anxiety. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 141–163). London: Guilford Press.
- Zentall, S. S., Cassady, J. C., & Javorsky, J. (2001). Social comprehension of children with hyperactivity. *Journal of Attention Disorders, 5*(1), 11–24. doi: 10.1177/108705470100500102

4

THE IMPORTANCE OF SELF-DETERMINATION AND INCLUSION FOR STUDENTS WITH INTELLECTUAL DISABILITY

What We Know and What We Still Need to Discover

Iva Strnadová

INTELLECTUAL DISABILITY: DEFINITIONS, IDENTIFICATION, PREVALENCE, EFFECTS

As eloquently put by Sinason (2010, p. 34), “no human group has been forced to change its name so frequently” as people with intellectual disability. And indeed, any time a new term is coined, it is done with best intentions; however, these new terms become quickly affected by the process of euphemism. An example is the once-prevailing terminology of “idiot”, which was a professional term describing a severe level of intellectual disability, but later became an abusive term. Thus, throughout history, different names have been used for this condition – including mental deficiency, mental retardation, and, more currently, intellectual disability and intellectual developmental disorders (ICD-11; Carulla et al., 2011) – which, as history shows us, are likely to change again.

The term “intellectual disability” (also referred to as learning disabilities in the UK) refers to concurrent difficulties in intellectual functioning (also called intelligence) and adaptive functioning (Papazoglou, Jacobson, McCabe, Kaufmann, & Zabel, 2014). The *Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition* (DSM-5; American Psychiatric Association, 2013, p. 33) specifies in its definition that the difficulties in adaptive functioning need to be at least in one of its three domains: conceptual, social, and practical. The conceptual domain includes academic skills, such as abstract thinking, problem-solving, reading, and numerical reasoning. The skills in the social domain are, for example, empathy and interpersonal communication skills; and the skills in the practical domain include money management and self-management (American Psychiatric

Association, 2013; Martin, Strnadová, O'Neill, & Cumming, 2017). Furthermore, according to the DSM-5, people with intellectual disability need ongoing support in at least one of the adaptive functioning domains across multiple settings of their lives (e.g., home, school, or work). The American Association on Intellectual and Developmental Disabilities also emphasizes the impact that environment has on people with intellectual disability, recognizing the role that environmental factors have in “closing the potentiality/actuality gap regarding the full participation and inclusion” of people with this disability in society (Foley, 2018, p. 3).

Intellectual disability occurs across all races. The prevalence is estimated at 1% of the population (American Psychiatric Association, 2013), with even higher rates in middle- and low-income countries (Maulik, Mascarenhas, Mathers, Dua, & Saxena, 2011; Salvador-Carulla et al., 2011). Often-occurring co-existing conditions include ADHD, depressive disorders, anxiety disorders, epilepsy, and autism spectrum disorder, to name a few (American Psychiatric Association, 2013). Intellectual disability is diagnosed using a complex set of measurements in the areas of intellectual and adaptive functioning.

The DSM-5 definition, which is used in this chapter, distinguishes the severity of intellectual disability according to adaptive skills, as opposed to only IQ scores, which was the case in the past (Papazoglou et al., 2014). Nevertheless, education systems in diverse countries still tend to distinguish severity of intellectual disability by referring to mild, moderate, severe, and profound intellectual disability. People with intellectual disability are not a homogeneous group: They vary in their individual abilities and support needs. They generally experience difficulties in learning from instruction and experience, working memory, abstract thought, as well as language processing difficulties (American Psychiatric Association, 2013; Woodcock, Dixon, & Tanner, 2013). Their support needs also differ within education psychology factors, such as learning, achievement, motivation, and engagement (for discussion of developmental disabilities, see Sigafoos, Green, O'Reilly, & Lancioni, Chapter 8, this volume).

INTRODUCTION TO SELF-DETERMINATION AS RELEVANT TO STUDENTS WITH INTELLECTUAL DISABILITY

Although social inclusion has been one of the guiding policy principles in developed countries such as Australia, Canada, Norway, Sweden, the United Kingdom, and the USA for the last 15 years (Mansell & Ericsson, 2013; Power, 2013), people with intellectual disability of all ages continue to be among the most marginalized and isolated populations in society (Ledger, Walmsley, Earle, & Tilley, 2016; Stancliffe, 2014; Strnadová & Evans, 2012). They are also perceived as having, and often have, limited self-determination, which can contribute to society's prevailing prejudices and stereotypes towards this population. It is, therefore, essential to explore ways of developing self-determination skills in students with this disability (see Wehmeyer & Shogren, Chapter 12, this volume, for further discussion of self-determinism and intellectual and developmental disabilities).

Research conducted to date shows that self-determination positively impacts both in-school and post-school adolescent student outcomes (Cho, Wehmeyer, & Kingston, 2012). Specifically, adolescent students with intellectual disability who have acquired self-determination skills have better in-school class participation (Gilberts,

Agran, Hughes, & Wehmeyer, 2001) and are successfully involved in planning transition to life after school, such as to employment and independent living (Test et al., 2009). There is also a documented relationship between self-determination and access to the mainstream education curriculum (Lee, Wehmeyer, & Shogren, 2015; Shogren, Palmer, Wehmeyer, Williams-Diehm, & Little, 2012; Wehmeyer, Palmer, Shogren, Williams-Diehm, & Soukup, 2013). Furthermore, there is a growing body of research (Powers Turner, Westwood, Matuszewski, Wilson, & Phillips, 2001; Shogren, Wehmeyer, Palmer, Rifenbark, & Little, 2015b; Wehmeyer & Palmer, 2003) on the relationship between self-determination and post-school outcomes for individuals with intellectual disability and other developmental disabilities, such as in education, employment, and independent living.

There are several factors that influence the development of self-determination skills, such as personal variables (e.g., gender, age, presence of intellectual disability, ethnicity; Mumbardó-Adam et al., 2017) and environment (Wehmeyer, 2007). Self-determination (in its various forms) is one of the most studied personal factors among individuals with intellectual disability. Research shows that students with intellectual disability have lower levels of self-determination skills compared with mainstream population or students with other types of disabilities (Shogren, Kennedy, Dowsett, Garnier-Villarreal, & Little, 2012), and that there is a relationship between the level of intellectual functioning and self-determination. In other words, the lower the intellectual functioning, the lower the levels of self-determination skills (McGuire & McDonnell, 2008). However, researchers have also suggested that environmental opportunities can be as important as the level of intellectual disability when it comes to self-determination skills (Lee et al., 2012).

In terms of environment, Soresi, Nota, and Wehmeyer (2011) argue that focusing on self-determination is key in promoting inclusion. Research (Wehmeyer, 2007) shows that inclusion in school and the community broadly provides more opportunities for the development of self-determination skills (e.g., choice-making, decision-making, goal-setting) than do restricted settings. Research also shows that people with disabilities living in inclusive environments have more self-determination than people living in segregated settings (Wehmeyer & Bolding, 1999). Indeed, Cumming, Marsh, and Higgins (2018) have suggested that self-determination interventions (such as self-advocacy) help to improve the sense of connectedness students with disabilities feel at school and improve access to mainstream education. Nonetheless, there is only limited research on the relationship between the inclusiveness of the school setting and self-determination skills (Shogren, Bovaird, Palmer, & Wehmeyer, 2010). For example, in their exploratory study with 47 students with intellectual disability attending three U.S. high schools, Hughes, Agran, Cosgriff, and Washington (2013) examined associations between inclusive school and community activities and students' self-determination skills. The results indicated that students educated primarily in special education classrooms showed significantly less use of self-determination skills than students who had more opportunities for inclusion. Eisenman, Pell, Poudel, and Pleet-Odle (2015) conducted a qualitative case study over a period of 5 years that examined students' experiences of self-determination as perceived by students, their parents, teachers, guidance staff, and administrators. Based on their findings, the authors suggested types of inclusive practices that can support development of students' self-determination. These included coaching students with disabilities on self-advocacy,

organization, and goal-monitoring practices throughout the day, as well as in after-school tutoring. Furthermore, teachers were autonomy-supportive. According to the participants in this study, the inclusive structures in the school were interconnected with intermediate student outcomes (e.g., self-advocacy skills, goal-setting, expressions of self-realization, and school engagement). It needs to be highlighted that none of the students participating in this study had intellectual disability, and only one student had developmental disabilities (i.e., autism).

There are numerous theories that focus on self-determination and motivation, which can influence the achievements of people with intellectual disability across the life span, such as action control theory, causal agency theory (Shogren, Wehmeyer, & Palmer, 2017; Shogren, Wehmeyer, Palmer, Forber-Pratt, Little, & Lopez, 2015), self-determination theory (SDT) (Deci & Ryan, 1985; Wehmeyer, 1992), and the zone of proximal development (Vygotsky, 1962). This chapter focuses on ways in which SDT has been applied to support students with intellectual disability and to improve their education and societal inclusion.

SELF-DETERMINATION THEORY

One of the key theories that can positively impact students with intellectual disability is SDT (see also Wehmeyer & Shogren, Chapter 12, this volume). SDT is a macro-theory of motivation, based on three key assumptions: (1) people are prone towards activity, learning, and engagement, and endowed with *intrinsic motivation*; (2) people need *basic psychological needs* (i.e., relatedness, competence, and autonomy) to be met so that they can function optimally, and they thus depend on a nurturing environment; and (3) people are in a dialectic relationship with environment, and, thus, development of self-determination skills is of the essence (Reeve, Ryan, & Deci, 2018). These three core assumptions will be discussed below in relation to people with intellectual disability, with a particular focus on self-determination skills.

Intrinsic/Extrinsic Motivation

SDT emerged from research on intrinsic (i.e., based on the inherent tendency to investigate and take an interest in novelty) and extrinsic (i.e., concerning external instrumentalities) motivation rewards and their effects on human motivation (Adams, Little, & Ryan, 2017). It perceives humans as proactive beings striving towards growth and optimal development, for which they require positive supports from their environment (Deci & Ryan, 2000). Intrinsic motivation is essential for success in school; however, research shows that it diminishes in adolescence (Guardia & Ryan, 2002). Extrinsic motivation is further differentiated to external (i.e., avoiding punishment, least autonomous), introjected (i.e., affected by feelings of worth and efforts to eliminate feelings of guilt and shame; together with external motivation referred to as *controlled motivation*), identified (i.e., driven by a person's values), and integrated (together with identified and intrinsic motivation referred to as *autonomous motivation*). This differentiation is based on relative autonomy of behavior; it is important to note that people can change their motivation type over their life span (Frielink, Schuengel, & Embregts, 2017, 2018). There is a limited research about

extrinsic motivation and people with intellectual disability. Frielink et al. (2017) conducted a study with 186 adults with borderline and mild intellectual disability in the Netherlands to examine whether subtypes of extrinsic motivation also apply to people with intellectual disability. The findings support the four-subtypes structure of extrinsic motivation for this population. Also, although people with intellectual disability tend to be perceived as passive and less motivated compared with the mainstream population, the findings of Frielink et al. (2017) do not support this assumption. Indeed, people with intellectual disability tend to be marginalized and segregated from early childhood and, therefore, they often lack opportunities to develop autonomy. This might lead to incorrect assumptions of low levels of motivation, when, in fact, providing opportunities for autonomy from an early age would lead to increased levels of motivation. Furthermore, autonomous motivation is linked to better life satisfaction and subjective well-being in the general population, whereas controlled motivation is often linked to depression. Frielink et al.'s (2018) study confirmed that the link between autonomous motivation and subjective well-being is also true for people with intellectual disability.

Basic Psychological Needs

SDT focuses on three basic psychological needs – competence, autonomy, and relatedness – which, when met, allow one to improve one's well-being and performance quality (Ryan & Deci, 2000). The need for competence gives satisfaction to humans, irrespective of the actual achievement of competence. People need to feel mastery, they need to feel capable of managing everyday life's challenges (Ryan & Deci, 2016). Another essential psychological need is autonomy. People can experience satisfaction of this need when they have choice and when they are the originators of action. The need for relatedness can be satisfied when people connect to others, feel significant to others, and experience that they belong (Adams et al., 2017).

It is important to highlight that, in SDT, autonomy is not the same as independence (Ryan & Deci, 2016); thus, one can be autonomous while not being an independent person. This makes SDT more applicable to the field of intellectual disability, where independence is not always possible (depending on the severity of the condition). Indeed, it is also questionable whether any person is independent, as we all depend and rely on others and environmental factors when making choices and decisions.

People with intellectual disability tend to be deprived in all three basic psychological needs. They tend to be perceived and treated by others as not particularly competent and/or autonomous, and the prevailing stereotypes about this population, which often include seeing them as eternal children, as asexual beings, or as incapable of living adult lives, undermine their status as autonomous agents and limit their opportunities to make choices in their daily lives (Björnsdóttir, Stefánsdóttir, & Stefánsdóttir, 2017; Strnadová & Evans, 2012, 2018). When it comes to relatedness, people with intellectual disability tend to be isolated (Power, 2013) and have smaller social networks, compared with the mainstream population (Forrester-Jones et al., 2006), with family members, personnel, and other people with intellectual disability constituting the majority of these networks (Bigby & Knox, 2009).

Self-Determination Skills

There are numerous definitions of self-determination, one of the most common being that of Wehmeyer (1996, p. 24), according to whom self-determination can be defined as “acting as the primary causal agent in one’s life and making choices and decisions regarding one’s quality of life free from undue influence or interference.” Wehmeyer and Abery (2013) further define self-determined actions as those identified by a person: (a) acting autonomously, (b) behaving in a self-regulated manner, (c) initiating and responding to events in a psychologically empowered manner, and (d) acting in a self-realizing manner. As the authors highlight, self-determination is crucial in an individual’s development. Yet we know that people with intellectual disability are among the most marginalized populations across their life span and are often perceived as not being capable of acting “as the primary causal agent” in their lives, of making choices and decisions. Thus, it is unsurprising that there is a substantial body of literature highlighting the importance of self-determination and its development in individuals so that they can “achieve more positive quality of life and community inclusion” for people with intellectual disability across the life span (Wehmeyer & Abery, 2013, p. 400).

There are numerous self-determination skills: (a) self-management, (b) independent living skills, (c) risk-taking skills, (d) safety skills, (e) internal locus of control, (f) decision-making, (g) choice-making, (h) problem-solving, (i) goal-setting and attainment, (j) self-instruction skills, (k) positive self-efficacy, (l) self-advocacy and leadership skills, (m) self-awareness, and (n) self-evaluation and reinforcement (Wehmeyer, 1997). Although the research surrounding the promotion and development of students’ self-determination skills has provided an evidence base for this practice (Shogren, 2013), there are self-determination skills that remain under-explored, such as autonomous functioning, problem-solving, and locus of control (Chou, Palmer, Wehmeyer, & Skorupski, 2017). (SDT is also explored in substantial detail in Chapter 12, this volume, by Wehmeyer & Shogren.)

People with intellectual disability need targeted support across self-determination skills, as the very nature of their disability makes them fare less successfully on self-determination skills than the mainstream population. For example, as explained in the introduction to this chapter, people with intellectual disability have problems in adaptive functioning. In the conceptual domain of adaptive functioning, this means difficulties with problem-solving, one of the core self-determination skills. In this chapter, diverse self-determination skills will be discussed in relation to people with intellectual disability.

Self-Determination in the Present Chapter

The author recognizes that all three major aspects of SDT (i.e., intrinsic/extrinsic motivation, basic psychological needs, and self-determination skills) are relevant to this chapter. All of these aspects will be traversed across the chapter, with the main focus on self-determination skills, which allows for practical suggestions on increasing the self-determination of people with intellectual disability of school age and beyond. Similarly, although the author acknowledges that there are six mini theories of self-determination (i.e., cognitive evaluation theory, organismic integration theory,

causality orientations theory, basic psychological needs theory, goal contents theory, and relationships motivation theory), it is not possible to address these within the scope of this chapter (interested readers should see Reeve et al., 2018).

UTILIZING SELF-DETERMINATION THEORY IN THE DEVELOPMENT OF SELF-DETERMINATION SKILLS: WHAT RESEARCH TELLS US

As argued above, research clearly shows the importance of developing self-determination skills in students with intellectual disability. Although self-determination skills usually increase with age (Nota, Soresi, Ferrari, & Wehmeyer, 2011), it is important to note that age interacts with environment, and, thus, self-determination skills instruction is invaluable for students with intellectual disability (Karvonen, Test, Wood, Browder, & Algozzine, 2006). Yet most self-determination skills instruction programs for students with this disability are aimed at adolescent students, not children (Hart & Brehm, 2013), and discussions on self-determination and early childhood are fairly recent (Brotherson, Cook, Erwin, & Weigel, 2008). In this section, the main focus is on development of self-determination skills in children and high school students with intellectual disability. Where relevant, the other two core aspects of SDT (i.e., intrinsic/extrinsic motivation, basic psychological needs) will be referred to.

Development of Self-Determination Skills in Preschool and Elementary School

Although researchers highlight the need to start with development of self-determination skills as early as possible, they also acknowledge that, “it would be developmentally inappropriate for preschool-age children to be expected to exercise independent choices, decisions, and problem solving as self-determination is defined for adolescents and young adults” (Palmer et al., 2012, p. 39). Thus, it is important to consider which skills are the foundations for self-determined behavior in preschool children and develop these (Palmer, Wehmeyer, & Shogren, 2017).

According to Palmer et al.’s (2012) foundations model, the key skills in early childhood that are essential for self-determination are choice-making, problem-solving, self-regulation, and engagement. Furthermore, it is important that these foundation skills are developed by both teachers and parents in a consistent manner. Despite the fact that preschool children without disabilities have many opportunities to make choices (e.g., articulating preference for a toy or a snack), children with intellectual disability may struggle with making choices, either owing to their disability or owing to an environment that does not provide opportunities for choice-making (e.g., adults making choices for a child; Clark & McDonnell, 2008). Similarly, problem-solving might be difficult for children with intellectual disability; however, adults can facilitate the acquisition of these skills. Agran, Blanchard, Wehmeyer, and Hughes (2002) identified four steps for teaching preschool children with intellectual disability problem-solving skills: (1) identification of the problem, (2) identification of solutions, (3) observation of obstacles to solving the problem, and (4) identification of effects of each solution.

Another key foundation skill for self-determination is self-regulation. Self-regulation can be defined as “the way in which children process and respond to input

or stimuli received from their environment through the management or control over their own emotions ... behaviour ... and attention” (Palmer et al., 2012, pp. 41–42). Self-regulation development can be difficult for children without any disability, but more problematic for preschool children with intellectual disability. Children with this condition diagnosed at preschool age usually have a moderate to severe level of this disability, which affects their ability to self-regulate. This is especially true for those who do not communicate verbally, as challenging behavior is often their way to communicate their wants and needs to others. Furthermore, in cases when a child has intellectual disability and autism spectrum disorder, sensory sensitivities play an important role in a child’s ability to regulate their behavior (e.g., sensory overload can lead to limited engagement with the learning process; American Psychiatric Association, 2013).

According to Blair and Diamond (2008), self-regulation has been linked to school readiness and school success in the mainstream population. Therefore, it is important that teachers, parents, special educators, teacher’s aides, and other relevant stakeholders are consistent in developing a child’s self-regulation. Palmer et al. (2017) highlight that, during a child’s (elementary) school years, self-regulation is most commonly applied to learning; this is applicable to all children, not just to those with intellectual disability. Consistency in the responses and expectations of all adults involved (parents, teachers, teacher’s aides, etc.), being responsive to children with intellectual disability, and teaching solving strategies remain the ongoing requirements while a child is of school age.

The self-determination skills that need to be a particular focus of any intervention for children with intellectual disability in preschool and elementary school are choice-making, problem-solving, and self-regulation skills. These are highly relevant to satisfying the basic psychological needs (i.e., competence, relatedness, autonomy).

Development of Self-Determination Skills in High School

As mentioned above, most research and educational literature focuses on the development of self-determination skills of adolescents with intellectual disability. There are several ways in which practitioners, such as teachers, teacher’s aides, and educational psychologists, can utilize the SDT in order to develop self-determination skills in adolescent students with intellectual disability. These will be described below, based on current research.

STUDENT INVOLVEMENT IN INDIVIDUALIZED EDUCATION PROGRAMS (IEPS)

The individualized education program (IEP) is often developed for students with intellectual and other disabilities (depending on a country’s legislation; it is mandated in some countries, such as the USA). It is designed to support and protect students with disabilities and to give their parents procedural safeguards (Twachtman-Cullen & Twachtman-Bassett, 2011). It contains a student’s history, strength and support needs, as well as an actual plan for support of the student in his or her classes and beyond, and who is responsible for each action. Involvement of a student in his or her IEP planning is one of the prerequisites of its success. Nevertheless, it is still quite

common that students with intellectual disability remain excluded from IEP meetings (Strnadová & Cumming, 2014). In the event that a student is included, they tend to be only passively present (Martin, Van Dycke, Christensen, et al., 2006), with a limited understanding of the whole process and its purpose (Wagner, Newman, Cameto, Javitz, & Valdes, 2012), instead of being an active decision maker. This is well expressed by the description of an IEP meeting experience of one of the students participating in Hughes et al.'s (2013, p. 8) study: "I sit in them. They talk about my reading skills, math skills, and what I will do after graduation." As a recent systematic literature review (Chandroot, Strnadová, & Cumming, 2018) concluded, transition planning needs to adopt a more student-centered approach, which would lead to students' empowerment and ability to become better self-advocates. This review also highlighted that teachers need to educate students about the transition planning process itself, so they can become more meaningfully engaged.

Another important element of student-focused planning is its focus on identification of students' strengths, preferences, interests, and needs. This is done by involving students in the IEP planning process, as well as putting support systems into place to assist students with intellectual disability achieve their goals and experience positive post-school outcomes (Mazzotti, Test, & Mustian, 2014). Being actively involved in their IEP is an invaluable opportunity for students with intellectual disability to develop their self-determination skills, such as choice-making, decision-making, and self-advocacy. If possible, teachers and other relevant stakeholders (e.g., parents, teacher's aides) should also focus on developing students' leadership skills, so that students with intellectual disability could lead their IEP planning (Hawbaker, 2007). As highlighted by Williams-Diehm, Wehmeyer, Palmer, Soukup, and Garner (2008), a self-determined individual has an agency in choice and decision-making about their future, which can well be put into practice in the process of IEP planning. This can be done across a spectrum of students' engagement, from being actively involved to leading the process.

There are various approaches to teaching self-determination skills that include instructing students how to develop their own IEP and how to actively participate in an IEP meeting (Cease-Cook, Test, & Scroggins, 2013). Most of these target adolescent students with intellectual disability; however, it is desirable to also prepare elementary school students to meaningfully participate in IEP planning and advocate for their IEP accommodations. Hart and Brehm (2013) proposed a 10-step self-advocacy model for obtaining IEP accommodations, which helps teachers and parents to support the students in self-advocacy at the elementary level in inclusive settings.

Student Involvement in the Transition Planning Process

Just like their typically developing peers, students with intellectual disability experience numerous transitions during their schooling years. These can be vertical (e.g., transition from primary to middle school, from middle school to high school, and from high school to post-school life) or horizontal (e.g., changing schools). In addition, students with intellectual disability often experience transitions from mainstream to special schools (rarely in the opposite direction). Schooling transitions can be demanding for any student, but students with intellectual disability often need to start planning the next transition much earlier than their mainstream counterparts

(Strnadová & Cumming, 2016). Students' active involvement in educational and transition planning has numerous advantages for them, especially when it comes to the development of self-determination skills. This is important, as increasingly policy, practice, and research call for opportunities for school students with (intellectual) disability to develop self-determined behavior (Carter et al., 2013b), and education and transition planning provides such an opportunity.

When previously discussing students' involvement in the IEP planning, it was highlighted that students with intellectual disability can remain passive participants in this process. This limited involvement can also be true for their transition planning. For example, Leonard et al. (2016) surveyed 203 Australian families and discovered that less than two-thirds of students with intellectual disability were involved in transition planning. Similarly, Strnadová and Cumming (2014) concluded in their survey study with 75 teachers in New South Wales, Australia, that the participating students did not demonstrate an active and self-determined involvement in the transition process. Indeed, none of the schools openly recognized students with developmental disabilities to be the key stakeholders in the transition process.

Research-based strategies that successfully promote the involvement of students with intellectual disability in educational and transition planning through teaching self-determination skills include the self-advocacy strategy (Cease-Cook et al., 2013; Test & Neale, 2004; Van Reusen, Deshler, & Schumaker, 1989), the self-directed IEP curriculum (Martin, Marshall, Maxson, & Jerman, 1997), TAKE CHARGE for the Future (Powers et al., 1996), and Whose Future Is It Anyway? (Wehmeyer, Lawrence, Kelchner, Palmer, Garner, & Soukup, 2004), to name a few. There are also other programs with a research base that is still developing. For example, Sparks, Pierce, Higgins, Miller, and Tandy (2016) piloted a choice-making training program with six high school students with intellectual disability. This training included choice-making in scenarios in the areas of job choices, hygiene choices, and lifestyle choices. The results indicated that all students gained significant improvements from this training.

Student Involvement in Extracurricular Programs

Schools increasingly provide a variety of contexts for their students, including extracurricular programs and activities. Extracurricular programs offer unique opportunities for students with intellectual disability to develop their self-determination skills, such as self-advocacy, leadership, choice-making, and goal-setting. These programs also afford students the opportunity to develop social connectedness and make friends (Vinoski, Graybill, & Roach, 2016). This is especially important for students with intellectual disability, who tend to be socially isolated (Chung, Carter, & Sisco, 2012) and tend not to meet their classmates outside of school (Siperstein, Parker, Bardon, & Widaman, 2007).

Research shows that only a small percentage of students with intellectual disability take part in extracurricular programs. For example, according to the National Longitudinal Transition Study-2 in the USA, only 41% of young people with intellectual disability, autism spectrum disorder, or multiple disabilities participated in any volunteer activity, compared with 75% of youth without disabilities (Cadwallader, Wagner, & Garza, 2003). Also telling is the USA-based study conducted by Powers et al. (2005), in which the authors analyzed the transition components of IEPs, according to which

only 11.3% of students with disabilities out of 399 were included in school-based extracurricular activities. This study also revealed that only 6.5% of students with disabilities received any self-determination training. Out of the 399 IEPs, 106 (26.6%) belonged to students with cognitive and developmental disabilities (i.e., intellectual disability, autism, multiple disabilities). According to 153 special education teachers included in a survey study conducted across five states in the USA (Agran et al., 2017), the majority of their students with intellectual disability (62%) were rarely included in school-based extracurricular activities.

According to Pence and Dymond (2015), there are three types of extracurricular activity in which students with intellectual and developmental disabilities tend to participate. These are school clubs, organized sports, and performance and creative activities, and all of these types present plenty of opportunities to develop self-determination skills for students with intellectual disability. Research also suggests that, the more time students with intellectual disability spend in unstructured activities, the higher the levels of social competence they develop (Brooks, Floyd, Robins, & Chan, 2015). This should be taken into consideration when planning suitable extracurricular activities for students with this disability.

Besides specific extracurricular activities, there are also inclusive extracurricular programs, such as the Partnerships for Success (PFS): Real-World Implementation program, implemented in 20 schools in Georgia, USA (Vinoski et al., 2016). Its aim is to provide “fun” experiences for students both with and without disabilities (e.g., in the areas of recreation and sports) and, at the same time, opportunities to work alongside, contributing to community and school. This program has integrated the development of self-determination throughout instructional and experiential activities, such as recruiting students with disability to be in leadership roles alongside their peers without disabilities.

Involving the Families of Students with Intellectual Disability in the Development of Self-determination Skills

There is limited research about the role that parents of students with intellectual disability play in the development of their children’s self-determination skills (Carter et al., 2013a). Yet family involvement has been linked with students’ improved post-school outcomes (Lindstrom, Doren, Metherny Johnson, & Zane, 2007). As Carter et al. (2013a) argue, given that family involvement in the final years of their child’s schooling is expected and highly encouraged, it can be assumed that the family’s perception and valuing of self-determination would likely influence the level of encouragement they provide in this matter. It is, therefore, important that home-school collaboration is emphasized and supported, and that there is a consistent approach to self-determination skills development in and outside of school. In the context of a preschool-aged child, Palmer et al. (2012) propose that effective home-school partnerships lead to numerous outcomes, such as mutual trust, coordinated efforts to implement activities in existing routines across the child’s environments, effective home-school communication, and an increased sense of competence of all parties involved. Palmer et al. (2012) further advocate for a “culturally aware partnership” between school and families, in which there is “a mutual understanding of self-determination – within the context of the family’s culture” (p. 43). This is especially

important in today's increasingly multicultural societies around the world, as some cultures define and promote self-determination skills in different ways, including focusing on interdependence. For example, Palmer et al. (2012) point to Rogoff's (2003) argument that collectivist cultures, such as Asian culture, prefer to socialize their children to interdependence, rather than individualism. Palmer et al. (2012) continue that self-determination "is more about capacity building and being competent within family or community life" (p. 43). Although this argument was made within the context of their foundations model, it is clear that schools need to "consider autonomy within the context of interdependence" (p. 43).

As discussed in this section, there are several ways, in which students with intellectual disability can increase their self-determination skills – in particular, through a student's involvement in the IEP planning and transition planning process, and in extracurricular activities. Involving the family of a student with intellectual disability in self-determination skills acquisition is equally important.

WHERE TO NEXT? IMPLICATIONS FOR RESEARCH AND PRACTICE

Implications for Future Research

As demonstrated earlier in this chapter, there is more research needed in regard to intellectual disability and SDT. Although some areas have been explored (e.g., development of self-determination skills), there are others where research is desired (e.g., intrinsic/extrinsic motivation and people with intellectual disability across life span, or basic psychologic needs from an educational psychology perspective). There is a substantial body of research focused on the importance of increasing the self-determination skills of students with intellectual disability. In this research, the voice of students with intellectual disability remains rather limited. For example, researchers opted for (a) training teachers to administer tests and scales to students with (intellectual) disability (e.g., Chou, Wehmeyer, Palmer, & Lee, 2017), (b) asking teachers and parents to complete assessments about their children (e.g., Carter, Owens, Trainor, Sun, & Swedeen, 2009), (c) surveying or interviewing students' proxies, such as parents and teachers (e.g., Carter et al., 2013b), (d) using observations (e.g., Martin, Van Dycke, Greene, et al., 2006), or (e) conducting randomized trials (e.g., Wehmeyer et al., 2013). All of these are important methodological approaches, and valid decisions were made in these studies regarding the participants; however, there is a dearth of qualitative studies on self-determination that predominantly targeted students with intellectual disability and captured their perspectives. It is, therefore, critical that researchers employ qualitative research methods, including participatory research methods, to allow students with intellectual disability to have a more prominent voice about their opinions, expectations, perspectives and experiences in regard to self-determination skills and behavior.

Furthermore, researchers have only invited students with intellectual disability to take part in their studies as participants and, thus, 'objects' of the research. The author of this chapter would like to urge researchers (herself included) to include these students in participatory roles, such as being advisors or co-researchers. This would be well in keeping with developments in the field of intellectual disability, where inclusive

research has grown considerably over the last few decades and has an established and increasingly important role (Bigby, Frawley, & Ramcharan, 2014; Strnadová & Walmsley, 2018; Walmsley, Strnadová, & Johnson, 2018). Inclusive research describes research conducted with people with intellectual disability who are included as actors, rather than subjects of research (Strnadová & Walmsley, 2018). There is a spectrum of approaches to conducting an inclusive study, from people with intellectual disability being in advisory roles, through collaborative (or participatory) roles, to user-led (emancipatory) approaches (Bigby et al., 2014). As argued by Strnadová and Walmsley (2018), inclusive research is values-driven, as it aims to change society so that people with intellectual disability will be active partners and contributors. It also aspires to be “of use to the people who are subject to it, which is relevant to their needs and can inform and promote needed social change” (Walmsley & Johnson, 2003, p. 9).

Research demonstrates the positive value and outcomes for students with intellectual disability when they develop self-determination skills in diverse ways, such as being involved in education and transition planning, and even leading their IEP meetings (Strnadová & Cumming, 2016). In the author’s opinion, the involvement of students with intellectual disability in inclusive research in the roles of advisers and researchers would be an important opportunity for self-determination skills development in itself. For example, in planning the research design, they can further develop their decision-making, choice-making, and goal-setting skills; in presenting the findings relevant to their lives, they can further develop their self-advocacy skills. Involving students with intellectual disability in inclusive research would provide us with an in-depth understanding of how self-determination and its importance are perceived by this population. There are many questions to be asked, such as what type of self-determination instruction do students with intellectual disability find particularly useful, and why? Are there other ways to support self-determination that are missing from the research?

Inclusive research provides a wide spectrum of ways in which these students could be included; for example, researchers can establish an advisory board of students with intellectual disability and consult with them on all key steps of the research process (recruitment, development of an interview protocol, etc.). They can also formally employ these individuals as researchers. In order for inclusive research among students with intellectual disability to avoid tokenistic inclusion, researchers would do well to consider training for students with intellectual disability to become researchers and ways of making research accessible to them. One way of making research accessible to students with intellectual disability – both as participants and researchers – is by using appropriate participatory research methods. There are numerous participatory research methods that can be utilized, such as arts-based methods, body-mapping, and Photovoice (Danker, Strnadová, & Cumming, 2017; Leavy, 2015). Photovoice is one of the more commonly known participatory action research methods, in which participants take photographs, and these photographs are then used so that they can engage in critical dialogue with policymakers and other influential stakeholders promoting social change (Povee, Bishop, & Roberts, 2014). Although Photovoice has been used with adults with intellectual disability (Akkerman, Janssen, Kef, & Meininger, 2014; Jurkowski, Rivera, & Hammel, 2009; Schleien, Brake, Miller, & Walton, 2009), students with this disability remain a somewhat omitted population.

Implications for Future Practice

Future practice needs to more fully consider all three aspects of SDT. Promotion of competence and autonomy of students with intellectual disability across their multiple environments (e.g., school, home) would, in the author's opinion, naturally lead to an increase in their intrinsic motivation. When it comes to self-determination skills development, there are several implications for practice to consider. First, there is a need to focus on the development of the foundation skills for self-determination, such as choice-making and self-regulation, in children with intellectual disability in their early years (Hart & Brehm, 2013). Second, home-school collaboration needs to be supported in the course of students' self-determination development (Strnadová & Cumming, 2016). Schools and other professionals should consider cultural and other diversities in families of children with intellectual disability and understand that self-determination skills and autonomous behavior can exist in the context of interdependence.

Wehmeyer and Shogren (2017) also argue that all evidence-based self-determination interventions are school-based, thus leaving preschool-aged children and adults with intellectual disability left behind. Establishing a convincing evidence base for intervention with preschool children and adults should be a joint aim of researchers and practitioners.

Future practice might also involve schools and families receiving more support for self-advocacy skills development. Current research highlights the importance of the development of self-awareness and self-advocacy skills for students' achieving successful post-school outcomes, especially in education and employment (Carter, Austin, & Trainor, 2012; Grigal, Hart, & Weir, 2013). Wehmeyer and Shogren (2017) highlight skills relevant to self-advocacy: (a) ability to compromise, (b) negotiation skills, (c) effective communication skills, as well as (d) self-awareness. They further draw attention to the fact that there is a strong association between self-advocacy skills and goal-setting and attainment. There is, however, limited literature on self-advocacy skills instruction for students with intellectual disability. An example of such instruction is the CD-ROM version of the self-advocacy strategy. Cease-Cook et al. (2013a) examined the effects of this instructional approach on quality of contributions in IEP meetings of high school students with intellectual disability in the USA and concluded that the participating students learned the skills, maintained them, and generalized them to their actual IEP meetings.

Although there are instructional strategies to develop students' self-advocacy skills, opportunities to utilize these remain limited. This is well demonstrated by an IEP meeting experience of one of the students participating in Hughes et al.'s (2013, p. 8) study: "Self-advocacy skills were mostly used when students had to defend themselves from bullying." Self-advocacy is, of course, important across a person's life span, not just at the point of crisis. There is a strong body of research literature about the importance of the self-advocacy movement and the importance of people with intellectual disability being self-advocates (Anderson & Bigby, 2017; Nonnemacher & Bambara, 2011; Walmsley & the Central England People First History Project Team, 2014). However, this literature is, to the author's best knowledge, limited to adults with intellectual disability being self-advocates. It would be desirable for schools to collaborate with self-advocacy organizations and to invite self-advocates

with intellectual disability to schools to present to all students. This would serve a number of purposes. First, mainstream and special school students would have an opportunity to meet adults with intellectual disability and to see that they can live successful, self-determined, and (inter)dependent lives. This would contribute to lessening the prejudice towards people with intellectual disability still prevalent in society. Second, in collaboration with school and family, self-advocates could work closely with students with intellectual disability and train them in obtaining self-advocacy skills and becoming self-advocates themselves.

CONCLUSION

This chapter has discussed what research tells us about the development of self-determination skills in students with intellectual disability and the importance of these skills to the inclusion of students with this disability. It has also discussed ways in which self-determination skills have been developed in school-aged students with intellectual disability and suggested implications for research and practice. The importance for researchers to use inclusive research, in which students with intellectual disability could be employed as advisors or researchers, has been established. Taken together, inclusive research in the area of self-determination has significant potential to develop core self-determination skills, address basic psychological needs, and promote intrinsic motivation among people with intellectual disability across the life span. In so doing, theory, research, and practice can contribute to help them live independent lives within the context of interdependence.

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REFERENCES

- Adams, N., Little, T. D., & Ryan, R. M. (2017). Self-determination theory. In M. L. Wehmeyer, K. A. Shogren, T. D. Little, & S. J. Lopez (Eds.), *Development of self-determination through the life-course* (pp. 47–54). Dordrecht, The Netherlands: Springer.
- Agran, M., Achola, E., Nixon, C. A., Wojcik, A., Cain, I., Thoma, C., & Tamura, R. B. (2017). Participation of students with intellectual and developmental disabilities in extracurricular activities: Does inclusion end at 3:00? *Training in Autism and Developmental Disabilities*, 52(1), 3–12.
- Agran, M., Blanchard, C., Wehmeyer, M., & Hughes, C. (2002). Increasing the problem-solving skills of students with developmental disabilities participating in general education. *Remedial and Special Education*, 23, 279–288.
- Akkerman, A., Janssen, C. G. C., Kef, S., & Meiningner, H. P. (2014). Perspectives of employees with intellectual disabilities on themes relevant to their job satisfaction. An explorative study using photovoice. *Journal of Applied Research in Intellectual Disabilities*, 27, 542–554. doi:10.1111/jar.12092
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders*, (DSM-5). Washington, DC: Author.
- Anderson, S., & Bigby, C. (2017). Self-advocacy as a means to positive identities for people with intellectual disability: “We just help them, be them really.” *Journal of Applied Research in Intellectual Disabilities*, 30(1), 109–120. doi:10.1111/jar.12223

- Bigby, C., Frawley, P., & Ramcharan, P. (2014). Conceptualising inclusive research with people with intellectual disability. *Journal of Applied Research in Intellectual Disabilities*, 27(1), 3–12. doi:10.1111/jar.12083
- Bigby, C., & Knox, M. (2009). “I want to see the Queen”: Experiences of service use by ageing people with an intellectual disability. *Australian Social Work*, 62, 216–231. doi:10.1080/03124070902748910
- Björnsdóttir, K., Stefánsdóttir, A., & Stefánsdóttir, G. V. (2017). People with intellectual disabilities negotiate autonomy, gender and sexuality. *Sexuality and Disability*, 35, 295–311. doi:10.1007/s11195-017-9492-x
- Blair, C., & Diamond, A. (2008). Biological processes in prevention and intervention: The promotion of self-regulation as a means of preventing school failure. *Development and Psychopathology*, 20, 899–911. doi:10.1017/S0954579408000436
- Brooks, B. A., Floyd, F., Robins, D. L., & Chan, W. Y. (2015). Extracurricular activities and the development of social skills in children with intellectual and specific learning disabilities. *Journal of Intellectual Disability Research*, 59(7), 678–687. doi:10.1111/jir.12171
- Brotherson, M. J., Cook, C. C., Erwin, E. J., & Weigel, C. J. (2008). Understanding self-determination and families of young children with disabilities in home environments. *Journal of Early Intervention*, 31, 22–43. doi:10.1177/1053815108324445
- Cadwallader, T., Wagner, M., & Garza, N. (2003). Participation in extracurricular activities. In M. Wagner, T. Cadwallader, & C. Marder (Eds.), *Life outside the classroom for youth with disabilities* (pp. 41–48). Menlo Park, CA: SRI.
- Carter, E. W., Austin, D., & Trainor, A. A. (2012). Predictors of postschool employment outcomes for young adults with severe disabilities. *Journal of Disability Policy Studies*, 23, 50–63. doi:10.1177/1044207311414680
- Carter, E. W., Owens, L., Trainor, A. A., Sun, Y., & Swedeen, B. (2009). Self-determination skills and opportunities of adolescents with severe intellectual and developmental disabilities. *American Journal on Intellectual and Developmental Disabilities*, 114(3), 179–192.
- Carter, E. W., Lane, K. L., Cooney, M., Weir, K., Moss, C. K., & Machalicek, W. (2013a). Parents assessments of self-determination importance and performance for students with autism or intellectual disability. *American Journal on Intellectual and Developmental Disabilities*, 118(1), 16–31. doi:10.1352/1944-7558-118.1.16
- Carter, E. W., Lane, K. L., Cooney, M., Weir, K., Moss, C. K., & Machalicek, W. (2013b). Self-determination among transition-age youth with autism or intellectual disability: Parent perspectives. *Research & Practice for Persons with Severe Disabilities*, 38(3), 129–138. doi:10.2511/027494813809330234
- Carulla, L. S., Reed, G. M., Vaez-Azizi, L. M., Cooper, S. A., Leal, R. M., Bertelli, M., ... & Girmaji, S. C. (2011). Intellectual developmental disorders: towards a new name, definition and framework for “mental retardation/intellectual disability” in ICD-11. *World Psychiatry*, 10(3), 175–180.
- Cease-Cook, J., Test, D. W., & Scroggins, L. S. (2013). Effects of the CD-Rom version of the self-advocacy strategy on quality of contributions in IEP meetings of high school students with intellectual disability. *Education and Training in Autism and Developmental Disabilities*, 48(2), 258–268.
- Chandoo, R. C., Strnadová, I., & Cumming, T. M. (2018). A systematic review of the involvement of students with autism spectrum disorder in the transition planning process: Need for voice and empowerment. *Research in Developmental Disabilities*, 83, 8–17. doi:10.1016/j.ridd.2018.07.011
- Cho, H., Wehmeyer, M., & Kingston, N. (2012). The effect of social and classroom ecological factors on promoting self-determination in elementary school. *Preventing School Failure*, 56(1), 19–28. doi:10.1080/1045988X.2010.548419
- Chou, Y. C., Palmer, S. B., Wehmeyer, M. L., & Skrupski, W. P. (2017). Comparison of self-determination of students with disabilities: Multivariate and discriminant function analyses. *Journal of Intellectual Disability Research*, 61(2), 144–154. doi:10.1111/jir.12297
- Chou, Y. C., Wehmeyer, M. L., Palmer, S. B., & Lee, J. (2017). Comparison of self-determination among students with autism, intellectual disability and learning disabilities: A multivariate analyses. *Focus on Autism and Other Developmental Disabilities*, 32(2), 124–132. doi:10.1177/1088357615625059
- Chung, J. C., Carter, E. W., & Sisco, L. G. (2012). Social interactions of students with disabilities who use augmentative and alternative communication in inclusive classrooms. *American Journal on Intellectual and Developmental Disabilities*, 117(5), 349–367. doi:10.1352/1944-7558-117.5.349
- Clark, C., & McDonnell, A. P. (2008). Teaching choice making to children with visual impairments and multiple disabilities in preschool and kindergarten classrooms. *Journal of Visual Impairment & Blindness*, 102, 397–409.
- Cumming, T., Marsh, R., & Higgins, K. (2018). *School connectedness for students with disabilities: From theory to evidence-based practice*. Melbourne: Routledge.

- Danker, J., Strnadová, I., & Cumming, T. M. (2017). Engaging students with autism spectrum disorders in research through participant-driven photo-elicitation research technique. *Australasian Journal of Special Education*, 41(1), 35–50. doi:10.1017/jse.2016.7
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behaviour*. New York: Plenum Press.
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227–268.
- Eisenman, L. T., Pell, M. M., Poudel, B. B., & Pleet-Odle, A. M. (2015). “I think I’m reaching my potential”: Students’ self-determination experiences in an inclusive high school. *Career Development and Transition for Exceptional Individuals*, 38(2), 101–112. doi:10.1177/2165143414537349
- Foley, S. (2018). *Intellectual disability and the right to a sexual life. A continuation of the autonomy/paternalism debate*. London: Routledge.
- Forrester-Jones, R., Carpenter, J., Coolen-Schrijner, P., Cambridge, P., Tate, A., Beecham, J., ... Wooff, D. (2006). The social networks of people with intellectual disability living in the community 12 years after resettlement from long-stay hospitals. *Journal of Applied Research in Intellectual Disabilities*, 19, 285–295. doi:10.1111/j.1468-3148.2005.00263.x
- Frielink, N., Schuengel, C., & Embregts, P. (2017). Distinguishing subtypes of extrinsic motivation among people with mild to borderline intellectual disability. *Journal of Intellectual Disability Research*, 61(7), 625–636. doi:10.1111/jir.12363
- Frielink, N., Schuengel, C., & Embregts, P. (2018). Autonomy support, need satisfaction, and motivation for support among adults with intellectual disability: Testing a self-determination theory model. *American Journal on Intellectual and Developmental Disabilities*, 123(1), 33–49. doi:10.1352/1944-7558-123.1.33
- Gilberts, G. H., Agran, M., Hughes, C., & Wehmeyer, M. (2001). The effects of peer delivered self-monitoring strategies on the participation of students with severe disabilities in general education classrooms. *JASH, Research and Practice for People with Severe Disabilities*, 26(1), 25–36.
- Grigal, M., Hart, D., & Weir, C. (2013). Postsecondary education for people with intellectual disability: Current issues and critical challenges. *Inclusion*, 1(1), 50–63.
- Guardia, J. G., & Ryan, R. M. (2002). What adolescents need: A self-determination theory perspective on development within families, school, and society. In F. Pajares & T. Urdan (Eds.), *Academic motivation of adolescents* (pp. 193–219). Greenwich, CT: Information Age Publishing.
- Hart, J. E., & Brehm, J. (2013). Promoting self-determination. A model for training elementary students to self-advocate for IEP accommodations. *TEACHING Exceptional Children*, 45(5), 40–48.
- Hawbaker, B. W. (2007). Student-lead IEP meetings: Planning and implementation strategies. *TEACHING Exceptional Children Plus*, 3(5), 1–19.
- Hughes, C., Agran, M., Cosgriff, J. C., & Washington, B. H. (2013). Students self-determination: A preliminary investigation of the role of participation in inclusive settings. *Education and Training in Autism and Developmental Disabilities*, 48(1), 3–17.
- Jurkowski, J., Rivera, Y., & Hammel, J. (2009). Health perceptions of Latinos with intellectual disabilities: The results of a qualitative pilot study. *Health Promotion Practice*, 10(1), 144–155. doi:10.1177/1524839907309045
- Karvonen, M., Test, D. W., Wood, W. M., Browder, D., & Algozzine, B. (2006). Putting self-determination into practice. *Exceptional Children*, 71, 23–41. doi:10.1177/001440290407100102
- Leavy, P. (2015). *Method meets art. Arts-based research practice*. London: Guildford Press.
- Ledger, S., Walmsley, J., Earle, S., & Tilley, E. (2016). Contraceptive decision-making and women with learning disabilities. *Sexualities*, 19(5-6), 698–724. doi:10.1177/1363460715620576
- Lee, S., Wehmeyer, M. L., & Shogren, K. A. (2015). The effects of instruction with the self-determined learning model of instruction on students with disabilities: A meta-analysis. *Education and Training in Autism and Developmental Disabilities*, 50, 237–247.
- Lee, Y., Wehmeyer, M. L., Palmer, S. B., Williams-Diehm, K., Davies, D. K., & Stock, S. E. (2012). Examining individual and instruction-related predictors of the self-determination of students with disabilities: Multiple regression analyses. *Remedial and Special Education*, 33(3), 150–161. doi:10.1177/0741932510392053
- Leonard, H., Foley, K. R., Pikora, T., Bourke, J., Wong, K., McPherson, L., ... Downs, J. (2016). Transition to adulthood for young people with intellectual disability: The experiences of their families. *European Child Adolescence Psychiatry*, 25, 1369–1381. doi:10.1007/s00787-016-0853-2
- Lindstrom, L., Doren, B., Metherny, J., Johnson, P., & Zane, C. (2007). Transition to employment: Role of the family in career development. *Exceptional Children*, 73(3), 348–366.

- Mansell, J., & Ericsson, K. (2013). *Deinstitutionalization and community living: Intellectual disability services in Britain. Scandinavia and the USA*. New York: Springer.
- Martin, A. J., Strnadová, I., O'Neill, S. C., & Cumming, T. M. (2017). The role of perceived competence in the lives of children with ADHD, emotional and behavioral disorder, learning disability, and developmental disability: A positive psychology perspective. In F. Guay, H. W. Marsh, R. G. Craven, & D. M. McInerney (Eds.), *SELF – Driving positive psychology and wellbeing* (pp. 1–26). Charlotte, NC: Information Age Publishing.
- Martin, J. E., Marshall, L. H., Maxson, L. M., & Jerman, P. L. (1997). *The self-directed IEP*. Longmont, CO: Sopris West.
- Martin, J. E., Van Dycke, J. L., Christensen, W. R., Greene, B. A., Gardner, J. E., & Lovett, D. L. (2006). Increasing student participation in IEP meetings: Establishing the self-directed IEP as an evidenced-based practice. *Exceptional Children*, 72, 299–316.
- Martin, J. E., Van Dycke, J. L., Greene, B. A., Gardner, J. E., Christensen, W. R., Woods, L. L., & Lovett, D. L. (2006). Direct observation of teacher-directed IEP meetings: Establishing the need for student IEP meeting instruction. *Exceptional Children*, 72, 187–200.
- Maulik, P. K., Mascarenhas, M. N., Mathers, C. D., Dua, T., & Saxena, S. (2011). Prevalence of intellectual disability: A meta-analysis of population-based studies. *Research in Developmental Disabilities*, 32, 419–436. doi:10.1016/j.ridd.2010.12.018
- Mazzotti, V. L., Test, D. W., & Mustian, A. L. (2014). Secondary transition evidence-based practices and predictors: Implications for policymakers. *Journal of Disability Policy Studies*, 25, 5–18.
- McGuire, J., & McDonnell, J. (2008). Relationships between recreation and levels of self-determination for adolescents and young adults with disabilities. *Career Development for Exceptional Individuals*, 31(3), 154–163. doi:10.1177/0885728808315333
- Mumbardó-Adam, C., Guàrdia-Olmos, J., Adam-Alcocer, A. L., Carbó-Carreté, M., Balcells-Balcells, A., Giné, C., & Shogren, K. A. (2017). Self-determination, intellectual disability, and context: A meta-analytic study. *Intellectual and Developmental Disabilities*, 55(5), 303–314. doi:10.1352/1934-9556-55.5.303
- Nonnemacher, S. L., & Bambara, L. M. (2011). “I’m supposed to be in charge”: Self-advocates’ perspectives on their self-determination support needs. *Intellectual and Developmental Disabilities*, 49(5), 327–340.
- Nota, L., Soresi, S., Ferrari, L., & Wehmeyer, M. (2011). A multivariate analysis of the self-determination of adolescents. *Journal of Happiness Studies*, 12(2), 245–266. doi:10.1007/s10902-010-9191-0
- Palmer, S. B., Summers, J. A., Brotherson, M. J., Erwin, E. J., Maude, S. P., Stroup-Rentier, V., & Haines, S. J. (2012). Foundations for self-determination in early childhood: An inclusive model for children with disabilities. *Topics in Early Childhood Special Education*, 33(1), 38–47. doi:10.1177/0271121412445288
- Palmer, S. B., Wehmeyer, M. L., & Shogren, K. A. (2017). The development of self-determination during childhood. In M. L. Wehmeyer, K. A. Shogren, T. D. Little, & S. J. Lopez (Eds.), *Development of self-determination through the life-course* (pp. 71–88). Dordrecht, The Netherlands: Springer.
- Papazoglou, A., Jacobson, L. A., McCabe, M., Kaufmann, W., & Zabel, T. A. (2014). To ID or not to ID? Changes in classification rates of intellectual disability using DSM-5. *Intellectual and Developmental Disabilities*, 52(3), 165–174. doi:10.1352/1934-9556-52.3.165
- Pence, A. R., & Dymond, S. K. (2015). Extracurricular school clubs. A time for fun and learning. *TEACHING Exceptional Children*, 47(5), 281–288. doi:10.1177/0040059915580029
- Povee, K., Bishop, B. J., & Roberts, L. D. (2014). The use of Photovoice with people with intellectual disabilities: Reflections, challenges and opportunities. *Disability & Society*, 29(6), 893–907. doi:10.1080/09687599.2013.874331
- Power, A. (2013). Making space for belonging: Critical reflections on the implementation of personalised adult social care under the veil of meaningful inclusion. *Social Science & Medicine*, 88, 68–75. doi:10.1016/j.socscimed.2013.04.008
- Powers, K. M., Gil-Kashiwabara, E., Geenan, S. J., Powers, L., Balandrán, J., & Palmer, C. (2005). Mandates and effective transition planning practices reflected in IEPs. *Career Development for Exceptional Individuals*, 28, 47–59. doi:10.1177/08857288050280010701
- Powers, L. E., Sowers, J., Turner, A., Nesbitt, M., Knowles, E., & Ellison, R. (1996). TAKE CHARGE! A model for promoting self-determination among adolescents with challenges. In L. E. Powers, G. H. S. Singer, & J. Sowers (Eds.), *On the road to autonomy: Promoting self-competence in children and youth with disabilities* (pp. 291–332). Baltimore, MD: Paul H. Brookes.

- Powers, L. E., Turner, A., Westwood, D., Matuszewski, J., Wilson, R., & Phillips, A. (2001). TAKE CHARGE for the future: A controlled field-test of a model to promote student involvement in transition planning. *Career Development for Exceptional Individuals*, 24, 89–103.
- Reeve, J., Ryan, R. M., & Deci, E. L. (2018). Sociocultural influences on student motivation as viewed through the lens of self-determination theory. In G. A. D. Liem & D. M. McInerney (Eds.), *Big theories revisited 2* (pp. 15–40). Charlotte, NC: Information Age Publishing.
- Rogoff, B. (2003). *The cultural nature of human development*. New York: Oxford University Press.
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55, 68–78.
- Ryan, R. M., & Deci, E. L. (2016). *Self-determination theory: Basic psychological needs in motivation development, and wellness*. New York: Guilford Press.
- Schleien, S. J., Brake, L., Miller, K. D., & Walton, G. (2009). Using Photovoice to listen to adults with intellectual disabilities on being part of the community. *Annals of Leisure Research*, 16(3), 212–229. doi:10.1080/11745398.2013.828364
- Shogren, K. A. (2013). *Self-determination and student involvement in transition planning*. Baltimore, MD: Paul H. Brookes.
- Shogren, K. A., Bovaird, J. A., Palmer, S. B., & Wehmeyer, M. L. (2010). Locus of control orientations in students with intellectual disability, learning disabilities, and no disabilities: A latent growth curve analysis. *Research and Practice for Persons with Severe Disabilities*, 35, 80–92.
- Shogren, K. A., Kennedy, W. K., Dowsett, C., Garnier-Villarreal, M., & Little, T. D. (2012). Exploring essential characteristics of self-determination for diverse students using data from NLTS2. *Career Development and Transition for Exceptional Individuals*, 39, 23–33. doi:10.1177/2165143413486927
- Shogren, K. A., Palmer, S. B., Wehmeyer, M. L., Williams-Diehm, K., & Little, T. D. (2012). Effect of intervention with the self-determined learning model of instruction on access and goal attainment. *Remedial and Special Education*, 33, 320–330. doi:10.1177/0741932511410072
- Shogren, K. A., Wehmeyer, M. L., & Palmer, S. B. (2017). Causal agency theory. In M. L. Wehmeyer, K. A. Shogren, T. D. Little, & S. J. Lopez (Eds.), *Development of self-determination through the life-course* (pp. 55–67). Dordrecht, The Netherlands: Springer.
- Shogren, K. A., Wehmeyer, M. L., Palmer, S. B., Forber-Pratt, A. J., Little, T. J., & Lopez, S. (2015). Causal agency theory: Reconceptualizing a functional model of self-determination. *Education and Training in Autism and Developmental Disabilities*, 50(3), 251.
- Shogren, K. A., Wehmeyer, M. L., Palmer, S. B., Rifenshark, G. G., & Little, T. D. (2015). Relationships between self-determination and postschool outcomes for youth with disabilities. *The Journal of Special Education*, 48(4), 256–267. doi:10.1177/0022466913489733
- Sinason, V. (2010). *Mental handicap and the human condition. An analytic approach to intellectual disability* (revised ed.). London: Free Association Books.
- Siperstein, G. N., Parker, R. C., Bardon, J. N., & Widaman, K. F. (2007). A national study of youth attitudes toward the inclusion of students with intellectual disabilities. *Exceptional Children*, 73(4), 435–455.
- Soresi, S., Nota, L., & Wehmeyer, N. L. (2011). Community involvement in promoting inclusion, participation and self-determination. *International Journal of Inclusive Education*, 15(1), 15–28. doi:10.1080/13603116.2010.496189
- Sparks, S. L., Pierce, T., Higgins, K., Miller, S., & Tandy, R. (2016). Increasing choice making in students with intellectual disability. *Education and Training in Autism and Developmental Disabilities*, 51(4), 331–343.
- Stancliffe, R. J. (2014). Inclusion of adults with disability in Australia: Outcomes, legislation and issues. *International Journal of Inclusive Education*, 18(10), 1053–1063. doi:10.1080/13603116.2012.693395
- Strnadová, I., & Cumming, T. M. (2014). Importance of quality transition process for students with disabilities across settings: Learning from the current situation in New South Wales. *Australian Journal of Education*, 58(3), 318–336. doi:10.1177/0004944114543603
- Strnadová, I., & Cumming, T. M. (2016). *Lifespan transitions and disability: A holistic perspective*. London: Routledge.
- Strnadová, I., & Evans, D. (2012). Subjective quality of life of women with intellectual disabilities: The role of perceived control over own life in self-determined behaviour. *Journal of Applied Research in Intellectual Disability*, 25(1), 71–79. doi:10.1111/j.1468-3148.2011.00646.x

- Strnadová, I., & Walmsley, J. (2018). Peer-reviewed articles on inclusive research: Do co-researchers with intellectual disabilities have a voice? *Journal of Applied Research in Intellectual Disabilities*, 31(1), 132–141. doi:10.1111/jar.12378
- Test, D., & Neale, M. (2004). Using the self-advocacy strategy to increase middle graders' IEP participation. *Journal of Behavioral Education*, 13, 135–145.
- Test, D. W., Fowler, C. H., Richter, S. M., White, J., Mazzotti, V., Walker, A. R., & Kortering, L. (2009). Evidence-based practices in secondary education. *Career Development for Exceptional Individuals*, 32, 115–128.
- Twachtman-Cullen, D., & Twachtman-Bassett, J. (2011). *The IEP from A to Z. How to create meaningful and measurable goals and objectives*. San Francisco: Jossey-Bass.
- Van Reusen, A. K., Deshler, D. D., & Schumaker, J. B. (1989). Effects of a student participation strategy in facilitating the involvement of adolescents with learning disabilities in individualized education program planning process. *Learning Disabilities*, 1, 23–34.
- Vinoski, E., Graybill, E., & Roach, A. (2016). Building self-determination through inclusive extracurricular programs. *TEACHING Exceptional Children*, 48(5), 258–265. doi:10.1177/0040059915626127
- Vygotsky, L. S. (1962). *Thought and language*. Cambridge, MA: MIT Press.
- Wagner, M., Newman, L., Cameto, R., Javitz, H., & Valdes, K. (2012). A national picture of parent and youth participation in IEP and transition planning meetings. *Journal of Disability Policy Studies*, 23(3), 140–155. doi:10.1177/1044207311425384
- Walmsley, J., & the Central England People First History Project Team. (2014). Telling the history of self-advocacy: A challenge for inclusive research. *Journal of Applied Research in Intellectual Disabilities*, 27(1), 34–43. 10.1111/jar.12086.
- Walmsley, J., & Johnson, K. (2003). *Inclusive research with people with learning disabilities: Past, present and futures*. London: Jessica Kingsley.
- Walmsley, J., Strnadová, I., & Johnson, K. (2018). The added value of inclusive research. *Journal of Applied Research in Intellectual Disabilities*, 31(5), 751–759. doi:10.1111/jar.12431
- Wehmeyer, M. (2007). *Promoting self-determination in students with developmental disabilities*. New York: Guilford Press.
- Wehmeyer, M. L. (1992). Self-determination and the education of students with mental retardation. *Education and Training in Mental Retardation*, 27(4), 302–314.
- Wehmeyer, M. L. (1996). Self-determination as an educational outcome: Why is it important to children, youth and adults with disabilities? In D. Sands & M. Wehmeyer (Eds.), *Self-determination across the life span: Independence and choice for people with disabilities* (pp. 17–36). Baltimore, MD: Brookes.
- Wehmeyer, M. L. (1997). Self-determination as an educational outcome: A definitional framework and implications for intervention. *Journal of Developmental and Physical Disabilities*, 9, 175–209.
- Wehmeyer, M. L., & Abery, B. H. (2013). Self-determination and choice. *Intellectual and Developmental Disabilities*, 51(5), 399–411. doi:10.1352/1934-9556-51.5.399
- Wehmeyer, M. L., & Bolding, N. (1999). Self-determination across living and working environments: A matched-samples study of adults with mental retardation. *Mental Retardation*, 37, 353–363.
- Wehmeyer, M. L., Lawrence, M., Kelchner, K., Palmer, S. B., Garner, N., & Soukup, J. (2004). *Whose Future Is It Anyway? A student-directed transition planning process* (2nd ed.). Lawrence, KS: Beach Centre on Disability.
- Wehmeyer, M. L., Palmer, S., Shogren, K., Williams-Diehm, K., & Soukup, J. (2013). Establishing a causal relationship between interventions to promote self-determination and enhanced student self-determination. *Journal of Special Education*, 46, 195–210. doi:10.1177/0022466910392377
- Wehmeyer, M. L., & Palmer, S. B. (2003). Adult outcomes for students with cognitive disabilities three-years after high school: The impact of self-determination. *Education in Training in Developmental Disabilities*, 38, 131–144.
- Wehmeyer, M. L., & Shogren, K. A. (2017). The development of self-determination during adolescence. In M. L. Wehmeyer, K. A. Shogren, T. D. Little, & S. J. Lopez (Eds.), *Development of self-determination through the life-course* (pp. 89–98). Dordrecht, The Netherlands: Springer.
- Williams-Diehm, K., Wehmeyer, M. L., Palmer, S. B., Soukup, J. H., & Garner, N. W. (2008). Student knowledge and perceptions of individual transition planning and its process. *The Journal for Vocational Special Needs Education*, 29(3), 13–21.
- Woodcock, S., Dixon, R., & Tanner, K. (2013). *Teaching in inclusive school environments*. Australia: David Barlow.

5

THE ROLES OF EXECUTIVE FUNCTIONS IN LEARNING AND ACHIEVEMENT

D. Jake Follmer and Rayne A. Sperling

Executive functions reflect a set of interconnected cognitive skills that facilitate learners' self-regulated behavior and support a range of important academic and behavioral outcomes (e.g., Zelazo, Blair, & Willoughby, 2016). Executive functions include the abilities to inhibit or override a prepotent response in support of a more adaptive response, switch flexibly between mental sets, tasks, and goals, and hold and update information in working memory (Miyake et al., 2000). These skills have been shown to contribute to learners' abilities to solve problems, engage in planning, and regulate attention and emotion (Blair & Ursache, 2011; Fuhs, Nesbitt, Farran, & Dong, 2014; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005; Zelazo & Cunningham, 2007), and have also been shown to enhance school readiness and success (Blair & Diamond, 2008). Importantly, individuals can vary greatly in their deployment of these skills as well as, more broadly, their abilities to regulate thought and behavior (Miyake & Friedman, 2012). Encouragingly, evidence suggests that executive skills can be instrumental in promoting learning and achievement (Blair & Diamond, 2008). On the other hand, research also suggests that breakdowns in executive and regulatory functioning can contribute significantly to difficulties in learning and to the later emergence of academic skills deficits (e.g., reading and mathematics; see Morgan et al., 2017). Understanding the links between executive skills and learning and achievement is particularly important in light of the stability of learning difficulties over time (Morgan, Farkas, & Wu, 2011) and given work suggesting that children with demonstrated learning difficulties are less likely to attend college and are more likely to experience social-emotional maladjustment (Lin et al., 2013).

It has been estimated that approximately 16% of American children enter school exhibiting readiness difficulties (Rimm-Kaufman, Pianta, & Cox, 2000). Further, a significant number of kindergarten teachers surveyed in previous research reported that half or more of their students demonstrated specific problems in areas related to and based on regulatory skills, including difficulty following directions, lack of academic

skills, and difficulty working independently (Rimm-Kaufman et al., 2000). Children growing up in poverty experience particular difficulty in these areas (Bierman, Domitrovich, et al., 2008), and research suggests that those with readiness difficulties are likely to remain low achievers throughout elementary school, are more likely to experience learning disabilities, and are at risk for negative events such as early school drop-out (e.g., Ryan, Fauth, & Brooks-Gunn, 2006). At the same time, research suggests that early childhood and elementary teachers report clear importance of and concern about children's abilities to regulate their behavior (Blair & Diamond, 2008). Certainly, understanding the nature and effects of executive function disorders is of significant importance to the study of the roles of cognitive and neurocognitive processes in both learning and achievement, and for maximizing efforts to improve learning outcomes through intervention (see Byrnes & Eaton, Chapter 27, this volume, for a review of educational neuroscience and children with special needs).

This chapter discusses the roles of executive functions in learning and achievement and, in particular, the effects of executive function disorders on learning and academic challenges. In the first section, we describe the nature of executive function disorders and present information regarding etiology and their associated symptoms. In the second section, we discuss the impact of executive function disorders on achievement and link academic difficulties to specific executive skill deficits. Next, we describe what is currently known about the effectiveness of interventions that aim to improve learning and achievement outcomes through emphasis on improvement of executive skills, and we also note current challenges in this area of study. We then provide a discussion of important issues associated with the measurement and theoretical delineation of executive functions. We conclude by highlighting directions for future research and by providing implications for practitioners involved in the evaluation of typically developing learners as well as learners with disabilities.

EXECUTIVE FUNCTION DISORDERS: SYMPTOMOLOGY AND ETIOLOGY

Executive function is defined as a set of interdependent cognitive processes, engaged during novel or challenging situations, that control and coordinate complex cognitive functioning and behavior in service of a future goal (Follmer & Sperling, 2016; Welsh, Friedman, & Spieker, 2006). Executive functions are involved in the abilities to plan and direct action, organize behavior, follow through with tasks, and override immediate demands in order to meet long-term goals (Dawson & Guare, 2010). More broadly, executive function supports our ability to regulate behavior. As noted in other work (Follmer, 2018), the study of executive function arose in part from examination of deficits in neuropsychological functioning. Theoretical support for the study of executive function in educational contexts is largely based on cognitive theories of learning, including information processing theory and models of working memory (Baddeley, 1996; Borkowski & Burke, 1996; Denckla, 1996; Oberauer, 2009; Swanson, Chapter 2, this volume; Welsh et al., 2006). More recently, empirical and theoretical work (e.g., Blair & Diamond, 2008; Blair & Raver, 2015; Follmer & Sperling, 2016) suggested inclusion of executive function within models of self-regulation, owing to the involvement of facets of executive functions (e.g., inhibition, shifting, and updating) in learners' self-regulated learning and strategy use (for a review of self-regulation and

metacognition theories, see Perry, Mazabel, & Yee, Chapter 13, this volume). Further, difficulties in or failures of self-regulation in learners have been attributed to reductions or impairments in executive functions (Hofmann, Schmeichel, & Baddeley, 2012).

Executive function disorders reflect marked impairment in one's ability to control and coordinate cognition and behavior, which results in difficulty executing complex and goal-directed behavior. Examples of specific symptoms associated with executive impairment include difficulties with planning and organizing thoughts and information, sustaining and regulating attention, making decisions, responding effectively to feedback, monitoring and correcting one's behavior, and starting and maintaining tasks. Because executive function is necessarily involved in behavior that is complex and goal-directed, and because executive functions develop over the course of infancy and through childhood and adolescence, the evaluation of executive function's involvement in a given task must take into account learners' development. In other words, as executive function develops, the complexity of the tasks in which it is involved increases. For example, at the preschool level, developmental tasks that recruit students' executive skills may include following verbal commands and inhibiting more basic behaviors (e.g., the desire to take a toy from another child; Dawson & Guare, 2010). Moving into the elementary grades, executive skills may be particularly involved in developing academic skills (e.g., basic mathematics and oral comprehension skills; Fuhs et al., 2014), as well as more complex tasks such as completing homework and assignments with independence, planning and executing school projects, and developing and maintaining a daily schedule (Dawson & Guare, 2010). As students progress into middle and high school (and beyond), executive skills play increasingly sophisticated roles in more complex learning (e.g., comprehension of expository science text; Follmer, 2018; Miller et al., 2014) and behavior (e.g., establishing, monitoring, and adjusting long-term goals; Dawson & Guare, 2010). Thus, it is believed that breakdowns or deficits in executive functions at any point along this developmental trajectory can influence concurrent difficulties with learning and achievement.

Impairments in executive functions have long been associated with varied forms of developmental psychopathology (Pennington & Ozonoff, 1996). For example, evidence of specific executive function deficits has been obtained in individuals with autism (i.e., impairment in verbal working memory) as well as individuals with attention deficit/hyperactivity disorder (ADHD; i.e., impairments in motor inhibition). At the individual level, evidence of executive function impairment is typically based on observed deficits on established task-based (i.e., direct) or questionnaire-based (i.e., indirect) measures of executive function. For example, Biederman and colleagues (2004) operationalized executive function deficits based on observed impairment on at least two executive function measures. At the study level, evidence of impairment and involvement of specific executive functions in various types of psychopathology is largely based on cross-sectional, case-control designs, where performance impairments on executive tasks are examined between groups (e.g., between a group with a specific disability and a group of healthy controls; Snyder, Miyake, & Hankin, 2015). Considerable evidence based on this approach has strongly implicated executive function impairments in a host of learning-based disorders, including, as examples, general reading disabilities, specific reading comprehension deficits, dyslexia, and dyscalculia

(Cutting, Materek, Cole, Levine, & Mahone, 2009; Georgiou & Das, 2016; Helland & Morken, 2016; Pelegrina, Capodieci, Carretti, & Cornoldi, 2015).

As noted in previous research (e.g., Snyder et al., 2015), however, executive function is a construct that is difficult to both define and measure. That is, existing work has not reached consensus on a unifying model of executive function (see the unity/diversity model of executive function, a promising approach to synthesizing features and components of executive processes; Miyake & Friedman, 2012), nor has there been consensus on or convergence among measures used to effectively tap executive processes (e.g., Malloy-Diniz, Miranda, & Grassi-Oliveira, 2017). Further, executive function disorders lack explicit inclusion in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association, 2013); instead, executive function deficits are referenced primarily in the case of neurocognitive disorders (see, for example, Table 1 on pp. 286–291 of the DSM-5 Desk Reference) and are suggested but not explicitly referenced in the diagnostic criteria for ADHD (see pp. 31–34 of the DSM-5 Desk Reference). There is similar ambiguity in the realm of school-based evaluations, where executive function deficits may contribute to a number of conditions covered by the Individuals with Disabilities Education Act (IDEA; also see “other health impairment” as a potentially applicable category of disability) but are not themselves explicitly included. Further compounding this difficulty is the finding that existing research linking executive function to learning-based outcomes has examined a variety of specific executive functions and based this examination on a multitude of measures. At a basic level, these conceptual, methodological, and diagnostic issues make it difficult to estimate both the incidence and extent of executive function disorders, as well as their direct involvement in deficits in learning and achievement.

Despite these difficulties, however, there is a wealth of research suggesting the presence of pronounced and fairly uniform deficits on a wide variety of executive functions in individuals with learning difficulties. In other words, existing research provides ample evidence of broad impairment in executive function across a range of disorders, supporting the notion of a more generalized executive function disorder and its involvement in learning-based disabilities. Yet, the etiology underlying patterns of executive function impairment is less clear. One account is based on delineating common and specific components of executive function (Snyder et al., 2015). In particular, evidence for broad impairment across executive function tasks suggests that individuals with psychopathology experience impairments in a unitary or common executive function component (Friedman et al., 2008; Miyake & Friedman, 2012). Such an account suggests general involvement of executive function, as a more global construct driven by multiple processes, and is based on the notion that individuals experience marked difficulty in the ability to “actively maintain task goals and use this information to provide top-down support for task-relevant responses” (Snyder et al., 2015, p. 16). As Snyder and colleagues indicate, such an account also has the advantage of serving as the more parsimonious interpretation of the mechanism underlying executive function impairment.

Another possible account of executive function disorders is that, in addition to impairment in a common executive function component, individuals with deficits in executive function also experience processing-specific impairments in shifting or updating. Based on this account, processing-specific impairments (e.g., in one’s abil-

ity to update and maintain numerical information in working memory) are linked with specific difficulties in learning (e.g., deficits in arithmetic ability; see, for example, research by Pelegrina et al., 2015) and exert particular influence on the manifestation of learning deficits above and beyond that of a common executive function factor. This component-process explanation of executive function deficits may provide a more nuanced examination of the roles of specific executive process impairments (e.g., the updating mechanisms underlying the maintenance of verbal information) in varied learning deficits, and it is largely consistent with more recent work examining the dynamic interactions among cognitive processes and academic outcomes (see, for example, Eason and colleagues' work on reader–text interactions: Eason, Goldberg, Young, Geist, & Cutting, 2012).

Existing research has also found that individual differences in executive functions reflect considerable genetic contributions at both the unity (i.e., common ability factor) and diversity (i.e., specific process) levels of executive function (Friedman et al., 2008). Specifically, Miyake and colleagues examined correlations obtained from both monozygotic and dizygotic twins based on inhibition, shifting, and updating tasks to analyze the extent to which genetic and environmental influences drive individual differences in the three executive functions. Their findings suggest that, at the level of latent variables, executive functions are highly heritable. Further, evidence of significant genetic influence on the development of specific executive functions also emerged (Miyake & Friedman, 2012). This finding, combined with research supporting the relative developmental stability of executive functions (Friedman, Miyake, Robinson, & Hewitt, 2011), suggests important biological underpinnings of executive functions – and of executive function disorders.

It is important to note that, as Miyake and colleagues (2012) suggest, evidence of high heritability does not indicate that executive functions are fixed or unable to be influenced over time. In addition to biological factors, existing work also suggests an important role of social and environmental supports for the promotion of executive functions (see Dawson & Guare, 2010, for a summary of tools to promote executive skill development in children and adolescents, including both individualized and group-based supports). Relatedly, considerable research has provided evidence for the restrictive effects of environmental risk, such as stress and poverty-related adversity, on the development of executive functions (see Blair, 2010; Blair & Raver, 2015, for reviews of existing research; also see Panlilio & Corr, 2019, Chapter 9, this volume, for discussion of maltreatment and trauma and self-regulation more broadly). Overall, existing work suggests critical neurobiological and social-environmental mechanisms through which deficits in learners' executive functions can develop and, conversely, through which children's and adolescents' executive function development can be promoted.

Another important conceptual issue in the study of the role of executive function deficits in learning and achievement is the existence of overlap among, as well as differentiation between, executive function disorders and ADHD. Barkley (1997), for example, proposed an early model that integrated executive functions – and, more broadly, self-regulation – with ADHD and positioned ADHD as associated with secondary impairments in executive abilities, including working memory, self-regulation of affect and motivation, internalization of speech, reconstitution, and motor control.

Based on the premise that ADHD is largely comprised of a deficit in behavioral inhibition, Barkley's work suggested that ADHD may be based on executive deficits. Other work (Brown, 2006) conceptualized clusters of cognitive (i.e., executive) functions, including activation, focus, effort, emotion, memory, and action, that are interdependent and operate interactively to support complex abilities and, at a more basic level, the successful completion of tasks and goals. Impairment in these functions is believed to contribute to the development of ADHD based on the notion that, "for all persons with ADHD, regardless of subtype, impairments of executive functions are the essence of their disorder" (Brown, 2006, p. 40).

In an empirical examination, Di Trani and colleagues (2011) studied the involvement of executive and intellectual functions in ADHD with and without comorbidity (i.e., internalizing vs. externalizing disorders). They found no differences in performance on the measures of executive function, including attention, working memory, and fluency, among the different subtypes of ADHD (i.e., ADHD-combined type, ADHD-primarily hyperactive type, ADHD-primarily inattentive type). Further, an impairment in sustained attention in those with ADHD was observed; performance on the other measures of executive function was not significantly lower than that of the normative sample. Differences were observed, however, based on comorbidity: Children with externalizing disorders performed significantly worse on the measures of executive function compared with children with internalizing disorders. As Di Trani and colleagues suggest, their findings only partially supported the role of a generalized executive function deficit in ADHD.

In a well-known meta-analytic review, Willcutt and colleagues (2005) examined evidence for the notion that ADHD arises from a primary deficit in executive functions. Specifically, they examined studies that administered measures of executive function to groups with ADHD and to groups without ADHD. Across the studies reviewed, Willcutt and colleagues found evidence of impairment on all executive function tasks, but observed stronger effects on measures of response inhibition, vigilance, working memory, and planning. Effect sizes based on differences in performance on the executive function measures largely fell within the medium range. Despite this evidence, the magnitude of group differences on executive function deficits was considerably smaller than group differences in ADHD symptoms, and other research (e.g., Willcutt et al., 2001) suggests that correlations between ADHD symptoms and performances on executive function tasks are rather small in magnitude. As Willcutt and colleagues (2005) suggest, the evidence indicates a clear role of executive function weaknesses in ADHD; however, their results "do not support the hypothesis that [executive function] deficits are the single necessary and sufficient cause of ADHD in all individuals with the disorder" (p. 1342). Across this work, there is strong evidence that the development of ADHD is associated with deficits in executive functions, and yet, evidence supporting the notion that ADHD symptomatology arises primarily from a generalized deficit in executive function is far from compelling. Thus, it appears that executive deficits are some of several important weaknesses faced by those with ADHD, and that ADHD may be best explained by a multiple-deficit model.

In the next section, we review the roles of specific executive functions in achievement-based skills and include in our review resultant outcomes of executive function disorders in both academic learning and achievement.

EXECUTIVE FUNCTIONS AND LEARNING AND ACHIEVEMENT

Considerable work has linked executive functions to varied learning and achievement outcomes (e.g., Fuhs, Farran, & Nesbitt, 2015; Jacob & Parkinson, 2015; Swanson & Sachse-Lee, 2001). Further, children who exhibit deficits in executive functions also experience learning difficulties (e.g., Biederman et al., 2004; Gathercole, Alloway, Willis, & Adams, 2006). For example, deficits in specific executive functions, such as inhibition, cognitive flexibility, and updating, are linked with difficulties in mathematical problem-solving (Swanson, Jerman, & Zheng, 2008), reading fluency (Cain, Oakhill, & Bryant, 2004), and comprehension (Cartwright, Parris, & Headley, 2015; Follmer, 2018; Sesma, Mahone, Levine, Eason, & Cutting, 2009; see also Swanson, Chapter 2, this volume, for a review of specific learning disabilities), as well as the abilities to follow complex directions and complete multi-step tasks (Gathercole, Lamont, & Alloway, 2006). In this section, we provide an illustrative overview of research examining the relations among specific executive functions and achievement in both typically developing learners and learners with disabilities.

In a well-known study, Best, Miller, and Naglieri (2011) examined age-related changes in executive function as well as the relations between executive function and academic achievement in a large, representative sample of children and adolescents 5–17 years of age. Executive function ability, as assessed through planning and monitoring tasks, improved across age but demonstrated greater improvement between the ages of 5 and 8; executive function improved moderately thereafter into early adulthood. Such findings, as discussed by Best and colleagues, are consistent with meta-analytic work (Romine & Reynolds, 2005) noting substantial improvement in executive skills in early childhood, with more moderate improvement in late childhood and into adolescence. Significant relations between executive function and both reading and mathematics achievement were found, and the strength of these relations was similar across achievement areas. Within each achievement domain, executive function also contributed more strongly to complex skills (e.g., executive function more strongly predicting applied problem-solving skills when compared with calculation-based skills in the area of mathematics). Based in part on their findings, the authors suggested a domain-general relation between more complex executive skills and academic achievement.

In more recent work, Morgan and colleagues (2017) examined the contributions of executive function deficits to first-grade children's reading and mathematics difficulties. Using measures of cognitive flexibility and working memory based on a nationally representative sample from the Early Childhood Longitudinal Study, Kindergarten class of 2022 (ECLS-K: 2011), they reported that cognitive flexibility and working memory deficits uniquely predicted kindergarten children's risk of experiencing reading and mathematics difficulties in first grade. These relations held after controlling for children's prior history of reading or mathematics difficulties, prior behavioral functioning, socio-demographic characteristics, and their family's participation in government assistance or childcare. This research and other studies (e.g., Berninger et al., 2006) provide strong evidence of the roles executive function deficits play in difficulties with specific achievement skills.

Executive function is also closely associated with school readiness and success (Blair & Diamond, 2008; Blair & Raver, 2015). In one study examining the role of executive

functions in explaining disparities in school readiness, Fitzpatrick, McKinnon, Blair, and Willoughby (2014) found that children's executive skills, including inhibition and working memory, accounted for unique variance in measures of mathematics, reading, and vocabulary skills after controlling for processing speed and general intelligence. Executive skills also mediated relations between socioeconomic status and children's mathematical skills, word identification skills, and oral language development and lexical knowledge. The study demonstrated clear links among poverty-related adversity, executive function development, and disparity in achievement skills of preschool children. Combined with other research (see Blair & Diamond, 2008, for a review), this work also suggests important pathways through which intervention efforts can be leveraged to target and promote executive function skills and remediate disparities in children's school readiness and academic skill development.

Executive functions have also been strongly implicated in learning outcomes in students with a variety of learning and neurodevelopmental disorders. May, Rinehart, Wilding, and Cornish (2013), for example, examined the relations between executive function, via sustained attention and attention shifting, and word reading and basic mathematics skills in children with autism spectrum disorder. Specifically, they examined two groups ($N = 40$ with autism spectrum disorder, and $N = 40$ typically developing children) of cognitively able children, 7–12 years of age, who were matched based on age, gender, and perceptual reasoning. Executive function and academic skills were measured at baseline as well as 1 year later. Children with autism spectrum disorder showed similar developmental profiles for both word reading and numerical operations, but demonstrated attention shifting deficits that were correlated with the academic skills. The findings overall suggested deficits in executive function related to attentional switching and regulation, and that atypical attention profiles may exist in children with autism spectrum disorders.

Similarly, in a recent systematic review, Craig and colleagues (Craig et al., 2016) reviewed studies that examined executive function deficits in children and adolescents with autism and ADHD. Specifically, they reviewed studies that compared the executive functions of inhibition, working memory, flexibility, planning, and monitoring, as examples, in children and adolescents with autism, with ADHD, and with both autism and ADHD. Deficits in the ability to regulate attention and monitor behavior were noted in all clinical groups in most of the studies reviewed. Similar performances with respect to working memory and fluency were observed across groups. Across studies, children with autism as well as with autism and ADHD, however, demonstrated marked deficits in both cognitive flexibility and planning compared with those with ADHD. On the other hand, evidence suggested that children with ADHD demonstrated specific impairment in response inhibition compared with children with autism. Craig and colleagues leveraged their review to suggest the presence of a common or co-occurring deficit in executive function in those with autism and ADHD, and also to suggest executive function training as a possible treatment mechanism for improving functioning.

Existing research has also examined the relations among executive function and other cognitive processes and reading comprehension in children and adolescents who are deaf. Daza, Phillips-Silver, Ruiz-Cuadra, & López-López (2014) examined the relations among language skills and nonverbal cognitive processes (including executive functions) and reading comprehension in prelingually deaf children between 8 and

16 years of age. Children who were categorized as good readers demonstrated better performance on measures of executive function as well as measures of language skills (e.g., vocabulary knowledge). Further, partial correlations indicated significant and moderate-to-strong relations among the measures of executive function and reading comprehension. The findings, as Daza and colleagues suggest, indicate involvement of executive processes in reading ability in children who are deaf, and that an alternative route to reading success for deaf children not based on spoken language may be supported through emphasis on nonverbal cognitive processes (see also Koo, Crain, LaSasso, & Eden, 2008).

A developing body of research has also examined the roles of executive functions in children with dyslexia. Reiter, Tucha, and Lange (2005), for example, assessed several executive functions, including working memory, inhibition, flexibility, and fluency, as well as concept formation and problem-solving skills, and examined the roles of these skills in dyslexic and non-dyslexic children. Children with dyslexia exhibited marked difficulties in working memory and fluency and, to a lesser degree, inhibition of inappropriate reactions. In a related examination, Helland and Morken (2016) studied the neurocognitive precursors of literacy developing in both first-language and second-language children across preliteracy, emergent literacy, and literacy stages. Children with and without dyslexia were compared. Significant group differences in measures of working memory and rapid automatized naming, for example, were observed across literacy stages. Group differences in the neurocognitive measures decreased over time or by literacy stage, suggesting critical time points during which targeted intervention work could be implemented to remediate deficits in children with specific reading difficulties.

As discussed, much of the existing work supporting the involvement of executive functions in achievement-based outcomes has obtained evidence of deficits in executive skills in those with concurrent academic skills deficits. This emphasis on cross-sectional, case-control designs as a method for supporting the role of executive function deficits in subsequent academic skill deficits largely parallels the approach utilized in the realm of psychopathology, as summarized by Snyder and colleagues (2015). Encouragingly, however, existing longitudinal examinations also suggest an important role of executive functions in academic skills across content areas and over time (see Blair & Ursache's, 2011, delineation of a bidirectional model of executive functions and self-regulation). For example, Fuhs and colleagues (2014) examined the longitudinal bidirectional associations between executive skills and achievement in the areas of mathematics, oral language, and literacy in 4-year-old children at the beginning and end of their prekindergarten year and through the end of kindergarten. They found evidence of bidirectional associations between executive skills and mathematics and oral comprehension skills, but not between executive and literacy skills. Executive skills also continued to predict mathematics and oral comprehension skills over time, suggesting that executive processes may promote the development of early mathematics and oral comprehension skills in children entering formal schooling.

Across studies briefly reviewed in this section, there is strong evidence of executive function's involvement in a host of important academic skills and, relatedly, of the role of executive function deficits in adversely affecting learning outcomes. This evidence is based on cross-sectional, longitudinal, and meta-analytic work examining a range of learners across a range of ages. Much of this research was instrumental in implicating

executive deficits in achievement-based difficulties. There is now a need to shift from studies only identifying broad deficits in executive function in those with learning difficulties to studies that provide dynamic and interactive examinations of executive and learning processes. This will support a more nuanced examination of the roles of executive functions in the development and use of academic skills (e.g., how reader characteristics and text characteristics interact and unfold over the course of reading to support text comprehension; see, for example, Eason et al., 2012; van Den Broek & Helder, 2017; van Moort, Koornneef, & van Den Broek, 2018). Additional work should aim to explicate specific mechanisms that can result in improved executive skills and, subsequently, learning and achievement outcomes. In the next section, we review current research examining the utility and promise of, as well as issues with, interventions targeting executive functions.

INTERVENTIONS TARGETING EXECUTIVE FUNCTIONS: CURRENT FINDINGS

A growing body of research has examined the ability of executive functions to be improved through intervention, as well as resultant improvements in academic and social-emotional skills (e.g., Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008; Blair & Diamond, 2008; Diamond, 2012; Dias & Seabra, 2015). In a well-known paper, Diamond and Lee (2011) outline diverse activities that have garnered initial support as effective mechanisms for improving children's executive functions. Based on their review, these activities include computerized training (e.g., CogMed), non-computerized games (e.g., reasoning or speed training), aerobics (e.g., running games), martial arts, and mindfulness practices (e.g., self-monitoring and planning-based questioning). In addition to these activities, Diamond and Lee also emphasize the role of targeted school curricula in the possible improvement of students' executive functions. One prominent example, Tools of the Mind, reflects a preschool and kindergarten curriculum that provides supports for developing children's executive skills via play, scaffolding, private speech, and other Vygotskian-based instructional strategies (Bodrova & Leong, 2007). This and other work (e.g., Menezes, Dias, Trevisan, Carreiro, & Seabra, 2015; Morgan et al., 2017; Novick, Hussey, Teubner-Rhodes, Harbison, & Bunting, 2014) clearly situate the study of executive function interventions as an expanding area of research.

One well-known intervention program is Head Start REDI (Research-based, developmentally informed; e.g., Bierman, Nix, et al., 2008), a research-based intervention that was integrated into existing Head Start programs for socioeconomically disadvantaged children. The program implemented the PATHS (Promoting Alternative Thinking Strategies) curriculum and also targeted students' language and emerging literacy skills. Based on a randomized controlled trial design, Bierman and colleagues found evidence of gains on two measures of executive function. The executive function gains also mediated intervention effects on measures of school readiness, including language and emergent literacy and social-emotional regulation. The findings provide broad support for the inclusion of curricula that target and promote children's executive skills, as well as the importance of those skills in developing learners' school readiness.

Another prominent example of a school-based program targeting regulatory skills is the Chicago School Readiness Project (CSRPP; Jones, Bub, & Raver, 2013). The CSRPP

reflects both a teacher- and classroom-focused intervention promoting children's self-regulation, in part through teacher professional development and emphasis on quality teacher-child relationships. Like other programs, it also places particular emphasis on improving regulatory outcomes for children from low-income environments. Existing work has found evidence for intervention effects on the quality of teachers' relationships with their students, and has also found that the quality of those relationships mediated the intervention's effects on children's self-regulation. Further, teacher-child relationship quality and children's self-regulation skills mediated the effects of the intervention on children's academic outcomes, including mathematics skills. These findings, combined with findings from other important intervention work (see Red Light, Purple Light; Tominey & McClelland, 2011), provide additional support for the viability of targeted programs that aim to promote diverse learners' regulatory and academic outcomes.

Executive function interventions supporting children and adolescents with attentional deficits have also been developed. Marlowe (2000), for example, provided an early model for intervention work targeting executive skills among children with executive dysfunction. A large part of the model emphasized adaptive thinking skills via a cognitive-behavioral approach to teaching executive and metacognitive thinking strategies. More recently, work such as that by Menezes and colleagues (2015) has examined the feasibility of an executive function intervention among children and adolescents with attentional deficits. In their work, children who received the 8-month executive function program demonstrated gains in attention and inhibition skills, as well as in measures of auditory working memory. As Menezes and colleagues note, however, the program did not lead to gains in higher-level or more complex executive skills such as flexibility and verbal fluency.

In general, much of this research examining the utility of executive function interventions has shown considerable promise; recent work, however, has also provided a more critical analysis of the extent to which a causal association exists between executive function – and, in particular, increases in executive functions – and student achievement (Jacob & Parkinson, 2015). Snyder and colleagues (2015) note an important issue when discussing the associations among executive function impairments and psychopathology:

it is unknown if [executive function] deficits (a) precede, and are a potential causal risk factor for, developing psychopathology, (b) follow, and are a consequence of, psychopathology, (c) are a correlate of psychopathology without playing a causal role (e.g., both poor EF and psychopathology may be related to a third factor), or some combination of these models.

(p. 15)

Although Snyder and colleagues' point is contextualized to the possible effects of executive function deficits on developed psychopathology, it aptly characterizes parallel uncertainty regarding the existence of causal associations among specific executive functions and academic skills and achievement.

A relatively recent meta-analytic review examined studies, among others, that assigned students to interventions designed to improve executive skills; it also examined the effects of obtained executive function improvements on academic

achievement (Jacob & Parkinson, 2015). Based on the studies they reviewed, Jacob and Parkinson noted limited evidence for the claim that improvement in executive functioning caused gains in achievement or academic skills. They based this conclusion on several key points. First, relatively few studies employed random assignment to conditions that aimed to improve children's executive functions and, critically, that also aimed to examine the effect of improvement in executive function on academic achievement. Further, many of the available studies examined gains in both executive function and academic achievement concurrently, thereby impairing the ability to examine an independent causal claim of executive function to academic achievement.

It is important to note that Jacob and Parkinson's review primarily examined these links among typically developing learners. Other meta-analytic work, such as that by Yeniad, Malda, Mesman, van IJzendoorn, and Pieper (2013), examined the role of shifting ability in predicting mathematics and reading performance among a more heterogeneous study sample, and work by Carretti, Borella, Cornoldi, and De Beni (2009) examined the role of working memory in explaining reading comprehension difficulties among studies including both good and poor readers. These reviews provide further support for the notion that executive functions are associated with the development of an array of academic skills. In many ways, however, the question of whether performance on or gains in executive functions are causal in the development of and improvement in learning and academic skills remains an open one. In the next sections, we discuss issues of measurement and theory as they relate to the study of executive function.

MEASUREMENT ISSUES IN THE STUDY OF EXECUTIVE FUNCTION AND EXECUTIVE FUNCTION DISORDERS

A common issue plaguing the study of executive function is its accurate measurement. The difficulty of "clean" measurement of executive function is compounded by several important issues. First, as discussed, there are a variety of executive function frameworks (see McCloskey, Perkins, & Van Diviner, 2008) that include overlapping but also somewhat distinct executive functions. Further, executive function as a whole reflects a multifaceted construct that many view as consisting of both lower-level and higher-level or more complex (e.g., planning and organizing, monitoring) executive functions. In part as a consequence of differing conceptual views about the nature and types of executive functions that are to be studied, there are myriad measures available that aim to tap specific executive processes. Importantly, whether different tasks (e.g., the category switch task, number-letter switch task, or color-shape switch task) that aim to capture the same executive functions (e.g., shifting) succeed in doing so in ways that are both reliable and valid is a matter of open debate (see, for example, early work by Phillips, 1997; Welsh et al., 2006; Welsh, Pennington, & Groisser, 1991).

Second, there also exist different types of executive function measure. The assessment of executive function is conducted primarily via so-called indirect or questionnaire-based measures and more direct or task-based measures. Questionnaire-based measures capture an overall account of one's executive functioning based on a rating scale format and are available in either parent-, teacher-, or self-report versions. Examples include the behavior rating inventory of executive function (BRIEF; Guy, Isquith, & Gioia et al., 2004) and the comprehensive executive function inven-

tory (Naglieri & Goldstein, 2013). Such measures are recommended by some scholars because they are believed to have greater ecological validity (Barkley & Fischer, 2011). Task-based measures require performance on established sets of criteria that provide and elicit both novelty and complexity, and they are designed to target specific executive functions (e.g., inhibition, shifting, updating). Examples include specific tasks such as the Wisconsin card sorting task, the Tower of London task, and variations of the Stroop task, as well as standardized task sets such as the Delis–Kaplan executive function system (Delis, Kaplan, & Kramer, 2001). Numerous studies examining the roles of executive functions in learning and achievement-based outcomes have relied on both types of measure (see, for example, Fuhs et al., 2015, 2014).

Despite common use of both types of measure, scholars have long expressed concerns about both the feasibility of exclusively relying on one type of executive function measure (see, for example, Barkley, 2012) and the extent to which the different formats converge to provide similar information about learners' executive function (Follmer & Stefanou, 2014). In a review of studies that examined the associations between performance-based and rating scale-based measures of executive function across samples of both children and adults, Toplak, West, and Stanovich (2011) found that the overall correlation between the measurement types was rather small (i.e., $r = 0.19$), and that 24% of the relevant correlations reported attained statistical significance. Toplak and colleagues use their findings to suggest that task-based and questionnaire-based measures of executive function may assess different underlying mental constructs related to executive function. Indeed it may be that the two types of measure should not be viewed as interchangeable; instead, they likely provide unique and non-overlapping information about learners' overall goal-directed behavior (e.g., the behavioral expression of executive function, as in the case of questionnaire-based measures), as well as their executive processing accuracy and efficiency (e.g., as in the case of task-based measures).

Perhaps most important to the difficulty inherent in measuring executive functions is the well-known task impurity problem (e.g., Miyake & Friedman, 2012). The assessment of executive function, particularly when using task-based measures, relies on factors and processes both related and unrelated to actual executive processes. In other words, a given executive function task (e.g., the plus-minus task as a measure of shifting; Miyake et al., 2000) relies on both executive (i.e., the ability to switch between mental sets or response rules) and non-executive (i.e., basic arithmetic skills, the ability to maintain task goals and sets in memory while executing the task, and the ability to monitor responses for perceived accuracy) processes. The consequence of the "loaded" nature of executive function tasks is that they necessarily include systematic variance attributable to non-executive processes (see Figure 2 of Snyder et al., 2015, p. 15). Thus, a given executive function task invariably captures effects of the specific executive function measured as well as effects related to non-executive process, which makes accurate interpretation of single executive function tasks difficult.

One relatively simple way of mitigating the error associated with using task-based measures of executive function is to administer multiple measures of each executive function component being examined. In their seminal paper, Miyake and colleagues (Miyake et al., 2000) used multiple (i.e., three) exemplar tasks that may vary in their task sets and goals but capture the same target executive function. They then employed latent variable modeling (i.e., via confirmatory factor analysis) to extract a

latent variable as the measure of the executive function under study. Such an approach effectively reduces the error associated with non-executive processes and produces a cleaner estimate of learners' executive function (Miyake & Friedman, 2012). Although a number of studies have effectively employed this approach, the use and administration of multiple executive function tasks present important study time and procedural constraints for experimenters. Ultimately, the researcher must weigh the advantages associated with obtaining a more precise estimate of executive function with the consequence of increased resources (e.g., time, cost) associated with administration of multiple tasks.

THEORETICAL ISSUES IN THE STUDY OF EXECUTIVE FUNCTION AND EXECUTIVE FUNCTION DISORDERS

One conclusion drawn from the studies reviewed here is that there is abundant variance in the manner in which executive functions are defined and delineated, as well as measured. Effective examination of executive functions and their reciprocal, and perhaps causal, relation with academic achievement outcomes remains complex. Some of the challenges in examining executive functions are evident and attributable to the internal nature of the explanatory constructs. Further, at times, scholars' vague attributions to executive functions for a myriad of inexplicable outcomes contribute to construct ambiguity.

Despite caution, much research in psychology and education that has examined executive functions has leaned on the apparent logic that executive functions have direct neural correlates. However, among others, Alvarez and Emory (2006), through meta-analytic review of frontal lobe imaging and lesion studies, provide ample evidence that neuropsychology has yet to establish such direct correlates. Additional empirical research is necessary in order to adequately explicate relations among specific brain structures and functions and measured executive functions.

Executive functions, rather, emerged as an explanatory tool for findings of disruption in learning and performance as tied closely to observed or tested processing deficits and ineffective behavioral regulation. One result is the development of a data-forward rather than theory-forward account of the construct. Foundational explanations of executive functions, nonetheless, rest within theories familiar to educational psychologists and special educators. Cognitive developmental and information-processing views of learning, as largely illustrated in this review, examine how internal processes provide explanation for limitations and affordances in learning, memory, and behavior. In this view, limitations in attentional processing, working memory, retrieval failure, and regulatory control, for example, provide explanation and support for how executive functions, such as inhibition, switching, flexibility, planning, and monitoring, relate directly to learning specifically and likely subsequent academic achievement.

Despite the transparent theoretical support for executive functions from cognitive views, as illustrated, it is reported that executive functions are theoretically heterogeneous. That is, different theories or frameworks not only include different definitions of executive functions, but also include varied executive functions. This heterogeneity represents significant challenges in construct delineation and effective measurement and limits subsequent generalizability of research findings. As a result, those who

study executive functions, the relations among executive functions, and the roles of executive functions in specific learning difficulties may draw inconclusive and inconsistent findings. In turn, without consistent findings, this heterogeneity undermines informative research trajectories and attempts to design effective interventions for those with learning difficulties. The community must work toward a consensus view and clear definition of executive function.

Research grounded in self-regulated learning theories also provides foundation for executive function research (e.g., Winne, 2005; Zimmerman, 2008). However, through lack of explanatory precision, theories of self-regulation, metacognition, and executive function contribute to construct confusion as, at times, these terms are used interchangeably (Dinsmore, Alexander, & Loughlin, 2008). In recent work Follmer and Sperling (2016), within self-regulated learning theory, sought to further explicate the relations among these regulatory constructs. Findings indicated relations among these constructs with executive functions predicting metacognition and self-regulation. Specified mediation analyses indicated that metacognition served to mediate the relationship between individual and omnibus executive functions and self-regulated learning. Although additional research is needed to explore these relations over time and under varied learning tasks, examination of regulatory processes hierarchically within a self-regulated learning framework may prove fruitful for future research.

IMPLICATIONS FOR PRACTITIONERS

The research and issues summarized in this chapter ground several implications for practitioners involved in the evaluation of learners with possible executive function difficulties. First, the assessment of executive function should be based on a multi-dimensional, multimethod approach (McCloskey et al., 2008). Such an approach is likely to yield a more accurate and holistic portrayal of a given learner's specific executive difficulties and, as a result, is likely to produce more specific and actionable information on which to base diagnostic and education-based decisions. For example, a comprehensive assessment of executive functions might include: (1) direct assessments, through task-based or standardized measures (e.g., D-KEFS, NEPSY), of performance on specific executive skills; (2) behavior ratings, through established rating scales (e.g., BRIEF, CEFI, D-REF), of executive functioning based on parent/guardian, teacher, and student reports; (3) behavioral observations of students as they engage with instruction, problems, or situations of varying complexity; (4) clinical interviews of parents/guardians, teachers, and student(s); and (5) anecdotal records of behavioral issues that may be indicative of difficulties with executive functions. The collection and use of multiple sources of information regarding a student's executive difficulties, where permitted by time and resources, are likely to aid the recommendation of targeted supports and services to more effectively address executive and learning difficulties.

Next, practitioners should act with caution as they examine potential interventions for learners who may demonstrate executive function challenges. Although many "training" programs exist, many lack needed efficacy. As indicated in the previous point, interventions implemented to address executive and learning difficulties should be as specific and targeted as possible, and they should incorporate explicit modeling of the effective use of executive functions. Emphases on and explicit connections between

how and when to “activate” and employ specific executive functions to support specific learning outcomes should also be established. Further, the modeling and use of skills, routines, and other schedule- or structure-based implements (e.g., structuring time and the environment) may be effective in supporting specific executive functions, as well as teaching the effective use of internal feedback, verbal mediation, and self-administered rewards to facilitate adaptive or goal-directed behavior (McCloskey et al., 2008). Aside from these supports, many tools and recommendations included in existing work (e.g., Dawson & Guare, 2010) borrow from more traditional behaviorist approaches to intervention for behavioral difficulties (see Sperling, Reeves, Follmer, Towle, & Chung, 2016) and include providing effective and conditional feedback and rewards as well as cueing for appropriate (i.e., effective) behavior.

To aid in these intervention-based decisions, a number of resources are available to support the implementation of tools, supports, and strategies in school-based settings. These include the following resources for educators and school-based practitioners: *Executive Skills in Children and Adolescents: A Practical Guide to Assessment and Intervention* (Dawson & Guare, 2010), *Promoting Executive Function in the Classroom* (Meltzer, 2010), and *Executive Function in the Classroom* (Kaufman, 2010), as well as resources for parents, including: *Late, Lost, and Unprepared: A Parent’s Guide to Helping Children with Executive Functioning* (Cooper-Kahn & Dietzel, 2008) and *Smart but Scattered* (Dawson & Guare, 2009). Finally, books such as *Essentials of Executive Functions Assessment* (McCloskey & Perkins, 2013) provide more technical guidance on the administration, scoring, and interpretation of assessments that test for executive function deficits and are designed for school-based psychologists and educational diagnosticians.

DIRECTIONS FOR FUTURE RESEARCH

The current work suggests several important directions for future research examining the roles of executive functions in specific learning processes, as well as the relations among executive function disorders and longitudinal achievement outcomes. An examination of the most current research on executive functions indicates continued theoretical heterogeneity, and, as such, additional attention to construct clarity as derived from empirical work remains necessary. Similarly, there remain opportunities for additional research on the relations among executive functions and other cognitive and regulatory constructs to continue to inform our understanding of executive functions and their role in regulating learning, emotion, and behavior. Executive functions and executive function disorders, as noted, are implicated in numerous learning and behavioral disabilities. A clearer understanding of the relations among executive functions and specific disabilities or difficulties also remains needed. Specific additional work that targets twice-exceptional learners – for example, who may excel at learning and yet struggle with executive function deficits that can result in decreased achievement-related behaviors – is also warranted (Mullet & Rinn, 2015). Although some research has delved into examination of executive functions and academic achievement for students with and without identified disabilities, much is yet to be learned through both cross-sectional studies and longitudinal studies of executive functions and achievement outcomes.

REFERENCES

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: Author.
- Alvarez, J. A., & Emory, E. (2006). Executive function and the frontal lobes: A meta-analytic review. *Neuropsychology Review*, 16(1), 17–42.
- Baddeley, A. (1996). Exploring the central executive. *The Quarterly Journal of Experimental Psychology Section A*, 49(1), 5–28.
- Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin*, 121(1), 65.
- Barkley, R. A. (2012). *Barkley deficits in executive functioning scale—children and adolescents (BDEFS-CA)*. New York: Guilford Press.
- Barkley, R. A., & Fischer, M. (2011). Predicting impairment in major life activities and occupational functioning in hyperactive children as adults: Self-reported executive function (EF) deficits versus EF tests. *Developmental Neuropsychology*, 36(2), 137–161.
- Berninger, V. W., Abbott, R. D., Thomson, J., Wagner, R., Swanson, H. L., Wijsman, E. M., & Raskind, W. (2006). Modeling phonological core deficits within a working memory architecture in children and adults with developmental dyslexia. *Scientific Studies of Reading*, 10(2), 165–198.
- Best, J. R., Miller, P. H., & Naglieri, J. A. (2011). Relations between executive function and academic achievement from ages 5 to 17 in a large, representative national sample. *Learning and Individual Differences*, 21(4), 327–336.
- Biederman, J., Monuteaux, M. C., Doyle, A. E., Seidman, L. J., Wilens, T. E., Ferrero, F., ... Faraone, S. V. (2004). Impact of executive function deficits and attention-deficit/hyperactivity disorder (ADHD) on academic outcomes in children. *Journal of Consulting and Clinical Psychology*, 72(5), 757.
- Bierman, K. L., Domitrovich, C. E., Nix, R. L., Gest, S. D., Welsh, J. A., Greenberg, M. T., ... Gill, S. (2008). Promoting academic and social-emotional school readiness: The head start REDI program. *Child Development*, 79(6), 1802–1817.
- Bierman, K. L., Nix, R. L., Greenberg, M. T., Blair, C., & Domitrovich, C. E. (2008). Executive functions and school readiness intervention: Impact, moderation, and mediation in the Head Start REDI program. *Development and Psychopathology*, 20(3), 821–843.
- Blair, C. (2010). Stress and the development of self-regulation in context. *Child Development Perspectives*, 4(3), 181–188.
- Blair, C., & Diamond, A. (2008). Biological processes in prevention and intervention: The promotion of self-regulation as a means of preventing school failure. *Development and Psychopathology*, 20(3), 899–911.
- Blair, C., & Raver, C. C. (2015). School readiness and self-regulation: A developmental psychobiological approach. *Annual Review of Psychology*, 66, 711–731.
- Blair, C., & Ursache, A. (2011). A bidirectional model of executive functions and self-regulation. *Handbook of Self-regulation: Research, Theory, and Applications*, 2, 300–320.
- Bodrova, E., & Leong, D. J. (2007). Play and early literacy: A Vygotskian approach. In K. A. Roskos & J. F. Christie (Eds.), *Play and literacy in early childhood: Research from multiple perspectives* (2nd ed., pp. 185–200). Mahwah, NJ: Erlbaum.
- Borkowski, J. G., & Burke, J. E. (1996). Theories, models, and measurements of executive functioning: An information processing perspective. In G. R. Lyon & N. A. Krasnegor (Eds.), *Attention, memory, and executive function* (pp. 235–261). Baltimore, MD: Paul H. Brookes.
- Brown, T. E. (2006). Executive functions and attention deficit hyperactivity disorder: Implications of two conflicting views. *International Journal of Disability, Development and Education*, 53(1), 35–46.
- Cain, K., Oakhill, J., & Bryant, P. (2004). Children's reading comprehension ability: Concurrent prediction by working memory, verbal ability, and component skills. *Journal of Educational Psychology*, 96(1), 31.
- Carretti, B., Borella, E., Cornoldi, C., & De Beni, R. (2009). Role of working memory in explaining the performance of individuals with specific reading comprehension difficulties: A meta-analysis. *Learning and Individual Differences*, 19(2), 246–251.
- Cartwright, K. B., Parris, S. R., & Headley, K. (2015). Executive function and reading comprehension. In S. R. Paris & K. Headley (Eds.), *Comprehension instruction: Research-based best practices* (3rd ed., pp. 56–71). New York, NY: Guilford Press.
- Cooper-Kahn, J., & Dietzel, L. (2008). *Late, lost, and unprepared: A parent's guide to helping children with executive functioning*. Bethesda, MD: Woodbine House.

- Craig, F., Margari, F., Legrottaglie, A. R., Palumbi, R., De Giambattista, C., & Margari, L. (2016). A review of executive function deficits in autism spectrum disorder and attention-deficit/hyperactivity disorder. *Neuropsychiatric Disease and Treatment*, 12, 1191.
- Cutting, L. E., Materek, A., Cole, C. A., Levine, T. M., & Mahone, E. M. (2009). Effects of fluency, oral language, and executive function on reading comprehension performance. *Annals of Dyslexia*, 59(1), 34–54.
- Dawson, P., & Guare, R. (2009). *Smart but Scattered*. New York: Guilford Press.
- . (2010). *Executive skills in children and adolescents: A practical guide to assessment and intervention*. New York: Guilford Press.
- Daza, M. T., Phillips-Silver, J., Del Mar Ruiz-Cuadra, M., & López-López, F. (2014). Language skills and nonverbal cognitive processes associated with reading comprehension in deaf children. *Research in Developmental Disabilities*, 35(12), 3526–3533.
- Delis, D. C., Kaplan, E., & Kramer, J. H. (2001). *Delis-Kaplan Executive function system: Examiners manual*. Boston, MA: Pearson.
- Denckla, M. B. (1996). Research on executive function in a neurodevelopmental context: Applications of clinical measures. *Developmental Neuropsychology*, 12, 5–16. doi:10.1080/87565649609540637
- Dias, N. M., & Seabra, A. G. (2015). Is it possible to promote executive functions in preschoolers? A case study in Brazil. *International Journal of Child Care and Education Policy*, 9, 1–18.
- Di Trani, M., Casini, M. P., Capuzzo, F., Gentile, S., Bianco, G., Menghini, D., & Vicari, S. (2011). Executive and intellectual functions in attention-deficit/hyperactivity disorder with and without comorbidity. *Brain and Development*, 33(6), 462–469.
- Diamond, A. (2012). Activities and programs that improve children's executive functions. *Current Directions in Psychological Science*, 21(5), 335–341.
- Diamond, A., & Lee, K. (2011). Interventions shown to aid executive function development in children 4 to 12 years old. *Science*, 333(6045), 959–964.
- Dinsmore, D. L., Alexander, P. A., & Loughlin, S. M. (2008). Focusing the conceptual lens on metacognition, self-regulation, and self-regulated learning. *Educational Psychology Review*, 20(4), 391–409.
- Eason, S. H., Goldberg, L. F., Young, K. M., Geist, M. C., & Cutting, L. E. (2012). Reader-text interactions: How differential text and question types influence cognitive skills needed for reading comprehension. *Journal of Educational Psychology*, 104(3), 515.
- Fitzpatrick, C., McKinnon, R. D., Blair, C. B., & Willoughby, M. T. (2014). Do preschool executive function skills explain the school readiness gap between advantaged and disadvantaged children?. *Learning and Instruction*, 30, 25–31.
- Follmer, D. J. (2018). Executive function and reading comprehension: A meta-analytic review. *Educational Psychologist*, 53(1), 42–60.
- Follmer, D. J., & Sperling, R. A. (2016). The mediating role of metacognition in the relationship between executive function and self-regulated learning. *British Journal of Educational Psychology*, 86(4), 559–575.
- Follmer, D. J., & Stefanou, C. R. (2014). Examining the correspondence between a direct and an indirect measure of executive functions: Implications for school-based assessment. *The School Psychologist*, 68(3), 12–18.
- Friedman, N. P., Miyake, A., Robinson, J. L., & Hewitt, J. K. (2011). Developmental trajectories in toddlers' self-restraint predict individual differences in executive functions 14 years later: A behavioral genetic analysis. *Developmental Psychology*, 47(5), 1410–1430.
- Friedman, N. P., Miyake, A., Young, S. E., DeFries, J. C., Corley, R. P., & Hewitt, J. K. (2008). Individual differences in executive functions are almost entirely genetic in origin. *Journal of Experimental Psychology: General*, 137(2), 201.
- Fuhs, M. W., Farran, D. C., & Nesbitt, K. T. (2015). Prekindergarten children's executive functioning skills and achievement gains: The utility of direct assessments and teacher ratings. *Journal of Educational Psychology*, 107(1), 207.
- Fuhs, M. W., Nesbitt, K. T., Farran, D. C., & Dong, N. (2014). Longitudinal associations between executive functioning and academic skills across content areas. *Developmental Psychology*, 50(6), 1698.
- Gathercole, S. E., Alloway, T. P., Willis, C., & Adams, A. M. (2006). Working memory in children with reading disabilities. *Journal of Experimental Child Psychology*, 93(3), 265–281.
- Gathercole, S. E., Lamont, E. M. I. L. Y., & Alloway, T. P. (2006). Working memory in the classroom. In S. Pickering (Ed.) *Working memory and education* (pp. 219–240). London: Academic Press.
- Georgiou, G. K., & Das, J. P. (2016). What component of executive functions contributes to normal and impaired reading comprehension in young adults?. *Research in Developmental Disabilities*, 49, 118–128.

- Guy, S. C., Isquith, P.K., & Gioia, G. A. (2004). *BRIEF-SR: behavior rating inventory of executive function-self-report version*. Lutz, FL: Psychological Assessment Resources.
- Helland, T., & Morken, F. (2016). Neurocognitive development and predictors of L1 and L2 literacy skills in dyslexia: A longitudinal study of children 5–11 years old. *Dyslexia*, 22(1), 3–26.
- Hofmann, W., Schmeichel, B. J., & Baddeley, A. D. (2012). Executive functions and self-regulation. *Trends in Cognitive Sciences*, 16(3), 174–180.
- Jacob, R., & Parkinson, J. (2015). The potential for school-based interventions that target executive function to improve academic achievement: A review. *Review of Educational Research*, 85(4), 512–552.
- Jones, S. M., Bub, K. L., & Raver, C. C. (2013). Unpacking the black box of the Chicago School Readiness Project intervention: The mediating roles of teacher–child relationship quality and self-regulation. *Early Education & Development*, 24(7), 1043–1064.
- Kaufman, C. (2010). *Executive function in the classroom: Practical strategies for improving performance and enhancing skills for all students*. Baltimore, MD: Brookes.
- Koo, D., Crain, K., LaSasso, C., & Eden, G. F. (2008). Phonological awareness and short term memory in hearing and deaf individuals of different communication backgrounds. *Annals of the New York Academy of Sciences*, 1145(1), 83–99.
- Lin, Y.-C., Morgan, P. L., Farkas, G., Hillemeier, M. M., Cook, M., & Maczuga, S. (2013). Reading, mathematics, and behavioral difficulties interrelate: Evidence from a cross-lagged panel design and population-based sample of U.S. upper elementary students. *Behavioral Disorders*, 38, 193–200.
- Malloy-Diniz, L. F., Miranda, D. M., & Grassi-Oliveira, R. (2017). Executive functions in psychiatric disorders. *Frontiers in Psychology*, 8, 1461.
- Marlowe, W. B. (2000). An intervention for children with disorders of executive functions. *Developmental Neuropsychology*, 18(3), 445–454.
- May, T., Rinehart, N., Wilding, J., & Cornish, K. (2013). The role of attention in the academic attainment of children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 43(9), 2147–2158.
- McCloskey, G., & Perkins, L. (2013). *Essentials of Executive Function Assessment*. Hoboken, NJ: Wiley.
- McCloskey, G., Perkins, L. A., & Van Diviner, B. (2008). *Assessment and intervention for executive function difficulties*. New York: Taylor & Francis.
- Meltzer, L. (2010). *Promoting executive function in the classroom*. New York: Guilford Press.
- Menezes, A., Dias, N. M., Trevisan, B. T., Carreiro, L. R. R., & Seabra, A. G. (2015). Intervention for executive functions in attention deficit and hyperactivity disorder. *Arquivos De Neuro-psiquiatria*, 73(3), 227–236.
- Miller, A. C., Davis, N., Gilbert, J. K., Cho, S. J., Toste, J. R., Street, J., & Cutting, L. E. (2014). Novel approaches to examine passage, student, and question effects on reading comprehension. *Learning Disabilities Research and Practice*, 29(1), 25–35. doi:10.1111/ldrp.12027
- Miyake, A., & Friedman, N. P. (2012). The nature and organization of individual differences in executive functions: Four general conclusions. *Current Directions in Psychological Science*, 21(1), 8–14.
- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. *Cognitive Psychology*, 41(1), 49–100.
- Morgan, P. L., Farkas, G., & Wu, Q. (2011). Kindergarten children’s growth trajectories in reading and mathematics: Who falls increasingly behind? *Journal of Learning Disabilities*, 44(5), 472–488.
- Morgan, P. L., Li, H., Farkas, G., Cook, M., Pun, W. H., & Hillemeier, M. M. (2017). Executive functioning deficits increase kindergarten children’s risk for reading and mathematics difficulties in first grade. *Contemporary Educational Psychology*, 50, 23–32.
- Mullet, D. R., & Rinn, A. N. (2015). Giftedness and ADHD: Identification, misdiagnosis, and dual diagnosis. *Roeper Review*, 37(4), 195–207.
- Naglieri, J. A., & Goldstein, S. (2013). *Comprehensive executive function inventory*. North Tonawanda, NY: Multi-Health Systems.
- Novick, J. M., Hussey, E., Teubner-Rhodes, S., Harbison, J. I., & Bunting, M. F. (2014). Clearing the garden-path: Improving sentence processing through cognitive control training. *Language, Cognition and Neuroscience*, 29(2), 186–217.
- Oberauer, K. (2009). Design for a working memory. *Psychology of Learning and Motivation*, 51, 45–100.
- Pelegrina, S., Capodici, A., Carretti, B., & Cornoldi, C. (2015). Magnitude representation and working memory updating in children with arithmetic and reading comprehension disabilities. *Journal of Learning Disabilities*, 48(6), 658–668.

- Pennington, B. F., & Ozonoff, S. (1996). Executive functions and developmental psychopathology. *Journal of Child Psychology and Psychiatry*, 37(1), 51–87.
- Phillips, L. H. (1997). Do “frontal tests” measure executive function? Issues of assessment and evidence from fluency tests. In P. M. A. Rabbitt (Ed.), *Methodology of frontal and executive function* (pp. 191–214). Hove, UK: Psychology Press.
- Reiter, A., Tucha, O., & Lange, K. W. (2005). Executive functions in children with dyslexia. *Dyslexia*, 11(2), 116–131.
- Rimm-Kaufman, S. E., Pianta, R. C., & Cox, M. J. (2000). Teachers’ judgments of problems in the transition to kindergarten. *Early Childhood Research Quarterly*, 15(2), 147–166.
- Romine, C. B., & Reynolds, C. R. (2005). A model of the development of frontal lobe functioning: Findings from a meta-analysis. *Applied Neuropsychology*, 12(4), 190–201.
- Ryan, R. M., Fauth, R. C., Brooks-Gunn, J. (2006). Childhood poverty: Implications for school readiness and early childhood education. In B. Spodek & O. N. Saracho (Eds.) *Handbook of research on the education of children*. (2nd ed., pp. 323–346). Mahwah, NJ: Erlbaum.
- Sesma, H. W., Mahone, E. M., Levine, T., Eason, S. H., & Cutting, L. E. (2009). The contribution of executive skills to reading comprehension. *Child Neuropsychology*, 15(3), 232–246.
- Snyder, H. R., Miyake, A., & Hankin, B. L. (2015). Advancing understanding of executive function impairments and psychopathology: Bridging the gap between clinical and cognitive approaches. *Frontiers in Psychology*, 6, 328.
- Sperling, R. A., Reeves, P. M., Follmer, D. J., Towle, A. L., & Chung, K. S. (2016). Teaching learning theories for educators: Teaching behaviorism to support self-regulation, integration, and transfer. In M. C. Smith & N. DeFrates-Densch (Eds.), *Challenges and innovations in educational psychology teaching and learning* (pp. 15–28). Charlotte, NC: Information Age Publishing.
- Swanson, H. L., Jerman, O., & Zheng, X. (2008). Growth in working memory and mathematical problem solving in children at risk and not at risk for serious math difficulties. *Journal of Educational Psychology*, 100(2), 343–379.
- Swanson, H. L., & Sachse-Lee, C. (2001). A subgroup analysis of working memory in children with reading disabilities: Domain-general or domain-specific deficiency? *Journal of Learning Disabilities*, 34(3), 249–263.
- Tominey, S. L., & McClelland, M. M. (2011). Red light, purple light: Findings from a randomized trial using circle time games to improve behavioral self-regulation in preschool. *Early Education & Development*, 22(3), 489–519.
- Toplak, M. E., West, R. F., & Stanovich, K. E. (2011). The cognitive reflection test as a predictor of performance on heuristics-and-biases tasks. *Memory & Cognition*, 39(7), 1275–1289.
- van Den Broek, P., & Helder, A. (2017). Cognitive processes in discourse comprehension: Passive processes, reader-initiated processes, and evolving mental representations. *Discourse Processes*, 54(5-6), 360–372.
- van Moort, M. L., Koornneef, A., & van Den Broek, P. W. (2018). Validation: Knowledge-and text-based monitoring during reading. *Discourse Processes*, 55(5–6), 1–17.
- Welsh, M., Friedman, S., & Spieker, S. (2006). Executive functions in developing children: Current conceptualizations and questions for the future. In K. McCartney & D. Phillips (Eds.), *Blackwell handbook of early childhood development* (pp. 167–187). Malden, MA: Blackwell. doi:10.1002/9780470757703.ch9
- Welsh, M. C., Pennington, B. F., & Groisser, D. B. (1991). A normative-developmental study of executive function: A window on prefrontal function in children. *Developmental Neuropsychology*, 7, 131–149. doi:10.1080/87565649109540483
- Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., & Pennington, B. F. (2005). Validity of the executive function theory of attention-deficit/hyperactivity disorder: A meta-analytic review. *Biological Psychiatry*, 57(11), 1336–1346.
- Willcutt, E. G., Pennington, B. F., Boada, R., Ogline, J. S., Tunick, R. A., Chhabildas, N. A., & Olson, R. K. (2001). A comparison of the cognitive deficits in reading disability and attention-deficit/hyperactivity disorder. *Journal of Abnormal Psychology*, 110(1), 157.
- Winne, P. H. (2005). Key issues in modeling and applying research on self regulated learning. *Applied Psychology*, 54(2), 232–238.
- Yeniad, N., Malda, M., Mesman, J., van IJzendoorn, M. H., & Pieper, S. (2013). Shifting ability predicts math and reading performance in children: A meta-analytical study. *Learning and Individual Differences*, 23, 1–9.

- Zelazo, P. D., Blair, C. B., & Willoughby, M. T. (2016). *Executive function: Implications for education (NCER 2017–2000)*. Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Research.
- Zelazo, P. D., & Cunningham, W. A. (2007). Executive function: Mechanisms underlying emotion regulation. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 135–158). New York, NY: Guilford Press.
- Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal*, 45(1), 166–183.

6

LANGUAGE IMPAIRMENTS

Challenges and Opportunities for Meeting Children's Needs and Insights from Psycho-Educational Theory and Research

Julie E. Dockrell and Geoff Lindsay

INTRODUCTION: CHALLENGES FOR MEETING CHILDREN'S NEEDS

Language development is a complex interaction between the child's cognitive skills, their family, school community, and the social and cultural context. Developing strong oracy skills is the key to effective communication in both the oral and written modality. There is consistent evidence that, when children experience difficulties with oral language literacy, behavior, mental health, and academic attainment are often affected (Bakopoulou & Dockrell, 2016; Cowan, Donlan, Newton, & Lloyd, 2005; Dockrell, Lindsay, & Connelly, 2009; Nation, Clarke, Marshall, & Durand, 2004; Snowling, Adams, Bishop, & Stothard, 2001; van Den Bedem et al., 2018; van Den Bedem, Dockrell, van Alphen, Kalicharan, & Rieffe, 2018; Young et al., 2002). As such, language delays and difficulties directly impact on students' ability to access the curriculum and interact with peers and adults, and on their self-esteem (Lindsay, Dockrell, & Palikara, 2010) and limits their academic and vocational attainments (Conti-Ramsden & Durkin, 2012), although there is significant variability in vocational outcomes (Carroll & Dockrell, 2012; Conti-Ramsden, Durkin, Toseeb, Botting, & Pickles, 2018).

Speech and language difficulties are reported to be the most common disability of early childhood (Law, Boyle, Harris, Harkness, & Nye, 2000; McLeod & McKinnon, 2007), but they are the least well detected (Prelock, Hutchins, & Glascoe, 2008) and are under-researched (Bishop, 2010). Given the wide range of ramifications of language learning difficulties, there is a key role for educational psychology, both in research and practice, in articulating the role of language in learning and, by corollary, in

identification, assessment, and intervention. Different diagnostic criteria used currently by researchers and practitioners hamper effective communication both between professionals and with parents. In this chapter, we not only focus on the relationship between educational psychology as a subdiscipline and psychology as a research science, but also consider educational psychology as an applied professional practice. In the UK, professional practitioners are referred to as educational psychologists (EPs) and have doctoral training. They are comparable to school psychologists in the US. Their role has historically been substantially concerned with children and young people with special educational needs (SEN), and their families. However, since the first EP, Cyril Burt, was appointed by London County Council in 1913, EPs have been engaged with more than SEN. Rather, their role has also been that of applying psychology to the education system as a whole, including schools and early years settings, through research, and interventions with children, families, and educational systems (Desforges & Lindsay, 2018).

This chapter explores the barriers to identifying and capturing the needs of children with language impairments and highlights the challenges these raise. We then consider how these challenges impact on the role of EPs and a conceptual framework that can be used to underpin effective practice.

LANGUAGE DEVELOPMENT

Communication refers to the ability to receive, send, and comprehend verbal, non-verbal, and graphic symbols. Language, in contrast, is primarily a representational system that emerges as the child's cognitive skills scaffold understanding and organization of their world. The language system is itself composed of a number of subcomponents. One way to divide the system is to consider phonology, structural language, and pragmatics (Saxton, 2010). Phonological aspects of language include the sounds that make up words and the rules that combine sounds. Structural language includes the lexicon (vocabulary), syntax (the rules for combining words into phrases and sentences), and morphology (the rules for constructing larger words out of smaller units of meaning; Jiang et al., 2018). The two dimensions of vocabulary and syntax capture the development of structural language well (Lonigan & Milburn, 2017). Pragmatic language goes beyond what is explicitly stated to reach the intended meaning or to resolve a structurally ambiguous message. Pragmatic skills typically require use of both the surrounding linguistic and social contexts (Ketelaars, Jansonius, Cuperus, & Verhoeven, 2016).

These subcomponents work together in a dynamic and developmental fashion to support effective and efficient communication. Children can experience difficulties with any aspect of the language system, either in isolation or in combination. For example, some children only have speech sound disorders (Skahan, Watson, & Lof, 2007), whereas others are reported to have specific grammatical difficulties (van der Lely & Stollwerck, 1996). However, evidence is increasing that children who experience specific developmental language difficulties, while a cohesive diagnostic group, cannot be further usefully differentiated into subtypes of disorder (Lancaster & Camarata, 2019), and that individual differences within the group are significant (Leonard, 2009).

Three key issues are relevant to our understanding of language problems. First, there is significant variation in the rates of language development, particularly in preschool

children, making it difficult to distinguish typical from atypical development (Reilly et al., 2010). Second, each component of the language system comprises a range of diverse skills challenging researchers, practitioners, and test developers. Finally, language development is influenced by a subtle interaction between the contexts in which children develop and the cognitive skills they bring to the language learning enterprise. This interaction both is the key to development and developmental disorders and necessitates looking at performance over time and in different contexts (Bishop, Snowling, Thompson, Greenhalgh, & Consortium, 2016).

Who Are the Children with Language Impairments?

In the following section, we describe the difficulties that exist in identifying children with language difficulties, the prevalence of language difficulties, the complexity of the children's developmental trajectories, and their associated needs. By providing a holistic picture of the research space, we set a foundation for discussing the ways in which educational psychology can inform our understanding and relevant professional practice.

Language impairments/disorders are persistent difficulties with language and communication that are not attributable to other medical or neurological conditions. These problems are captured within the neurodevelopmental disorders section of DSM-5 (American Psychiatric Association, 2013) and categorized as *communication disorders*, which are further differentiated into four diagnostic categories – *language disorder*, *social (pragmatic) communication disorder*, *speech sound disorder*, and *childhood onset fluency disorder* (stuttering). Arguably, these problems are not explained by comorbid factors, such as social disadvantage or poorer cognitive skills, but, as we will argue, differential diagnosis is challenging, and there is marked heterogeneity within the population.

Language disorders are often conceptualized as neurodevelopmental disorders, which are defined by children's performance on a relevant set of standardized language measures. Children with language disorders may experience problems with the structural dimensions of language (grammar and vocabulary) and/or pragmatic aspects of the language system (Bishop, 1992; Conti-Ramsden, Botting, & Faragher, 2001; Krok & Leonard, 2015; Nash & Donaldson, 2005). Debate persists as to whether the children's difficulties are caused by domain-specific language features (Rice, 2012; Riches, 2015; van der Lely, 2005) or domain-general learning mechanisms, such as working memory, processing speed, executive function, or other learning mechanisms (Lammertink, Boersma, Wijnen, & Rispens, 2017; Lukács & Kemény, 2014; Pauls & Archibald, 2016).

Persistent difficulties in the acquisition and use of language have variously been referred to as specific language impairment, language learning disabilities, and language disorder in the research literature (Bishop, 2014; Reilly et al., 2014). Within the UK educational system, speech, language, and communication needs (SLCN) or speech and language difficulties are the terms that are used (when describing research, we use the terms used in the relevant studies). Recently, there has been an attempt to develop a more consistent terminology to describe the children and their difficulties. The CATALISE study recommended the use of 'developmental language disorders' (Bishop et al., 2016; Bishop, Snowling, Thompson, Greenhalgh, &

Consortium, 2017). The term was generated by consensus among professionals, primarily researchers and speech and language therapists (SLTs), but is not universally accepted and, although included in ICD-11 (World Health Organization, 2018), it is not used in DSM-5 (APA, 2013) or in educational contexts within the UK – for example, SLCN is the term used by the UK government (Department for Education and Department for Health, 2015). This is of concern for educational psychology as the professional applied psychologists who primarily work within the educational system and provide assessment and advice on children and young people's SEN, as part of statutory assessments for education, health, and care plans under the Children and Families Act (2014), are EPs. Furthermore, theories of learning and intervention strategies are primarily generated from within educational contexts. A lack of connection between the two approaches to terminology and classification will influence the ways in which the children's needs are conceptualized by practitioners (EPs and SLTs/pathologists) in particular, and also researchers, and the interventions formulated.

How Are Children with Language Difficulties Identified?

There is no gold standard for the diagnosis of a language disability; tests vary markedly in their ability to discriminate between children with significant language learning needs (Shahmahmood, Jalaie, Soleymani, Haresabadi, & Nemati, 2016). Children identified with language difficulties by parents or professionals are not necessarily the same children identified by language tests (Tomblin et al., 1997), although combining parental report with test results is particularly effective in establishing the existence of significant language impairments (Bishop & McDonald, 2009).

One of the challenges has been that standards of language growth either have been lacking or are inconsistent. Recently, researchers have attempted to address this gap in our understanding by establishing benchmarks for typically developing language and for children with language impairments (Schmitt, Logan, Tambyraja, Farquharson, & Justice, 2017). These data have demonstrated considerable variability longitudinally, both for typically developing children and for those with language impairments. Variability was also evident for the different components of language measured (vocabulary and grammar) for typically developing children, where greater growth was evident for vocabulary in the younger children and for grammar at school age. A similar pattern was not evident for those with language impairments, leading the authors to suggest that, for children who qualify for language services with English as their mother tongue, at age 5 there is less rapid language growth throughout the academic year compared with their younger peers.

Indeed, a focus on children's growth in language skills and response to intervention, as opposed to static measures of development, appears to be a promising approach to identifying children with language learning difficulties (Hasson, Dodd, & Botting, 2012) and complements current frameworks within educational psychology (Cho, Compton, Fuchs, Fuchs, & Bouton, 2014; Tiekstra, Minnaert, & Hessels, 2016). These approaches could go some way in addressing the notable disconnect between learning, language development, and practice (Kamhi, 2014) and in developing models of intervention if effective mechanisms are going to be put in place to appropriately support children (Ebbels, McCartney, Slonims, Dockrell, & Norbury, 2019).

Prevalence of Language Impairments

These unexplained difficulties in language comprehension or production are common in development (Law et al., 2000). Many children enter school with language difficulties (Norbury et al., 2016). Between 7 and 16 percent of children are reported to have poor language development (more than 1.5 SD below the mean on norm-referenced tests), unexplained by other developmental challenges at this time (Reilly et al., 2010). Whether this group of children reflects the lower end of the normal distribution (Dollaghan, 2011) or represents a qualitatively different population (Conti-Ramsden et al., 2001) remains a matter of debate (Lancaster & Camarata, 2019). A further 2.3 percent experience language problems as part of another neurodevelopmental disorder (Norbury et al., 2016).

Establishing the prevalence of language disorders in younger children (under 5) is problematic owing to different, and often unexplained, developmental trajectories (Reilly et al., 2010) and the fact that there are no unequivocal language behaviors that allow the identification of language problems in a reliable and valid way (Pawlowska, 2014). Attempts have been made to isolate risk factors that may play a key role in early identification, where both the context of the child's development (e.g., maternal education) and child-specific factors (e.g., gender) have been identified (Rudolph, 2017). None of these risk factors was related to the children's language performance per se, and a significant number of children who show typical patterns of early vocabulary production and word combinations develop marked language problems (Poll & Miller, 2013).

More consistency exists in the prevalence of language difficulties once children are of elementary school age, where boys are more affected than girls (Law et al., 2000; Tomblin et al., 1997). Language difficulties evident at school entry tend not to resolve (Beitchman et al., 2008; Law, Tomblin, & Zhang, 2008; Tomblin, Zhang, Buckwalter, & O'Brien, 2003), although growth and variability are still evident (McKean et al., 2015; Schmitt et al., 2017). The best predictor of language abilities at age 7 is language at age 4, and the addition of other factors does not improve prediction (McKean et al., 2017). Neither nonverbal ability nor behavior problems impact on the stability of language performance (Bornstein, Hahn, & Putnick, 2016). Thus, by the age of 5, language abilities are much more stable, and kindergarten- or school-aged children with language difficulties are at high risk of persistent language disorder and other ensuing academic difficulties.

This stability in language development reported in the research literature appears to be at odds with the reduction in both language therapy and reported language learning needs in school-aged pupils. In the US, IDEA (<https://sites.ed.gov/idea/>) child count figures for children receiving speech language therapy drop from 49 percent of all children under IDEA at age 6 to 23 percent at age 10, 11 percent at age 12, and 4 percent at age 15 (Scott, 2014), and a similar drop is evident in speech and language therapy provision in the UK (Dockrell, Ricketts, Palikara, Charman, & Lindsay, 2019). There are also longitudinal data reflecting changes in the children's purported primary need in education (Dockrell, Lindsay, Roulstone, & Law, 2014). This raises questions about whether the children's language learning needs are no longer evident in educational contexts or whether other types of problem have become more salient. Research suggests the latter suggestion is more parsimonious with the currently available data (Dockrell & Hurry, 2018).

Drawing on a national dataset of children in the US, the proportion of students labelled as having speech language impairment declined from kindergarten to Grade 5. By contrast, the proportion of students labelled as having learning disabilities increased in an almost perfectly inverse relationship (Mashburn & Myers, 2010). This change in identification of students' primary special educational need, from identified language difficulties to a primary need relating to learning difficulties, has also been found in the UK (Meschi, Micklewright, Vignoles, & Lindsay, 2012). This signals an apparent inconsistency between research studies demonstrating stability in language performance within the child at age 5 and studies from education indicating changing reported needs, with significant reductions in children identified as experiencing language difficulties as their primary need as they became older, but a proportion then being classified as having learning difficulties and other types of special educational need (Meschi et al., 2012). However, whereas clinical studies rely on objective test measures, within education, the data are not necessarily based on either standardized measures or standard criteria (see, for example, Dockrell et al., 2014).

Co-occurring Developmental Difficulties

As with other developmental disabilities, pure language problems do not reflect clinical or educational reality and, indeed, are rare (Kaplan, Dewey, Crawford, & Wilson, 2001). Language difficulties co-occur with a range of other developmental disabilities including autism (Kjelgaard & Tager-Flusberg, 2001), attention-deficit/hyperactivity disorder (ADHD) (DuPaul, Gormley, & Laracy, 2013), developmental co-ordination disorder (Flapper & Schoemaker, 2013), dyslexia (Fraser, Goswami, & Conti-Ramsden, 2010), and social, emotional, and behavioral difficulties (Lindsay & Dockrell, 2012a, 2012b; St Clair, Pickles, Durkin, & Conti-Ramsden, 2011). Associated problems are so widespread among children with language difficulties that specific cases are thought to be the exception rather than the rule (Bishop, 2004) and are captured in the CATALISE studies by the inclusion of DLD + [another disorder/problem] (Bishop et al., 2017). Children with co-occurring difficulties are more likely to receive services than children with only language difficulties (Redmond, 2016).

Wider Impacts of Language Difficulties

Language difficulties have significant impacts on a wide number of developmental domains. As language learning difficulties often co-occur with literacy, numeracy, and social, emotional, and behavior problems, it is not surprising that children with language difficulties tend to have poorer educational outcomes (Durkin, Simkin, Knox, & Conti-Ramsden, 2009), with reported high risks of difficulties in literacy (Snowling & Hayiou-Thomas, 2006), numeracy (Cowan, Donlan, Newton, & Lloyd, 2005; Donlan, Cowan, Newton, & Lloyd, 2007), and in producing written text (Dockrell et al., 2009; Dockrell, Ricketts, Charman, & Lindsay, 2014). These co-occurring difficulties impact on children's progress and the effectiveness of pedagogy (see Storkel et al., 2017, for an example in relation to interactive book reading) but can also mask the underlying problems with the language system itself. Two examples, reading comprehension and behavior problems, serve to illustrate why a wider

perspective, including educational psychology, examining learning, and engagement with education, is important.

There has been an awareness for some time that children who struggle with reading typically experience difficulties with the phonological aspects of oral language (Lewis & Freebairn, 1992). Less attention has been paid to how oral language might underpin reading comprehension. There is now consistent evidence that children who struggle with reading comprehension have difficulties with wider aspects of oral language and vocabulary (Cain, Oakhill, & Bryant, 2004; Nation et al., 2004; Nation, Cocksey, Taylor, & Bishop, 2010). Understanding the ways in which oral language underpins performance on academic tasks is necessary to develop targeted effective interventions (Education Endowment Foundation, 2019).

When behavior is the focus of concern, there is growing evidence that some children and young people who demonstrate behavior difficulties experience language problems (Chow, Ekholm, & Coleman, 2018; Chow & Wehby, 2019), although the causal relationship between language and social behavior is still being examined (van Den Bedem et al., 2018, 2019). Recently, research has served to highlight the previously unidentified language difficulties in youth offenders (Hopkins, Clegg, & Stackhouse, 2018; Snow, 2019), further highlighting the need to develop sophisticated frameworks to understand language difficulties within a wider context.

Co-occurrence does not necessarily imply causation, and understanding these associations, once again, raises important challenges for both theory and practice. These relationships are rarely unidirectional and require longitudinal data sets and complex modelling to disentangle the factors involved. For example, in a study of the writing difficulties of adolescents with specific language impairment, it was found that the adolescents continued to demonstrate poor writing, as evidenced by short texts, poor sentence structure, and difficulties with ideas and organization. Importantly, although concurrent measures of vocabulary and spelling were significant factors in explaining writing performance, previous levels of literacy mediated the impact of oral language skills (Dockrell et al., 2009). For research, this clearly indicates that focusing solely on concurrent skills may result in essential causal factors being missed.

Meeting the Children's Needs

SLTs play a pivotal role in meeting the needs of children with language disorders and delays. Pediatric services typically prioritize young children or those with the highest level of need in the school years (Ebbels et al., 2019). The appropriateness of this approach is not without its critics (Law, 2019). For example, Law (2019) argues that, given the fundamental importance of communication, the high prevalence of children and young people with speech, language, and communication needs should be seen as a public health issue. The gap between the amount of provision and need and the unequivocal evidence that language underpins learning and attainment in school and beyond highlight the importance of a broader approach both to conceptualization of the needs of children with language difficulties and to appropriate interventions. This indicates the importance of recognizing and engaging educational psychology theory and practice. However, to achieve this aim, there is a need to engage directly with the complexities we have outlined

Implications for Educational Psychology

Stability and Variation over Time

Language difficulties challenge educational psychology with both phenomena that are well recognized and also ones that are new. For example, the construct of stability (or lack thereof) in language development reflects assumptions of stability of other psychoeducational difficulties, including the many criticisms of the presumed stability of IQ measures and educational decisions made based on these measures. For example, selective (grammar school) education was determined in part by such measures in England (the eleven plus), until a major change to comprehensive schools in the 1960s and 1970s. The importance of change in measured IQ over chronological age was identified by studies reporting the later higher achievement of student “failures” of the eleven plus examination at the end of primary school in England and also by longitudinal studies indicating changes in measured IQ among substantial minorities of children (e.g., Hindley & Owen, 1978). These concerns about presumed stability have persisted (Law, Charlton, & Asmussen, 2017). For example, Lindsay and Strand (2016) report consistent and substantial reductions in the national prevalence of SLCN in England over the age range 5–11 years.

Early Identification

Similarly, the challenges related to identification of development problems are well documented. Psychoeducational screening, of students at preschool/kindergarten or in the early years of schooling, including measures of language, was popular in the 1960s and 1970s, but the limited power of prediction of later literacy and other learning difficulties raised serious concerns (Lindsay & Wedell, 1982; Wedell & Lindsay, 1980). Despite this, schools, school districts and local authorities, and national governments have sought to develop schemes of early identification where language development has been a key element. In England, “baseline assessment” during students’ first term (about 4 months) of school entry at 4–5 years was implemented nationwide but was found to have significant problems of reliability and validity (Lindsay & Lewis, 2003; but see Klem, Hagtvet, Hulme, & Gustafsson, 2016, for an alternative argument). With respect to language difficulties, studies of young children have indicated that many children improve and effectively outgrow their language difficulties (Law, Rush, Anandan, Cox, & Wood, 2012; McKean et al., 2015), although there remains a debate about the extent to which early language difficulties are resolved in individual children (Dale, McMillan, Hayiou-Thomas, & Plomin, 2014), and for others language difficulties emerge during elementary school (Poll & Miller, 2013).

For EPs and SLTs, the early identification of and interventions to limit or alleviate early language difficulties remain high-priority tasks. However, the evidence on the limitations of the early identification process indicates the need to move away from a focus on simple one-off models of screening to a systematic approach also comprising recognition of the variation in children’s developmental language trajectories and the influence of school (and other) factors. There is now substantial evidence that prevalence rates for a range of SEN, including language impairment, vary relative to the administrative district – for example, the state and the school district in the US,

and the local authority in the UK (Christensen, et al., 2016; Morgan et al., 2015; Strand & Lindsay, 2009). At the school level, a similar pattern of variability is also apparent, with associations between identification of language impairment and school size, type of school (e.g., faith schools), and the proportion of minority ethnic students in the school (Lindsay & Strand, 2016).

Disproportionality

A further complexity, again well documented within the educational psychology literature but not often addressed in studies about children with language problems, is the notion of disproportionality. Prevalence of language difficulties is typically higher in disadvantaged populations, but rates of identification in these settings are often low (King et al., 2005). The relationship between language difficulties and ethnicity or race is less well researched, but Strand and Lindsay (2009) reported that children of Chinese, Bangladeshi, Black African, Black Caribbean, and Black Other backgrounds were over-represented in the national data for England of children with reported language difficulties. Similarly, children whose first language is not English (English as an additional language; EAL) are overrepresented in samples of children with reported language difficulties compared with monolingual English speakers (Dockrell et al., 2014).

Disproportionality brings to the forefront the importance of a wider framework in identifying the interplay between a complex set of contextual and child factors. For example, when prevalence rates are examined taking into account age, gender, ethnicity, EAL, and socioeconomic disadvantage, gender had the strongest association with SLCN, with boys 2.6 times more likely to be identified than girls (Lindsay & Strand, 2016). The importance for language difficulties of socioeconomic disadvantage was also shown, with the odds of identification for students entitled to a free school meal (an index of deprivation) 1.8 times higher than the odds of identification for children not entitled. Furthermore, the overrepresentation of children and young people with SLCN from different ethnic groups changed over time when national prevalence rates for 7 successive years were calculated, controlling for these variables. Substantial reductions over 7 years were found in odds ratios, compared with White British students, of students of Bangladeshi heritage (1.57:1 reducing to 0.91:1), Black African (1.78:1 to 1.06:1), and Black Other groups (1.83:1 to 1.17:1); the only raised odds remaining at the end of this period were for Black Caribbean (1.80:1 to 1.29:1) and Chinese (1.39:1 to 1.32:1) students, although both of these also reduced.

Language and Educational Difficulties

Language delays and disorders also speak to the development of educational psychology practice in new ways. There has been less engagement within educational psychology with the fundamental role that oral language plays in development, and children with language disorders bring this to the fore. Indeed, work with children who experienced language difficulties has led to a greater awareness of the role of oral language in the development of students' written texts (Dockrell et al., 2009). The multifaceted nature of language development is further captured through the consistent evidence that children from lower socioeconomic status backgrounds are exposed to less high-quality language both at home (e.g., Vanormelingen & Gillis, 2016) and in

school (Wright & Neuman, 2014), and that this leads to poorer vocabulary, grammar, and language-processing (Schwab & Lew-Williams, 2016). As a result, factors that are susceptible to change can be identified, and the role that education can play in bolstering children's oracy skills can be established (Mercer, 2010).

Finally, the high level of co-occurrence across developmental disorders raises challenges for both theory and practice. From a theoretical perspective, it challenges attempts to isolate the developmental routes of a disorder and requires detailed analytic studies of potential endotypes (Marshall, Harcourt-Brown, Ramus, & van der Lely, 2009). As an example, spelling difficulties are a common occurrence in both dyslexia (Sumner, Connelly, & Barnett, 2016) and language impairment (Silliman, Bahr, & Peters, 2006), but these developmental disabilities frequently co-occur (Snowling & Hayiou-Thomas, 2006). However, not all children with language impairment experience reading difficulties, and so different causal pathways need to be considered. To identify the cognitive drivers of spelling problems, for example, it is necessary to assess the underpinning causal factors independent of diagnostic category and, ideally, explicitly interrogate the notion of co-occurrence of disability (e.g., see Joye, Broc, Olive, & Dockrell, 2019). From a practitioner perspective, diagnosis can only provide an indication of the problems likely to be experienced by a child and requires a profiling of wider needs (Dockrell et al., 2014). This is particularly important for language disorders where, as we have discussed, there is significant within-disorder heterogeneity both for children of the same age and across development. In summary, disproportionality is an important aspect of language difficulties/disorders that should be considered when estimating the prevalence of not only gender and age, but also social disadvantage, ethnicity, and first-language status.

Disorder, Delay, and Low Achievement

A further area where educational psychology has an important role for both science and for practitioners concerns developmental disorders where there is no clear boundary between disorder and "normality": different patterns of identification within clinical samples and across educational provision occur (Lindsay, 2011). Some researchers have attempted to distinguish low achievement from disorder (Cowan & Powell, 2014), but this necessitates choosing an arbitrary statistical cutoff to draw the distinction. Similarly, some have argued that children with a delay "catch up," whereas those with a disorder never do (Bishop et al., 2016) and as such require highly specialized therapy. This seemingly explanatory concept is not straightforward for a complex, multidimensional skill such as language. For example, a delay in vocabulary acquisition can make an impact on grammatical development, which also then becomes delayed. Therefore, by the time the child enters school, their language skills may be more akin to those of a 3–4-year-old, but the language they encounter in school is not sufficiently differentiated to meet their needs. The child's language becomes further compromised. Is this still a delay or has it morphed into a disorder? Similarly, an 8-year-old with the language level of a 4-year-old in a class of typically developing children may appear disordered, but it is necessary to establish whether their language proficiency is like a 4-year-old's (delayed) or significantly different (disordered). Where appropriate controls – for example, language matched – have been used in

research studies, it has been difficult to identify language performance that is fundamentally different to children matched for language levels (but, see Rice, 2012). By contrast, developmental trajectories are markedly slower.

Focusing solely on clinical populations using diagnostic criteria limits the generalizability of results to children with wider language disorders (Law, McBean, & Rush, 2011) and acts as a barrier to understanding profiles of needs and changes in developmental trajectories. As a corollary, the majority of children with language disorders are found in mainstream schools but will not necessarily have received a clinical diagnosis; however, their needs will be met in these settings (Dockrell et al., 2014). Here, both the curriculum and access to additional resources will be determined by professionals working within the educational service (e.g. EPs, SLTs, in collaboration with other professionals, e.g. specialist teachers; Dockrell et al., 2014).

In summary, the identification of children and young people with language impairment is not just a matter of individual assessment of their capabilities. In addition, a range of demographic and environmental factors are relevant. Developmental language difficulties must be addressed as an interaction between both within-child factors and environmental factors. There are important impacts on development caused by any child's age, gender, ethnicity, and the level of socioeconomic disadvantage of the family, together with their use of EAL to their home language. There are sociopolitical implications in terms of funding, training, professional development, and the implementation of the interpretation of local or state policies. There are also professional implications for EPs and SLTs in terms of the organization of services to meet needs equitably, as well as practice with individual children and their families. This is not only a matter of identification of needs, but also a matter of appropriate interventions that are tuned to children's social contexts and developmental needs (e.g., see Scott, 2014).

Conceptualizing Development and Intervention

Language difficulties can be considered from different conceptual perspectives. However, having an overarching framework to guide research and practice provides the basis for developing more nuanced and evidence-based understanding of drivers of language development. Diagnostic models, in theory, provide a basis for scientific study and potentially provide a bridge between theory and practice because of a shared understanding. As we have argued, this conceptualization does not capture the reality of language disorders.

Bronfenbrenner's Ecosystemic Theory

In addressing this issue, both educational psychology researchers and practitioners have found the ecosystem model proposed by Bronfenbrenner very helpful for conceptualization and, also, guiding intervention (also see Hue, Chapter 10, and Macfarlane, Macfarlane, & Mataiti, Chapter 25, this volume). Bronfenbrenner (1979) proposed a four-part model that captures more specifically the complexities of understanding language difficulties. In this framework, development is affected by a complex system of relationships within their wider environment, which may be understood in terms of an ecosystemic model, made up of a microsystem, mesosystem, exosystem,

and macrosystem. A further development to his work added the chronosystem (Bronfenbrenner, Bolger, Caspi, Downey, & Moorehouse, 1988).

The first, and most local, level is called the *microsystem*. Bronfenbrenner defines the microsystem as “a pattern of activities, roles, and interpersonal relations experienced over time by the developing person in a given setting with particular physical and material characteristics” (2005, p. 22). The microsystem for children includes the places they inhabit, the people who live there with them, and the things they do together and is influenced by their own skills and competencies. An important part of Bronfenbrenner’s definition is that he emphasizes both the physical setting and the relationships between the individuals in that setting. For example, it is not social deprivation per se that limits language development but the interaction between adults and children and the resources, such as books in the home (McKean et al., 2015). There is also clear evidence that the ways in which adults talk with children can be effective in scaffolding their language learning such as recasting children’s utterances (Cleave, Becker, Curran, Van Horne, & Fey, 2015). In educational settings, this is often referred to as a language-rich curriculum (Justice, 2004).

The social relations in a microsystem can also determine the success or failure of the activities that occur in that setting. For example, empathetic skills scaffold positive peer interactions of children. Children with less empathetic skills have fewer positive social relationships and, as a result, show less growth in their friendships as they get older. Despite the fact that children with language problems report more negative friendship features, their different communication problems do not seem to be the primary driver of these difficulties (van Den Bedem et al., 2018,): empathetic skills are more important.

Bronfenbrenner uses the term *mesosystem* to describe situations in which behavior is a function of events that occur in more than one environment. Of particular importance for children with language difficulties will be the relations between different professional groups supporting the children and their families. If microsystems fail to complement each other, then unnecessary barriers to progress are likely to occur (Lindsay & Dockrell, 2004). Speech and language therapy, education, and medical professionals all approach language, speech, and communication impairments from different viewpoints (Dockrell, Howell, Leung, & Fugard, 2017). Of particular importance for children with language difficulties are educational/school psychologists and SLTs/pathologists. However, differences in approach, including the use of assessments for diagnostic purposes and the preference for inclusive as opposed to specialist provision, can lead to significant barriers in meeting children’s needs (Vivash, 2015). The central principle here is that the stronger the links between settings, the more powerful the resulting influence on the child’s development (Lindsay, Ricketts, Peacey, Dockrell, & Charman, 2016).

The *exosystem* is concerned with social settings that do not necessarily contain children but may nevertheless indirectly affect them, such as the relation between the workplace of the child’s parents or local community services and the home. For the parent, this includes the relation between the school and the local neighborhood peer group – for example, a parent or parent–teacher association. Bronfenbrenner emphasizes the importance of exosystem support for a child’s development. For example, flexible work schedules, paid maternity and paternity leave, and sick leave for parents whose children are ill are ways in which exosystem factors can affect a child. With specific reference to parents of children with developmental difficulties, access

to advisory services for themselves can impact on their mental health and well-being, which influences their children (Neece, 2014)

The last level of Bronfenbrenner's model is the *macrosystem*. It is not a specific environmental context but refers to the ideology and values of a culture, which affect decisions made at other levels of the model (Lindsay & Thompson, 1997). One example to which we wish to draw specific attention here concerns the values that affect decisions about the educational provision for children with language difficulties and the relative invisibility of language difficulties/disorders within the broader field of language difficulties.

Finally, the *chronosystem* is concerned with changes over time. Importantly, this refers not only to changes in single dimensions, but to the changes in the interactions between the different factors in the four preceding levels. Together, these interact with chronological time to produce *compensatory* interaction, whereby interactions may vary from one factor to another, and relative to time, which reflects the child's aging. As we have shown throughout this chapter, changes over time are significant in terms of language competencies, but also in terms of academic achievement and social skills for children and young people.

More recently, Bronfenbrenner's ecosystemic theory has been referred to as the "bioecological theory of human development," which emphasizes proximal processes. It further considers a framework of four concepts necessary to explore the interrelations among the systems, which comprise process, person, context, and time, and are referred to as the PPCT model. The role of proximal processes is central to the PPCT model, recognizing that the extent to which processes influence development is dependent on the person, the environmental context in which the processes occur, and the specific time periods in which the processes arise (Bronfenbrenner, 2005). In particular, it is recognized that the individual characteristics of a person, categorized by Bronfenbrenner as "demand", "resource," and "force" characteristics, can influence social interactions, and thus it is important to recognize that no two individuals are the same, even though the contexts in which they interact may be similar.

Bronfenbrenner's ecosystemic theory provides a strong framework for understanding the different factors that impact on development, identification, and interventions and, hence, provides a powerful model for both research and practice (Kelly, Woolfson, & Boyle, 2016). The model, while including child factors, highlights the roles played by parents, schools, practitioners, and the wider social and political practice over time. The framework leads us to present a model of identification based on the child's current needs, intervention framed within universal, targeted, and specialist provision, and an understanding of proximal and distal drivers of development.

For children with language difficulties, this would include the overall system for SEN. This can be conceptualized as including, at the top, international policies and guidance on valuing and meeting the needs of children and young people with SEN; the legislative framework, the laws and guidance, at national government level; and regional (state, local authority) interpretations and enactment of those policies. For children with language difficulties, particular aspects will include their relative recognition and being valued within the overall SEN system, which is itself embedded in a higher-level sociopolitical system.

For example, the UK government commissioned the Bercow Review of provision for children and young people with SLCN because it was persuaded that the provision

available for these children and young people was insufficient or inappropriate, and that it was important to analyze the nature of this unacceptable provision and plan positive action for improvement (Bercow, 2008). A key factor in the success of the Bercow Review was the strength of the political commitment from national government, exemplified by the Secretary of State for Children, Schools and Families at the time, Ed Balls, accepting *all* recommendations of the Bercow Review – a rare, if not unprecedented, outcome. As a result, a national action plan was created and funded (Department for Children, Schools and Families, 2009), including provision for further research, which funded the Better Communication Research Programme (Dockrell et al., 2014; Lindsay, Dockrell, Law, & Roulstone, 2012).

Intervention

Approaches to intervention for children with language difficulties have increasingly moved away from a diagnosis-based model. This has been driven in part by the research that has clearly revealed the limitations of this model (Reilly et al., 2014). Rather than plan interventions by diagnostic category, given the heterogeneity of children with language difficulties, there has been an increasing development of a needs-based strategy for assessment. This approach is informed by profiling needs given individuals' developmental changes. This differs from diagnosis-led intervention strategies as there is recognition that needs may be shared by children and young people with different diagnostic classifications. For example, as part of a prospective study of children categorized as having either language impairment or autism spectrum disorder, there were substantial overlaps between the groups on both language and social relationship measures (Dockrell et al., 2012).

This model takes into account needs relevant to all children, needs of groups of children with similar difficulties, and individual needs of every child (Norwich, 2009). Consequently, there are similarities, and also differences, between children within diagnostic categories of language difficulties and also overlaps between diagnostic groups of children with language difficulties. There are also overlapping needs between categories of language difficulties and, for example, autism spectrum disorder (Dockrell et al., 2019).

In addition, interventions can usefully be conceptualized as three types (Ebbels et al., 2019; Law et al., 2017; Lindsay et al., 2012). First, universal provision of high-quality language and communication support addresses the needs of all children. Examples include high-quality preschool education, which is appropriate to the needs of all children who attend. In areas of social disadvantage, the “universal” level will differ from that provided in affluent areas. Second, targeted provision will be made for children and young people whose needs are not being met fully by universal provision. This provision includes adaptations to the curriculum and to pedagogy. It includes programs that address specific aspects of language or communication, preferably those with an acceptable evidence base for their effectiveness (Law et al., 2012; Law, Roulstone, & Lindsay, 2015). Third, for a small minority of children, additional specialist provision is necessary. Here, there may also be more extensive and focused teaching, more highly structured learning, and learning with very high levels of distributed practice and consolidation (see also Ebbels et al., 2019).

However, note that these three types of intervention are not simply *levels* where a child moves from one to another. Rather, the model symbolizes this approach as onion-like, a sphere of concentric layers. That is, all children require universal support; targeted support is an addition to the universal support; and specialist support is an addition to both targeted and universal support (in the centre of the onion).

This latter model has clear similarities to the response to intervention (RTI) model, which has become increasingly popular in the US, UK, and other countries. However, the RTI model's strengths are also offset to some extent by a continuing, underlying purpose to address diagnostic criteria (Cavendish, 2013). This, in turn, reflects the need for determination of resource allocation, which may be governed by law and which is often operationalized by diagnostic criteria. In that sense, the RTI approach is used to provide further evidence on diagnosis for access to provision. Although an improvement on the earlier criteria – for example, the use of IQ – there remain a number of concerns (Reynolds & Shaywitz, 2009). Furthermore, the focus of use of RTI has been on learning disabilities, whereas the argument we present is more generally applicable, although here we focus on children and young people with language difficulties. Cavendish (2013) argues that, despite its strengths, RTI has not been shown to be a valid diagnostic paradigm, but we would argue that that is not the point: It is the seeking of an improved paradigm for diagnosis, which is inappropriate, and should be replaced by a focus on needs.

Mutable Proximal and Distal Factors

This chapter has conceptualized language difficulties as a complex problem related to multiple risks related to the child and the wider social context. As we have argued, this has a significant implication for conceptualizing and assessing needs. It also has important messages for considering levers of change – that is, mutable factors – and, as such, driving the research agenda. These factors either may be proximal to the child or further removed (distal). When we consider mutable proximal factors, we are highlighting the ways in which adults talk with children and the type of language support that is provided – for example, recasting children's utterances (Cleave et al., 2015) or conversational responsivity (Piasta et al., 2012). Mutable proximal factors also include altering patterns of shared book reading, TV viewing, and the numbers of books in the child's home. A number of interventions have provided some success in addressing precisely these factors (Law et al., 2012), although it is important to understand what does not work and why (Pentimonti et al., 2017; Piasta et al., 2017), as well as what works, and why it works (Pentimonti et al., 2017).

There are also mutable distal factors, which are more likely to be affected by policy changes. These include improvements in family literacy, reduction in neighborhood disadvantage, and improvements in family income.

Limitations of the Bronfenbrenner Model

Bronfenbrenner's model is a widely accepted and commonly used model in current and recent research in child development. Because of this wide adoption, Darling (2007) warned that researchers can sometimes be guilty of oversimplification or misusing the model, and, although this is not a criticism of the model itself, it highlights

how the fidelity of the approach can be compromised. Tudge and colleagues echoed this sentiment and suggested that some researchers may only assess on certain aspects of the model and do not make explicit the systems they are omitting (Tudge, Mokrova, Hatfield, & Karnik, 2009). A further criticism of the model is how it gives little emphasis to the biological or cognitive influences of development (Dixon & Lerner, 1988), and Christensen (2010) argued that the model pays little attention to an individual's strengths and how factors such as resiliency may overcome a negative environment. Indeed, such criticisms were recognized by Bronfenbrenner, who acknowledged that much of his earlier work had focused more on the context of the environment than on the individual (Bronfenbrenner, 2005).

Implications for Educational Psychology

Throughout the chapter, we have explicitly mentioned factors that are part of the wider remit of educational psychology, including social context, learning, socio-emotional development, and developmental trajectories, which have typically not been the focus of studies on children with language difficulties/disorders. Addressing children's SLCN requires the engagement of both education and health professionals, and research studies have argued for the benefit of collaborative work between professionals (e.g. Law et al., 2000). Yet there is consistent evidence that understanding and meeting the needs of children with SLCN challenges professionals and models of service delivery (Dockrell et al., 2014; Glover, McCormack, & Smith-Tamaray, 2015). The lack of consensus on the criteria that should be used to identify and classify the children's problems and the variety of terms used to describe those problems raise particular challenges (Bishop, 2014; Reilly et al., 2014), which influence collaboration, appropriately targeted interventions, and the research agenda.

To develop effective and efficient support for children with language learning needs, practitioners need to go beyond a diagnostic model. To capture the interactions between the child and their current context and between practitioners from different professional backgrounds, there is a need to be aware of "red flags" for language difficulties evident in the language system itself and more widely in the child's socio-educational context. The chapter concludes by identifying three areas in need of further research: the identification of language learning difficulties in mainstream classrooms, the ways in which response to intervention could inform current practice, and effective models of school provision for children with language learning needs.

Implications for Researchers and Future Research

To understand and address the needs of children and young people with language learning difficulties, a multidimensional, multidisciplinary approach is needed. Language difficulties influence a wide range of developmental tasks, and often these difficulties are masked by more obvious problems with literacy and behavior. These impacts can be minimized or exacerbated by the contexts in which children are developing. Understanding what lies behind the children's impaired language skills is key, so that developmental pathways that lead to poorer than expected progress can be identified. To do this requires cognizance of the significant individual differences and variability in outcomes for the children. If we want to articulate the role oral language

plays in learning and development, studies need to consider within-child variables, contextual variables, and time. Educational psychology can begin to address these factors by considering what makes an effective language learning environment, how this changes over time, why children fail to respond to effective language learning environments, and what skills are needed by professionals to scaffold learning.

CONCLUSION

Language difficulties occur frequently. These difficulties impact on children's learning, attainment, and life chances. The field of educational psychology has been relatively silent in addressing these children's needs, both in terms of practice and research, and creating effective language learning environments. Support for children's language learning needs can be embedded across the curriculum, targeting structural language for key skills such as literacy and numeracy, but also supporting reasoning in different curricular areas (Nippold, 2018). This is a challenge for which EPs, both academic researchers and applied professional practitioners, are particularly well qualified.

REFERENCES

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.
- Bakopoulou, I., & Dockrell, J. E. (2016). The role of social cognition and prosocial behaviour in relation to the socio-emotional functioning of primary aged children with specific language impairment. *Research in Developmental Disabilities*, 49–50(354–370). doi:10.1016/j.ridd.2015.12.013
- Beitchman, J. H., Jiang, H., Koyama, E., Johnson, C. J., Escobar, M., Atkinson, L., ... Vida, R. (2008). Models and determinants of vocabulary growth from kindergarten to adulthood. *Journal of Child Psychology and Psychiatry*, 49(6), 626–634. doi:10.1111/j.1469-7610.2008.01878.x
- Bercow, J. (2008). *The Bercow Report: A review of services for children and young people with speech, language and communication needs*. Nottingham, UK: DCSF Publications.
- Bishop, D. V. M. (1992). The underlying nature of specific language impairment. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 33(1), 3–66. doi:10.1111/j.1469-7610.1992.tb00858.x
- Bishop, D. V. M. (2004). Specific language impairment: Diagnostic dilemmas. In L. Verhoeven & H. van Balkom (Eds.), *Classification of developmental language disorders: Theoretical issues and clinical implications* (pp. 309–326). Mahwah, NJ: Lawrence Erlbaum.
- Bishop, D. V. M. (2010). Which neurodevelopmental disorders get researched and why?. *PLoS One*, 5(11). doi:10.1371/journal.pone.0015112
- Bishop, D. V. M. (2014). Ten questions about terminology for children with unexplained language problems. *International Journal of Language & Communication Disorders*, 49(4), 381–415. doi:10.1111/1460-6984.12101
- Bishop, D. V. M., & McDonald, D. (2009). Identifying language impairment in children: Combining language test scores with parental report. *International Journal of Language & Communication Disorders*, 44(5), 600–615. doi:10.1080/13682820802259662
- Bishop, D. V. M., Snowling, M. J., Thompson, P. A., Greenhalgh, T., & Consortium, C. (2016). CATALISE: A multinational and multidisciplinary Delphi consensus study. Identifying language impairments in children. *PLoS One*, 11(7). doi:10.1371/journal.pone.0158753
- Bishop, D. V. M., Snowling, M. J., Thompson, P. A., Greenhalgh, T., & Consortium, C. (2017). Phase 2 of CATALISE: A multinational and multidisciplinary Delphi consensus study of problems with language development: terminology. *Journal of Child Psychology and Psychiatry*, 58(10), 1068–1080. doi:10.1111/jcp.12721
- Bornstein, M. H., Hahn, C. S., & Putnick, D. L. (2016). Stability of core language skill across the first decade of life in children at biological and social risk. *Journal of Child Psychology and Psychiatry*, 57(12), 1434–1443. doi:10.1111/jcp.12632

- Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press.
- Bronfenbrenner, U. (2005). *Making human beings human: Bioecological perspectives on human development*. Thousand Oaks, CA: Sage.
- Bronfenbrenner, U. (1988). Interacting systems in human development: Research paradigms, present and future. In N. Bolger, A. Caspi, G. Downey, & M. Moorehouse (Eds.), *Persons in context: Developmental processes* (pp. 25–49). New York: Cambridge University Press.
- Cain, K., Oakhill, J., & Bryant, P. (2004). Children's reading comprehension ability: Concurrent prediction by working memory, verbal ability, and component skills. *Journal of Educational Psychology*, 96(1), 31–42. doi:10.1037/0022-0663.96.1.31
- Carroll, C., & Dockrell, J. E. (2012). Enablers and challenges of post-16 education and employment outcomes: The perspectives of young adults with a history of SLI. *International Journal of Language & Communication Disorders*, 47(5), 567–577. doi:10.1111/j.1460-6984.2012.00166.x
- Cavendish, W. (2013). Identification of learning disabilities: Implications of proposed DSM-5 criteria for school-based assessment. *Journal of Learning Disabilities*, 46(1), 52–57.
- Cho, E., Compton, D. L., Fuchs, D., Fuchs, L. S., & Bouton, B. (2014). Examining the predictive validity of a dynamic assessment of decoding to forecast response to tier 2 intervention. *Journal of Learning Disabilities*, 47(5), 409–423. doi:10.1177/0022219412466703
- Chow, J. C., Ekholm, E., & Coleman, H. (2018). Does oral language underpin the development of later behavior problems? A longitudinal meta-analysis. *School Psychology Quarterly*, 33(3), 337–349. doi:10.1037/spq0000255
- Chow, J. C., & Wehby, J. H. (2019). Profiles of problem behavior in children with varying language ability. *Journal of Emotional and Behavioral Disorders*, 27(2), 110–118. doi:10.1177/1063426617733714
- Christensen, D. L., Braun, K. V., Baio, J., Bilder, J., Charles, J., Constantino, J. N., ... Yeargin-Allsopp, M. (2016). Prevalence and characteristics of autism spectrum disorder among children aged 8 years — Autism and developmental disabilities monitoring network, 11 Sites, United States, 2012. *MMWR Surveillance Summaries*, 65(13), 1–23.
- Christensen, J. (2010). Proposed enhancement of Bronfenbrenner's development ecology model. *Education Inquiry*, 1(2), 117–126.
- Cleave, P. L., Becker, S. D., Curran, M. K., Van Horne, A. J. O., & Fey, M. E. (2015). The efficacy of recasts in language intervention: A systematic review and meta-analysis. *American Journal of Speech-Language Pathology*, 24(2), 237–255. doi:10.1044/2015_ajslp-14-0105
- Conti-Ramsden, G., Botting, N., & Faragher, B. (2001). Psycholinguistic markers for specific language impairment (SLI). *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 42(6), 741–748.
- Conti-Ramsden, G., & Durkin, K. (2012). Postschool educational and employment experiences of young people with specific language impairment. *Language Speech and Hearing Services in Schools*, 43(4), 507–520. doi:10.1044/0161-1461(2012/11-0067)
- Conti-Ramsden, G., Durkin, K., Toseeb, U., Botting, N., & Pickles, A. (2018). Education and employment outcomes of young adults with a history of developmental language disorder. *International Journal of Language & Communication Disorders*, 53(2), 237–255. doi:10.1111/1460-6984.12338
- Cowan, R., Donlan, C., Newton, E. J., & Lloyd, D. (2005). Number skills and knowledge in children with specific language impairment. *Journal of Educational Psychology*, 97(4), 732–744. doi:10.1037/0022-0663.97.4.732
- Cowan, R., & Powell, D. (2014). The contributions of domain-general and numerical factors to third-grade arithmetic skills and mathematical learning disability. *Journal of Educational Psychology*, 106(1), 214–229. doi:10.1037/a0034097
- Dale, P. S., McMillan, A. J., Hayiou-Thomas, M. E., & Plomin, R. (2014). Illusory recovery: Are recovered children with early language delay at continuing elevated risk? *American Journal of Speech-Language Pathology/American Speech-Language-Hearing Association*, 23(3), 437–447. doi:http://doi.org/10.1044/2014_AJSLP-13-0116
- Darling, N. (2007). Ecological systems theory: The person in the center of the circles. *Research in Human Development*, 4(3-4), 203–217.
- Department for Children, Schools and Families. (2009). *Better communication: An action plan to improve services for children and young people with speech, language and communication*. DCSF-01062-2008. Nottingham, UK: webarchive.nationalarchives.gov.uk/20130320200453/www.education.gov.uk/publications/eOrderingDownload/Better_Communication.pdf.

- Department for Education and Department for Health (2015). *Special educational needs and disability code of practice: 0 to 25 years*. London: DfE.
- Desforges, M. F., & Lindsay, G. (Eds.) (2018). *A retrospective case study in the development of a professional educational psychology service: The Sheffield Psychological Service 1937-2000*. *Educational and Child Psychology Special Issue: March 2018*. Leicester, UK: British Psychological Society. (85pp). ISBN: 978-1-85433-757-3, ISSN: 0267-1611.
- Dixon, R. A., & Lerner, R. M. (1988). A history of systems in developmental psychology. In M. H. Bornstein & M. E. Lamb (Eds.), *Developmental psychology: An advanced textbook* (pp. 3–50). Hillsdale, NJ, US: Lawrence Erlbaum.
- Dockrell, J. E., Howell, P., Leung, D., & Fugard, A. J. B. (2017). Children with speech language and communication needs in England: challenges for practice. *Front. Educ.*, 2, 35. doi:10.3389/educ.2017.00035
- Dockrell, J. E., & Hurry, J. (2018). The identification of speech and language problems in elementary school: Diagnosis and co-occurring needs. *Research in Developmental Disabilities*, 81, 52–64. doi:10.1016/j.ridd.2018.04.009
- Dockrell, J. E., Lindsay, G., & Connelly, V. (2009). The impact of specific language impairment on adolescents' written text. *Exceptional Children*, 75(4), 427–446.
- Dockrell, J. E., Lindsay, G., Roulstone, S., & Law, J. (2014). Supporting children with speech, language and communication needs: An overview of the results of the better communication research programme. *International Journal of Language & Communication Disorders*, 49(5), 543–557. doi:10.1111/1460-6984.12089
- Dockrell, J. E., Ricketts, J., Charman, T., & Lindsay, G. (2014). Exploring writing products in students with language impairments and autism spectrum disorders. *Learning and Instruction*, 32, 81–90. doi:10.1016/j.learninstruc.2014.01.008
- Dockrell, J. E., Ricketts, J., Palikara, O., Charman, T., & Lindsay, G. (2012). *Profiles of need and provision for children with language impairment and autism spectrum disorders in mainstream schools: A prospective study* (p. 182). London: DfE. www.education.gov.uk/publications/standard/publicationDetail/Page1/DFE-RR247-BCRP9
- Dockrell, J. E., Ricketts, J., Palikara, O., Charman, T., & Lindsay, G. A. (2019). What drives educational support for children with developmental language disorder or autism spectrum disorder: needs, or diagnostic category?. *Front. Educ.*, 4, 29. doi:10.3389/educ.2019.00029
- Dollaghan, C. A. (2011). Taxometric analyses of specific language impairment in 6-year-old children. *Journal of Speech Language and Hearing Research*, 54(5), 1361–1371. doi:10.1044/1092-4388(2011/10-0187)
- Donlan, C., Cowan, R., Newton, E. J., & Lloyd, D. (2007). The role of language in mathematical development: Evidence from children with specific language impairments. *Cognition*, 103(1), 23–33. doi:10.1016/j.cognition.2006.02.007
- DuPaul, G. J., Gormley, M. J., & Laracy, S. D. (2013). Comorbidity of LD and ADHD: Implications of DSM-5 for assessment and treatment. *Journal of Learning Disabilities*, 46(1), 43–51. doi:10.1177/0022219412464351
- Durkin, K., Simkin, Z., Knox, E., & Conti-Ramsden, G. (2009). Specific language impairment and school outcomes. II: Educational context, student satisfaction, and post-compulsory progress. *International Journal of Language & Communication Disorders*, 44(1), 36–55. doi:10.1080/13682820801921510
- Ebbels, S. H., McCartney, E., Slonims, V., Dockrell, J. E., & Norbury, C. F. (2019). Evidence-based pathways to intervention for children with language disorders. *International Journal of Language & Communication Disorders*, 54(1), 3–19. doi:10.1111/1460-6984.12387
- Education Endowment Foundation. (2019). *Oral language interventions*. <https://educationendowmentfoundation.org.uk/evidence-summaries/teaching-learning-toolkit/oral-language-interventions/> (accessed July 22, 2019).
- Flapper, B. C. T., & Schoemaker, M. M. (2013). Developmental coordination disorder in children with specific language impairment: Co-morbidity and impact on quality of life. *Research in Developmental Disabilities*, 34(2), 756–763. doi:10.1016/j.ridd.2012.10.014
- Fraser, J., Goswami, U., & Conti-Ramsden, G. (2010). Dyslexia and specific language impairment: The role of phonology and auditory processing. *Scientific Studies of Reading*, 14(1), 8–29. doi:10.1080/10888430903242068
- Glover, A., McCormack, J., & Smith-Tamaray, M. (2015). Collaboration between teachers and speech and language therapists: Services for primary school children with speech, language and communication needs. *Child Language Teaching & Therapy*, 31(3), 363–382. doi:10.1177/0265659015603779
- Hasson, N., Dodd, B., & Botting, N. (2012). Dynamic assessment of sentence structure (DASS): Design and evaluation of a novel procedure for the assessment of syntax in children with language impairments. *International Journal of Language & Communication Disorders*, 47(3), 285–299. doi:10.1111/j.1460-6984.2011.00108.x

- Hindley, C. B., & Owen, C. F. (1978). The extent of individual changes in I.Q. for ages between 6 months and 17 years, in a British longitudinal sample. *Journal of Child Psychology and Psychiatry*, 19(4), 329–2350. doi:10.1111/j.1469-7610.1978.tb00480.x
- Hopkins, T., Clegg, J., & Stackhouse, J. (2018). Examining the association between language, expository discourse and offending behaviour: An investigation of direction, strength and independence. *International Journal of Language & Communication Disorders*, 53(1), 113–129. doi:10.1111/1460-6984.12330
- Joye, N., Broc, L., Olive, T., & Dockrell, J. (2019). Spelling performance in children with developmental language disorder: A meta-analysis across European Languages. *Scientific Studies of Reading*, 23(2), 129–160. doi:10.1080/10888438.2018.1491584
- Justice, L. (2004). Creating language-rich preschool classroom environments. *Teaching Exceptional Children*, 37(2), 36–44.
- Justice, L., Cain, K., Jiang, H., Logan, J., Jia, R., Jiang, H., ... & Jia, R. (2018). Modeling the nature of grammar and vocabulary trajectories from prekindergarten to Third Grade. *Journal of Speech, Language, and Hearing Research*, 61(4), 910–923.
- Kamhi, A. G. (2014). Improving clinical practices for children with language and learning disorders. *Language Speech and Hearing Services in Schools*, 45(2), 92–103. doi:10.1044/2014_lshss-13-0063
- Kaplan, B. J., Dewey, D. M., Crawford, S. G., & Wilson, B. N. (2001). The term comorbidity is of questionable value in reference to developmental disorders: Data and theory. *Journal of Learning Disabilities*, 34(6), 555–565. doi:10.1177/002221940103400608
- Kelly, B., Woolfson, L., & Boyle, J. (2016). *Frameworks for practice in educational psychology: A textbook for trainees and practitioners*. London, UK: Jessica Kingsley.
- Ketelaars, M. P., Jansonius, K., Cuperus, J., & Verhoeven, L. (2016). Narrative competence in children with pragmatic language impairment: A longitudinal study. *International Journal of Language & Communication Disorders*, 51(2), 162–173. doi:10.1111/1460-6984.12195
- King, T. M., Rosenberg, L. A., Fuddy, L., McFarlane, E., Sia, C., & Duggan, A. K. (2005). Prevalence and early identification of language delays among at-risk three year olds. *Journal of Developmental and Behavioral Pediatrics*, 26(4), 293–303. doi:10.1097/00004703-200508000-00006
- Kjelgaard, M. M., & Tager-Flusberg, H. (2001). An investigation of language impairment in autism: Implications for genetic subgroups. *Language and Cognitive Processes*, 16(2-3), 287–308.
- Klem, M., Hagtvet, B., Hulme, C., & Gustafsson, J. E. (2016). Screening for language delay: Growth trajectories of language ability in low- and high-performing children. *Journal of Speech Language and Hearing Research*, 59(5), 1035–1045. doi:10.1044/2016_jslhr-l-15-0289
- Krok, W. C., & Leonard, L. B. (2015). Past tense production in children with and without specific language impairment across Germanic Languages: A meta-analysis. *Journal of Speech Language and Hearing Research*, 58(4), 1326–1340. doi:10.1044/2015_jslhr-l-14-0348
- Lammertink, I., Boersma, P., Wijnen, F., & Rispens, J. (2017). Statistical learning in specific language impairment: A meta-analysis. *Journal of Speech Language and Hearing Research*, 60(12), 3474–3486. doi:10.1044/2017_jslhr-l-16-0439
- Lancaster, H. S., & Camarata, S. (2019). Reconceptualizing developmental language disorder as a spectrum disorder: Issues and evidence. *International Journal of Language & Communication Disorders*, 54(1), 79–94. doi:10.1111/1460-6984.12433
- Law, J. (2019). The changing perception of communication needs – A litmus test for the Warnock legacy. *Frontiers in Education*, 4, 42. doi:10.3389/educ.2019.00042
- Law, J., Beecham, J., & Lindsay, G. (2012). *Effectiveness, costing and cost effectiveness of interventions for children and young people with speech, language and communication needs* (p. 51). London: DfE.
- Law, J., Boyle, J., Harris, F., Harkness, A., & Nye, C. (2000). Prevalence and natural history of primary speech and language delay: Findings from a systematic review of the literature. *International Journal of Language & Communication Disorders*, 35(2), 165–188. doi:10.1080/136828200247133
- Law, J., Charlton, J., & Asmussen, K. (2017). *Language as a wellbeing indicator*. London: Early Intervention Foundation. www.eif.org.uk/wp-content/uploads/2017/09/language-child-wellbeing-indicator_Sep2017.pdf
- Law, J., Charlton, J., Gascoigne, M., Dockrell, J. E., McKean, C., & Theakston, A. (2017). *Early language development: Needs, provision, and intervention for preschool children from socio-economically disadvantage backgrounds*. Retrieved from London, UK: https://educationendowmentfoundation.org.uk/public/files/Law_et_al_Early_Language_Development_final.pdf

- Law, J., Lee, W., Roulstone, S., Wren, Y., Zeng, B., & Lindsay, G. (2012). "What works": Interventions for children and young people with speech, language and communication needs. London: DfE. www.education.gov.uk/publications/standard/publicationDetail/Page1/DFE-RR247-BCRP10
- Law, J., McBean, K., & Rush, R. (2011). Communication skills in a population of primary school-aged children raised in an area of pronounced social disadvantage. *International Journal of Language & Communication Disorders*, 46(6), 657–664. doi:10.1111/j.1460-6984.2011.00036.x
- Law, J., Roulstone, S., & Lindsay, G. (2015). Integrating external evidence of intervention effectiveness with both practice and parent perspective: Development of "what works" for speech, language and communication needs (SLCN). *Developmental Medicine and Child Neurology*, 57(223–228). doi:10.1111/dmcn.12630
- Law, J., Rush, R., Anandan, C., Cox, M., & Wood, R. (2012). Predicting language change between 3 and 5 years and its implications for early identification. *Pediatrics*, 130(1), 132–137.
- Law, J., Tomblin, J. B., & Zhang, X. Y. (2008). Characterizing the growth trajectories of language-impaired children between 7 and 11 years of age. *Journal of Speech Language and Hearing Research*, 51(3), 739–749. doi:10.1044/1092-4388(2008/052)
- Leonard, L. B. (2009). Is expressive language disorder an accurate diagnostic category? *American Journal of Speech-Language Pathology*, 18(2), 115–123. doi:10.1044/1058-0360(2008/08-0064)
- Lewis, B. A., & Freebairn, L. (1992). Residual effects of preschool phonology disorders in grade school, adolescence, and adulthood. *Journal of Speech and Hearing Research*, 35(4), 819–831.
- Lindsay, G. (2011). The collection and analysis of data on children with speech, language and communication needs: The challenge to education and health services. *Child Language Teaching and Therapy*, 27(2), 135–150. doi:10.1177/0265659010396608
- Lindsay, G., & Dockrell, J. E. (2004). Whose job is it? Parents' concerns about the needs of their children with language problems. *Journal of Special Education*, 37(4), 225–235.
- Lindsay, G., & Dockrell, J. E. (2012a). *The relationship between speech, language and communication needs (SLCN) and behavioural, emotional and social difficulties (BESD)* (p. 44). London: DfE. www.education.gov.uk/publications/standard/publicationDetail/Page1/DFE-RR247-BCRP6
- Lindsay, G., & Dockrell, J. E. (2012b). Longitudinal patterns of behavioral, emotional and social difficulties and self-concept in adolescents with a history of specific language impairment. *Language, Speech, and Hearing Services in Schools*, 43(4), 445–460. doi:10.1044/0161-1461(2012/11-0069)
- Lindsay, G., Dockrell, J. E., Law, J., & Roulstone, S. (2012). *Better communication research programme: Improving provision for children and young people with speech, language and communication needs* (p. 38). London: DfE. www.education.gov.uk/publications/standard/publicationDetail/Page1/DFE-RR247-BCRP1
- Lindsay, G., Dockrell, J. E., & Palikara, O. (2010). Self-esteem of adolescents with specific language impairment as they move from compulsory education. *International Journal of Language and Communication Disorders*, 45, 561–571. doi:10.3109/13682820903324910
- Lindsay, G., & Lewis, A. (2003). An evaluation of the use of accredited baseline assessment schemes in England. *British Educational Research Journal*, 29(2), 149–167.
- Lindsay, G., Ricketts, J., Peacey, L. V., Dockrell, J. E., & Charman, T. (2016). Meeting the educational and social needs of children with language impairment or autism spectrum disorder: The parents' perspectives. *International Journal of Language & Communication Disorders*, 51(5), 495–507. doi:10.1111/1460-6984.12226
- Lindsay, G., & Strand, S. (2016). Children with language impairment: Prevalence, associations and ethnic disproportionality in an English population. *Frontiers in Education*, 1.2. doi:10.3389/feduc.2016.00002
- Lindsay, G., & Thompson, D. (eds). (1997). *Values into practice in special education*. London: David Fulton.
- Lindsay, G., & Wedell, K. (1982). The early identification of educationally "at risk" children: Revisited. *Journal of Learning Disabilities*, 15, 212–217.
- Lonigan, C. J., & Milburn, T. F. (2017). Identifying the dimensionality of oral language skills of children with typical development in preschool through fifth grade. *Journal of Speech Language and Hearing Research*, 60(8), 2185–2198. doi:10.1044/2017_jslhr-1-15-0402
- Lukács, Á., & Kemény, F. (2014). Domain-general sequence learning deficit in specific language impairment. *Neuropsychology*, 28(3), 472–483. doi:10.1037/neu0000052
- Marshall, C. R., Harcourt-Brown, S., Ramus, F., & van der Lely, H. K. J. (2009). The link between prosody and language skills in children with specific language impairment (SLI) and/or dyslexia. *International Journal of Language & Communication Disorders*, 44(4), 466–488. doi:10.1080/13682820802591643

- Mashburn, A. J., & Myers, S. S. (2010). Advancing research on children with speech-language impairment: An introduction to the early childhood longitudinal study-kindergarten cohort. *Language Speech and Hearing Services in Schools, 41*(1), 61–69. doi:10.1044/0161-1461(2009/08-0037)
- McKean, C., Mensah, F. K., Eadie, P., Bavin, E. L., Bretherton, L., Cini, E., & Reilly, S. (2015). Levers for language growth: Characteristics and predictors of language trajectories between 4 and 7 years. *PLoS One, 10*, 8. doi:10.1371/journal.pone.0134251
- McKean, C., Wraith, D., Eadie, P., Cook, F., Mensah, F., & Reilly, S. (2017). Subgroups in language trajectories from 4 to 11 years: The nature and predictors of stable, improving and decreasing language trajectory groups. *Journal of Child Psychology and Psychiatry, 58*(10), 1081–1091. doi:10.1111/jcp.12790
- McLeod, S., & McKinnon, D. H. (2007). Prevalence of communication disorders compared with other learning needs in 14500 primary and secondary school students. *International Journal of Language & Communication Disorders, 42*, 37–59. doi:10.1080/136828206001173262
- Mercer, N. (2010). The analysis of classroom talk: Methods and methodologies. *British Journal of Educational Psychology, 80*(1), 1–14. doi:10.1348/000709909x479853
- Meschi, E., Micklewright, J., Vignoles, A., & Lindsay, G. (2012). *The transition between categories of special educational needs of pupils with speech, language and communication needs (SLCN) and autism spectrum disorder (ASD) as they progress through the education system* (p. 74). London: DfE. www.education.gov.uk/publications/standard/publicationDetail/Page1/DFE-RR247-BCRP11
- Morgan, P. L., Farkas, G., Hillemeier, M. M., Mattison, R., Maczuga, S., Li, H., & Cook, M. (2015). Minorities are disproportionately underrepresented in special education: Longitudinal evidence across five disability conditions. *Educational Researcher, 44*(5), 278–292.
- Nash, M., & Donaldson, M. L. (2005). Word learning in children with vocabulary deficits. *Journal of Speech Language and Hearing Research, 48*(2), 439–458. doi:10.1044/1092-4388(2005/030)
- Nation, K., Clarke, P., Marshall, C. M., & Durand, M. (2004). Hidden language impairments in children: Parallels between poor reading comprehension and specific language impairment? *Journal of Speech Language and Hearing Research, 47*(1), 199–211.
- Nation, K., Cocksey, J., Taylor, J. S. H., & Bishop, D. V. M. (2010). A longitudinal investigation of early reading and language skills in children with poor reading comprehension. *Journal of Child Psychology and Psychiatry, 51*(9), 1031–1039. doi:10.1111/j.1469-7610.2010.02254.x
- Neece, C. L. (2014). Mindfulness-based stress reduction for parents of young children with developmental delays: Implications for parental mental health and child behavior problems. *Journal of Applied Research in Intellectual Disabilities, 27*(2), 174–186.
- Nippold, M. A. (2018). The literate lexicon in adolescents: Monitoring the use and understanding of morphologically complex words. *Perspectives of the ASHA Special Interest Groups, 3*(Part 4), SIG 1, 211–221.
- Norbury, C. F., Gooch, D., Baird, G., Charman, T., Simonoff, E., & Pickles, A. (2016). Younger children experience lower levels of language competence and academic progress in the first year of school: Evidence from a population study. *Journal of Child Psychology and Psychiatry, 57*(1), 65–73. doi:10.1111/jcp.12431
- Norwich, B. (2009). Dilemmas of difference and the identification of special educational needs/disability: International perspectives. *British Educational Research Journal, 35*(3), 447–467. doi:10.1080/0141192080204444
- Pauls, L. J., & Archibald, L. M. D. (2016). Executive functions in children with specific language impairment: A meta-analysis. *Journal of Speech Language and Hearing Research, 59*(5), 1074–1086. doi:10.1044/2016_jslhr-l-15-0174
- Pawlowska, M. (2014). Evaluation of three proposed markers for language impairment in English: A meta-analysis of diagnostic accuracy studies. *Journal of Speech Language and Hearing Research, 57*(6), 2261–2273. doi:10.1044/2014_jslhr-l-13-0189
- Pentimonti, J. M., Justice, L. M., Yeomans-Maldonado, G., McGinty, A. S., Slocum, L., & O'Connell, A. (2017). Teachers' use of high- and low-support scaffolding strategies to differentiate language instruction in high-risk/economically disadvantaged settings. *Journal of Early Intervention, 39*(2), 125–146. doi:10.1177/1053815117700865
- Piasta, S. B., Justice, L. M., Cabell, S. Q., Wiggins, A. K., Turnbull, K. P., & Curenton, S. M. (2012). Impact of professional development on preschool teachers' conversational responsivity and children's linguistic productivity and complexity. *Early Childhood Research Quarterly, 27*(3), 387–400. doi:10.1016/j.ecresq.2012.01.001

- Piasta, S. B., Justice, L. M., O'Connell, A. A., Mauck, S. A., Weber-Mayrers, M., Schachter, R. E., ... Spear, C. F. (2017). Effectiveness of large-scale, state-sponsored language and literacy professional development on early childhood educator outcomes. *Journal of Research on Educational Effectiveness*, 10(2), 354–378. doi: 10.1080/19345747.2016.1270378
- Poll, G. H., & Miller, C. A. (2013). Late talking, typical talking, and weak language skills at middle childhood. *Learning and Individual Differences*, 26, 177–184. doi:10.1016/j.lindif.2013.01.008
- Prelock, P. A., Hutchins, T., & Glascoe, F. P. (2008). Speech-language impairment: How to identify the most common and least diagnosed disability of childhood. *The Medscape Journal of Medicine*, 10(6), 136.
- Redmond, S. M. (2016). Language Impairment in the attention-deficit/hyperactivity disorder context. *Journal of Speech Language and Hearing Research*, 59(1), 133–142. doi:10.1044/2015_jslhr-l-15-0038
- Reilly, S., Tomblin, B., Law, J., McKean, C., Mensah, F. K., Morgan, A., ... Wake, M. (2014). Specific language impairment: A convenient label for whom? *International Journal of Language & Communication Disorders*, 49(4), 416–451. doi:10.1111/1460-6984.12102
- Reilly, S., Wake, M., Ukoumunne, O. C., Bavin, E., Prior, M., Cini, E., ... Bretherton, L. (2010). Predicting language outcomes at 4 years of age: Findings from early language in Victoria study. *Pediatrics*, 126(6), E1530–E1537. doi:10.1542/peds.2010-0254
- Rice, M. L. (2012). Toward epigenetic and gene regulation models of specific language impairment: Looking for links among growth, genes, and impairments. *Journal of Neurodevelopmental Disorders*, 4. doi:10.1186/1866-1955-4-27
- Riches, N. (2015). Past tense -ed omissions by children with specific language impairment: The role of sonority and phonotactics. *Clinical Linguistics & Phonetics*, 29(6), 482–497. doi:10.3109/02699206.2015.1027832
- Rudolph, J. M. (2017). Case history risk factors for specific language impairment: A systematic review and meta-analysis. *American Journal of Speech-Language Pathology*, 26(3), 991–1010. doi:10.1044/2016_ajslp-15-0181
- Reynolds, C. R., & Shaywitz, S. E. (2009). Response to intervention: Ready or not? Or, from wait-to-fail to watch-them-fail. *School Psychology Quarterly*, 24(2), 130.
- Saxton, M. (2010). *Child language: Acquisition and development*. London: Sage.
- Schmitt, M. B., Logan, J. A. R., Tambyraja, S. R., Farquharson, K., & Justice, L. M. (2017). Establishing language benchmarks for children with typically developing language and children with language impairment. *Journal of Speech, Language, and Hearing Research*, 60(2), 364–378. doi:10.1044/2016_JSLHR-L-15-0273
- Schwab, J. F., & Lew-Williams, C. (2016). Language learning, socioeconomic status, and child-directed speech. *Wiley Interdisciplinary Reviews-Cognitive Science*, 7(4), 264–275. doi:10.1002/wcs.1393
- Scott, C. M. (2014). One size does not fit all: Improving clinical practice in older children and adolescents with language and learning disorders. *Language Speech and Hearing Services in Schools*, 45(2), 145–152. doi:10.1044/2014_lshss-14-0014
- Shahmahmood, T. M., Jalaie, S., Soleymani, Z., Haresabadi, F., & Nemati, P. (2016). A systematic review on diagnostic procedures for specific language impairment: The sensitivity and specificity issues. *Journal of Research in Medical Sciences*, 21(5), 67. doi: 10.4103/1735-1995.189648
- Silliman, E. R., Bahr, R. H., & Peters, M. L. (2006). Spelling patterns in preadolescents with atypical language skills: Phonological, morphological, and orthographic factors. *Developmental Neuropsychology*, 29(1), 93–123.
- Skahan, S. M., Watson, M., & Lof, G. L. (2007). Speech-language pathologists' assessment practices for children with suspected speech sound disorders: Results of a national survey. *American Journal of Speech-Language Pathology*, 16(3), 246–259. doi:10.1044/1058-0360(2007/029)
- Snow, P. C. (2019). Speech-language pathology and the youth offender: Epidemiological overview and roadmap for future speech-language pathology research and scope of practice. *Language Speech and Hearing Services in Schools*, 50(2), 324–339. doi:10.1044/2018_lshss-ccjs-18-0027
- Snowling, M. J., Adams, J. W., Bishop, D. V. M., & Stothard, S. E. (2001). Educational attainments of school leavers with a preschool history of speech-language impairments. *International Journal of Language & Communication Disorders*, 36(2), 173–183.
- Snowling, M. J., & Hayiou-Thomas, M. E. (2006). The dyslexia spectrum – Continuities between reading, speech, and language impairments. *Topics in Language Disorders*, 26(2), 110–126.
- St Clair, M. C., Pickles, A., Durkin, K., & Conti-Ramsden, G. (2011). A longitudinal study of behavioral, emotional and social difficulties in individuals with a history of specific language impairment (SLI). *Journal of Communication Disorders*, 44(2), 186–199. doi:10.1016/j.jcomdis.2010.09.004

- Storkel, H. L., Voelmle, K., Fierro, V., Flake, K., Fleming, K. K., & Romine, R. S. (2017). Interactive book reading to accelerate word learning by kindergarten children with specific language impairment: Identifying an adequate intensity and variation in treatment response. *Language Speech and Hearing Services in Schools*, 48(1), 16–30. doi:10.1044/2016_lshss-16-0014
- Strand, S., & Lindsay, G. (2009). Evidence of ethnic disproportionality in special education in an English population. *Journal of Special Education*, 43, 174–190.
- Sumner, E., Connelly, V., & Barnett, A. L. (2016). The influence of spelling ability on vocabulary choices when writing for children with dyslexia. *Journal of Learning Disabilities*, 49(3), 293–304. doi:10.1177/0022219414552018
- Tiekstra, M., Minnaert, A., & Hessels, M. G. P. (2016). A review scrutinising the consequential validity of dynamic assessment. *Educational Psychology*, 36(1), 112–137. doi:10.1080/01443410.2014.915930
- Tomblin, J. B., Records, N. L., Buckwalter, P., Zhang, X. Y., Smith, E., & O'Brien, M. (1997). Prevalence of specific language impairment in kindergarten children. *Journal of Speech Language and Hearing Research*, 40(6), 1245–1260.
- Tomblin, J. B., Zhang, X. Y., Buckwalter, P., & O'Brien, M. (2003). The stability of primary language disorder: Four years after kindergarten diagnosis. *Journal of Speech Language and Hearing Research*, 46(6), 1283–1296. doi:10.1044/1092-4388(2003/100)
- Tudge, J. R., Mokrova, I., Hatfield, B. E., & Karnik, R. B. (2009). Uses and misuses of Bronfenbrenner's bioecological theory of human development. *Journal of Family Theory & Review*, 1(4), 198–210.
- van Den Bedem, N. P., Dockrell, J. E., van Alphen, P. M., de Rooij, M., Samson, A. C., Harjunen, E. L., & Rieffe, C. (2018). Depressive symptoms and emotion regulation strategies in children with and without developmental language disorder: A longitudinal study. *International Journal of Language & Communication Disorders*, 53(6), 1110–1123. doi:10.1111/1460-6984.12423
- van Den Bedem, N. P., Dockrell, J. E., van Alphen, P. M., Kalicharan, S. V., & Rieffe, C. (2018). Victimization, bullying, and emotional competence: Longitudinal associations in (pre)adolescents with and without developmental language disorder. *Journal of Speech Language and Hearing Research*, 61(8). doi:10.1044/2018_jslhr-l-17-0429
- van Den Bedem, N. P., Willems, D., Dockrell, J. E., Van Alphen, P. M., & Rieffe, C. (2019). Interrelation between empathy and friendship development during (pre)adolescence and the moderating effect of developmental language disorder: A longitudinal study. *Social Development*, 28, 599–619. doi:https://doi.org/10.1111/sode.12353
- van der Lely, H. K. J. (2005). Domain-specific cognitive systems: Insight from grammatical-SLI. *Trends in Cognitive Sciences*, 9(2), 53–59. doi:10.1016/j.tics.2004.12.002
- van der Lely, H. K. J., & Stollwerck, L. (1996). A grammatical specific language impairment in children: An autosomal dominant inheritance? *Brain and Language*, 52(3), 484–504. doi:10.1006/brln.1996.0026
- Vanormelingen, L., & Gillis, S. (2016). The influence of socio-economic status on mothers' volubility and responsiveness in a monolingual Dutch-speaking sample. *First Language*, 36(2), 140–156. doi:10.1177/0142723716639502
- Vivash, J. (2015). The use of Bronfenbrenner's eco-systemic model to explore the role of educational psychologists in supporting provision for children with speech, language and communication needs. *PhD thesis. uk.bl.ethos.710898*.
- Wedell, K., & Lindsay, G. (1980). Early identification procedures: What have we learned? *Remedial Education*, 15, 130–135.
- World Health Organization. (2018). *International statistical classification of diseases and related health problems* (11th revision). Retrieved from <https://icd.who.int/browse11/l-m/en>
- Wright, T. S., & Neuman, S. B. (2014). Paucity and disparity in kindergarten oral vocabulary instruction. *Journal of Literacy Research*, 46(3), 330–357. doi:10.1177/1086296x14551474
- Young, A. R., Beitchman, J. H., Johnson, C., Douglas, L., Atkinson, L., Escobar, M., & Wilson, B. (2002). Young adult academic outcomes in a longitudinal sample of early identified language impaired and control children. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 43(5), 635–645.

7

UNDERSTANDING THE DEVELOPMENT AND INSTRUCTION OF READING FOR ENGLISH LEARNERS WITH LEARNING DISABILITIES¹

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In 2014, English learners (ELs) constituted 9.4% of enrollment in public elementary and secondary schools in the United States (National Center for Education Statistics [NCES], 2016). In the United States, ELs are disproportionately represented among students with disabilities, and this disproportionate representation is present especially within the category of specific learning disability (LD; National Clearinghouse for English Acquisition and Instruction Educational Programs [NCELA], 2017). During the 2013–2014 school year, the overall proportion of students who were primarily identified with LDs was significantly higher for ELs (50.5%) than for monolingual (i.e., English-only [EO]) students (38.2%; NCELA, 2017).²

The disproportionate representation of ELs among students with LDs is the result of a combination of factors that include, but are not limited to, (a) the significant role of language in learning in general and in reading in particular (e.g., Dockrell & Lindsay, Chapter 6, this volume), (b) psychometric challenges that prevent accurate assessment of learning difficulties in students who are language learners (e.g., August & Hakuta, 1997; Collier & Hoover, 1987; Shore & Sabatini, 2009), and (c) socio-contextual factors associated with the high levels of poverty experienced by many ELs in the United States. For example, Spanish-speaking ELs in the United States are more likely than EO students to have family incomes below or near poverty levels (Fry & Gonzales, 2008; Hernandez, Denton, & Macartney, 2008) and parents with relatively low levels of education and literacy (Capps et al., 2005; Hernandez et al., 2008). They are also more likely to be enrolled in under-resourced, low-performing schools (Capps et al., 2005; Cosentino de Cohen, Deterding, & Clewell, 2005). As a result, many ELs in the United States have fewer opportunities to access texts and experiences that contribute to successful literacy acquisition at home and at school. It is also important to acknowledge that experiences at home and at school influence the neural systems that underlie learning. Environmental factors can impact biological factors

(e.g., gene expression and brain structure/function) that, in turn, influence cognitive processes (e.g., phonological processing) and behavioral/psychosocial processes (e.g., attention). These processes in turn influence the development of reading and other academic skills (Fletcher, Lyon, Fuchs, & Barnes, 2018).

DEFINING LEARNING DISABILITIES

It may be useful to further define what we mean by LD in the context of this chapter. According to the U.S. federal government,

specific learning disability means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations, including conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia.

(<https://sites.ed.gov/idea/regs/b/a/300.8/c/10>, 34 CFR § 300.8)

The definition put forth by the federal government outlines exclusionary criteria as well. LDs do *not* include “learning problems that are primarily the result of visual, hearing, or motor disabilities, of mental retardation, of emotional disturbance, or of environmental, cultural, or economic disadvantage” (34 CFR § 300.8). Fletcher et al. (2018) argue that LDs are best understood as impairments in core cognitive processes (e.g., phonological awareness) that are neurobiological in origin and result in unexpected underachievement in the context of instruction that is effective for most individuals. These cognitive processing impairments of neurobiological origin are influenced by factors in the environment (including risk factors such as poverty and inadequate early instruction; e.g., Blair, 2010; Blair & Raver, 2012), and they interact with behavioral/psychosocial factors (e.g., attention difficulties, anxiety, low motivation, self-regulation difficulties; Cadima, Gamela, McClelland, & Peixoto, 2015; Sektnan, McClelland, Acock, & Morrison, 2010; Wanless et al., 2011) that are frequently associated with LDs (e.g., Carroll, Maughan, Goodman, & Meltzer, 2005; Pastor & Reuben, 2008). Students with LD account for 35% of all students receiving special education services in U.S. schools, and about 4.6% of all students in the U.S. public school system (NCES, 2017).

Learning disabilities are dimensional disorders. Fletcher et al. (2018) observe that the low achievement and inadequate response to instructional interventions that define LDs are “normally distributed in the population and there is little evidence of qualitative variation that would suggest categories, much less where LDs begin in relation to typical development. Such decisions are often resource-driven” (p. 2). It is for this reason that many researchers prefer to refer to “learning difficulties,” a term that implies a continuum, rather than LDs. In this chapter, we use the terms “learning difficulties” and “learning disabilities” interchangeably. We have endeavored to describe as precisely as possible the criteria (e.g., cutoff scores on particular measures) researchers used to identify participants with LD in research studies for which we report findings. LDs impact academic achievement in mathematical computation, mathematical problem-solving, written expression, and oral expression, as well as

impacting reading. In this chapter, however, we will focus particularly on the domains within the construct of LD that pertain specifically to reading (i.e., word reading, linguistic comprehension, and reading comprehension). LDs that impact reading are the most prevalent type of LD (Moll, Kunze, Neuhoﬀ, Bruder, & Schulte-Körne, 2014). We will refer to students with LDs that impact reading as students with or at risk for reading disabilities.

STATEMENT OF PURPOSE

The complex and challenging question we aim to address in this chapter is twofold: Is reading development for EL students with LDs different from reading development for EO students with LDs? And, if reading development for ELs with LDs is different than reading development for EO students with LDs, then how should we intervene differently to remediate reading diﬃculties for EL students? In order to answer these questions, we will first outline frameworks of reading comprehension that inform our understanding of reading development and remediation for all students with reading disabilities (Tunmer, Chapman, Greaney, & Prochnow, 2002). In doing so, we will provide an overview of the core cognitive processes that research suggests are influential during reading. We then describe the ways in which these theories are particularly relevant to ELs with or at risk for reading disabilities.

Theoretical Frameworks for Understanding Reading Development in ELs

Reading comprehension is a dynamic, interactive, and incredibly complex process that takes place within the context of an individual reader's goals and purposes for reading, as well as within a larger sociocultural context that includes:

economic resources, class membership, ethnicity, neighborhood, and school culture" and "can be seen in oral language practices, in students' self-concepts, in the types of literacy activities in which individuals engage, in instructional history, and of course in the likelihood of successful outcomes.

(Snow, 2002, p. 17)

As Perfetti and Stafura (2014) point out, "reading comprehension is too broad a target for precise models" (p. 23). Still, in order to understand the sources of reading diﬃculties for students who are ELs, it is useful to refer to broad frameworks that identify the component subsystems of reading comprehension and the cognitive processes that drive each subsystem. In this section, we will briefly introduce two frameworks for understanding reading comprehension: The Reading Systems Framework (RSF; Perfetti & Stafura, 2014) and the simple view of reading (SVR; Hoover & Gough, 1990). We will also discuss studies that have explored the implications of these theories for ELs with or at risk for reading disabilities.

Historically, models of reading comprehension have been categorized as either "bottom-up" or "top-down." Bottom-up models of reading comprehension begin with word recognition and progress in a unidirectional fashion from word recognition to text comprehension. Top-down models start with the activation and application of knowledge; knowledge of the local and global contexts in which meaning emerges in a

text is the primary influence on word recognition. However, the vast bulk of research evidence during the last three decades supports “interactive” models of reading comprehension, ones that suggest simultaneous involvement of bottom-up and top-down processes (e.g., Kintsch, 1988; Perfetti, Landi, & Oakhill, 2005).

THE READING SYSTEMS FRAMEWORK

One such interactive model, the RSF (Perfetti & Stafura, 2014), proposes that three classes of knowledge are used in reading: linguistic knowledge (i.e., phonological, syntactical, and morphological knowledge), orthographic knowledge (i.e., knowledge of spelling/word forms), and general knowledge (i.e., knowledge about the world, including knowledge of text forms). The reader uses these sources of knowledge in interactive ways. Word recognition is a crucial prerequisite for enactment of the comprehension processes detailed in the RSF (e.g., parsing sentences, building propositions, generating inferences, and constructing a situation model). At the same time, comprehension processes inform and expand the reader’s lexicon, which in turn influences word recognition. Perfetti and Stafura (2014) posit that the reader’s central executive system directs (and constrains) these reading processes. The executive system guides the reader to (a) inhibit irrelevant knowledge, (b) activate new sources of knowledge, and (c) integrate information in order to resolve inconsistencies or ambiguities (e.g., in selecting from among multiple meanings of a polysemous word).

Several lines of research suggest the validity of the RSF as a theoretical framework for understanding reading development and reading difficulties. Some of this research focuses particularly on the lexical quality hypothesis (LQH; Perfetti, 2007; Perfetti & Hart, 2002), a theoretical account of a subsystem within the RSF that focuses on the word identification-related processes involved in comprehension. For example, Perfetti and Hart (2001), in studies of word-level semantic processing in EO participants (e.g., of participants’ speed and accuracy in judging the semantic relations of word pairs during trials that sometimes contained homophones of words that would have been related, such as *knight—evening* or *wails—dolphins*), reported findings suggesting that good comprehenders activate phonological, orthographic, and semantic knowledge more quickly than do poor comprehenders (i.e., good readers registered form–meaning confusion in the case of low-frequency homonyms more quickly and also accurately resolved the confusion more efficiently than did poor readers). In a study exploring the implications of the LQH for ELs, O’Connor, Geva, and Koh (2018) used latent profile analysis to characterize profiles of good and poor readers (defined by comprehension assessment) within a sample of Grade 5 EL and EO students. They found that, for both EL and EO students, the analysis yielded a two-group solution, comprising a group with good reading comprehension performance (70.2% of EL students, 80.9% of EO students) and a group of students with reading comprehension difficulties. Regardless of language status, good comprehenders demonstrated relatively strong performance on measures of phonological awareness, orthographic knowledge, and both expressive and receptive vocabulary knowledge. Poor comprehenders, whether they were EL or EO, demonstrated significantly weaker performance on all of these assessments (although there was variability in the component skills within each language group). The authors interpreted their findings to suggest that phonological, orthographic,

and semantic knowledge contribute similarly to reading for ELs as they do to reading for EO students.

The importance of semantic knowledge during both word reading and reading comprehension is central to the RSF. Semantic knowledge is, in the words of Perfetti and Stafura (2014), a key “pressure point in the system”:

The lexicon sits astride two reading systems: one, the word identification system, requires high-quality linguistic and orthographic information to enable rapid word identification; the second, the comprehension system, takes its input from the word identification system to build meaning units (propositions). Knowledge of written word forms and meanings, then, is central to reading and thus a pressure point for reading comprehension—a prime candidate for a cause of reading comprehension difficulty.

(p. 26)

Perfetti and Stafura (2014) further point out that, in a sample of adolescent readers, vocabulary/semantic knowledge contributed to reading comprehension to a greater degree than it did to oral language or listening comprehension (Braze, Tabor, Shankweiler, & Mencl, 2007). In explaining this finding, Braze et al. (2007) hypothesized that spoken words may more effectively or automatically activate semantic representations than written words. In the words of Perfetti and Stafura (2014), “a stronger semantic connection (a more integrated set of word constituents)” may be needed to compensate for the “lower orthographically initiated activation” of semantic information during reading (p. 31), relative to the more automatically initiated activation of word meanings that occurs while listening to spoken language.

Much research evidence supports the RSF’s positioning of semantic knowledge as central to both word reading and reading comprehension. A number of cross-sectional studies have reported that word knowledge is a dominant predictor of reading comprehension (Adlof, Catts, & Little, 2006; Ahmed et al., 2016; Cromley & Azevedo, 2007), both (a) by directly impacting comprehension processes (e.g., sentence parsing, proposition building, word-to-text integration, inference generation) and (b) by indirectly impacting reading comprehension through its effect on word reading (Language and Reading Research Consortium, 2015; Tunmer & Chapman, 2012; Verhoeven, Voeten, & Vermeer, 2019). The efficacy of semantic knowledge in supporting working memory processes may be one mechanism for the relationship between semantic knowledge and reading comprehension. Chrysochoou, Bablekou, and Tsigilis (2011) and Currie and Cain (2015) each determined that vocabulary knowledge mediated the relationship between working memory and inferential comprehension in samples of upper elementary grade students. They theorized that more accurate and available representations of semantic information in long-term memory supported more efficient manipulation of information in working memory (Nation, Adams, Bowyer-Crane, & Snowling, 1999; Walker & Hulme, 1999), which in turn supported reading comprehension. Semantic knowledge may similarly support the efficiency of memory processes involved in word reading. In a longitudinal study of ELs where Grade 1 vocabulary predicted Grade 6 phonological short-term memory, Grade 1 phonological short-term memory also predicted Grade 6 vocabulary, suggesting the potential for mutual facilitation (Farnia & Geva, 2011).

The authors of the RSF refer to the fact that reading takes place under the direction of the central executive and “within a cognitive system that has pathways between perceptual and long-term memory systems and limited processing resources” (p. 25). It is important that researchers aiming to understand and remediate reading difficulties consider these underlying cognitive processes, because deficits in certain core cognitive processes are reliable predictors of the academic difficulties and inadequate response to instruction that are the defining features of LDs (Fletcher et al., 2018). In addition, there is evidence that elements of this cognitive machinery function similarly across languages.

CORE COGNITIVE PROCESSES ASSOCIATED WITH READING DISABILITIES AND THE UNDERLYING COMMON COGNITIVE PROCESSES HYPOTHESIS

The core cognitive processes most reliably associated with word reading disabilities include phonological processing, rapid automatized naming (RAN), and phonological short-term memory. There is research evidence supporting Geva and Ryan’s (1993) underlying common cognitive processes hypothesis, which holds that cross-language correlations in reading comprehension may be attributed to underlying cognitive processes that facilitate reading in any language and include those mentioned above. Indeed, research has demonstrated that a number of these cognitive processes can predict word reading, reading comprehension, and/or reading fluency cross-linguistically. For example, studies have found that cognitive processing skills (e.g., phonological awareness, RAN) assessed in students’ first language predicted word reading in their second language (e.g., Durgunoğlu, 2002; Durgunoğlu, Nagy, & Hancin-Bhatt, 1993; Erdos, Genesee, Savage, & Haigh, 2014; Jared, Cormier, Levy, & Wade-Woolley, 2011; Swanson, Sáez, Gerber, & Leafstedt, 2004). This has been found to be the case even when students’ first and second languages involved different writing systems (Marinova-Todd, Zhao, & Bernhardt, 2010; Saiegh-Haddad & Geva, 2010; Wade-Woolley & Geva, 2000). These underlying cognitive processes are detailed here in relation to reading difficulties in ELs.

Phonological processing entails segmenting speech into sounds; phonemic processing, a subtype of phonological processing, enables an individual to segment speech into phonemes, which are the smallest units of sound in any language; in English, there are 44 phonemes. Because sounds are typically co-articulated during speech to facilitate rapid communication, it is not an easy task to separate overlapping sounds in oral language. Phonemic awareness is a prerequisite for the mapping of phonemes to graphemes (i.e., developing knowledge of letter–sound correspondence), which is the crucial task of the emerging reader. There is much cross-sectional and longitudinal evidence supporting the pivotal role of phonological processing in the development of word reading (Hulme, Bowyer-Crane, Carrol, Duff, & Snowling, 2012; Hulme & Snowling, 2009; Shankweiler & Crain, 1986; Wagner, Torgesen, & Rashotte, 1994). Phonological awareness has emerged as the dominant predictor of word reading for language learners (e.g., Gottardo, Collins, Baciú, & Gebotys, 2008; Jared et al., 2011; Lindsey, Manis, & Bailey, 2003), as well as for monolingual students.

RAN refers to the ability to quickly name letters, digits, and other stimuli that are not alphabetic or numeric. In cross-sectional and longitudinal research, deficits in

RAN have been associated with word reading difficulties, even when controlling for phonological processing (e.g., Araújo, Reis, Petersson, & Faisca, 2015; Wagner et al., 1994; Wagner, Torgesen, Rashotte, & Hecht, 1997).³ This is true for EL as well as EO students: Nakamoto, Lindsey, and Manis (2007), in a longitudinal study involving Spanish-speaking ELs, determined that, even when controlling for phonological processing, RAN was a significant predictor of English word decoding. Research has demonstrated that, over time, typical language learners perform comparably to monolingual students on second-language RAN tasks, despite the fact that they have lower levels of language proficiency than the monolingual students, whereas ELs at risk for reading disabilities may demonstrate RAN deficits (e.g., Chiappe, Siegel, & Wade-Woolley, 2002; Lesaux & Siegel, 2003).

Phonological short-term memory⁴ is involved in mentally holding acoustic and speech-based information across a short duration of time (e.g., digit span and/or non-word repetition tasks). Melby-Lervåg, Lyster, and Hulme (2012) conducted a meta-analysis of 235 studies of the relation of phonological awareness and phonological short-term memory to word reading and found that there was a significant difference, on average, in the phonological short-term memory capacity of good and poor readers ($ES = 0.71$), even if this difference was smaller than the difference between good and poor readers in the context of phonological processing ($ES = 1.37$). In another meta-analysis of 48 studies, Kudo, Lussier, and Swanson (2015) found similar differences between good and poor readers in verbal short-term memory ($ES = 0.56$) as well as working memory ($ES = 0.79$), although these were again smaller than the difference in phonological processing ($ES = 1.00$). In contrast, Wagner et al. (1997) did not find phonological short-term memory tests to contribute unique variance once phonological processing was included in the model. There is again some question as to whether phonological short-term memory problems are independent of phonological processing problems (Fletcher et al., 2018). In Farnia and Geva's (2011) study of Punjabi, Tamil, and Portuguese ELs in Grades 1–6, English and native language phonological short-term memory (i.e., non-word repetition) correlated with English language phonological awareness (i.e., elision using high-frequency words) in Grade 1. However, when both Grade 1 phonological short-term memory and Grade 1 phonological awareness were entered into the model as contributors to Grade 6 English vocabulary knowledge, Grade 1 English and native language phonological short-term memory both contributed to unique variance in the Grade 6 outcome. In another study with EL participants, Swanson et al. (2004) administered a battery of Spanish and English language cognitive measures (i.e., phonological short-term memory, working memory, vocabulary, real word reading, and decodable non-word reading) to a sample of Spanish-speaking Grade 1 students and demonstrated that English word identification and pseudo-word reading performance were predicted by a Spanish-language measure of phonological short-term memory as well as by a latent measure of working memory that combined Spanish and English task performance.

Research has also shown the self-regulatory processes of working memory, inhibition, and attentional control (i.e., executive function; Miyake et al., 2000; Zelazo, Carlson, & Kesek, 2008)⁵ to contribute to reading comprehension (Cirino et al., 2017), including for students who are ELs (Swanson et al., 2004). Swanson, Sáez, and Gerber (2006) found that, in elementary grade ELs with reading difficulties, working memory growth in Spanish rhyming and semantic association tasks predicted

reading growth in English word reading and non-word decoding tasks, providing evidence for cross-language transfer of such executive function processes. McClelland and Wanless (2012) followed 83 EL and EO children with varying levels of family income across preschool and kindergarten, testing self-regulation with a head-to-toes task (McClelland et al., 2007) that required children to maintain instructions in their working memory and inhibit certain responses. They found a significant positive association of self-regulation and reading skill for all students, regardless of EL or family income status. Teaching self-regulation strategies (i.e., goal-setting, planning, self-monitoring, evaluation) independently or in combination with reading has been shown to have significant positive impacts on student reading outcomes in general for diverse samples of students in elementary grades (Dignath, Buettner, & Langfeldt, 2008; Perry, Mazabel, & Yee, Chapter 13, this volume), notably helping students with learning disabilities maintain and generalize their reading skills (Berkeley & Larsen, 2018). Related to self-regulation, motivation and engagement are also associated with positive reading outcomes (Baker & Wigfield, 1999; Horner & Shwery, 2002; Wigfield & Guthrie, 1997).

Finally, a variety of higher-level sentence and discourse-level cognitive processing skills (e.g., word-to-text integration, inference generation, and comprehension monitoring) are also involved in reading comprehension. Research suggests that semantic knowledge is a very necessary but insufficient condition for successfully carrying out these higher-level cognitive processes: In studies that have controlled for semantic knowledge (as well as phonological and orthographic knowledge), discourse-level processes such as inference generation contributed to unique variance in reading comprehension (Cain, Oakhill, & Bryant, 2000, 2004). These higher-level cognitive processing skills may also be common to reading comprehension in more than one language. However, there is little research that explores the cross-linguistic transfer of higher-level discourse processing skills.

THE SIMPLE VIEW OF READING

The SVR (Gough & Tunmer, 1986) provides a final useful theory for understanding the predictors of reading difficulties in school-aged children.⁶ According to the SVR, reading comprehension is equal to the product of word reading and linguistic comprehension.⁷ Within the SVR equation, word reading is defined as a developmentally constrained construct that might be assessed via non-word measures in the earliest stages of reading development, context-free word recognition measures during later stages of reading growth, and timed measures of efficient word recognition at more advanced stages (Tunmer & Chapman, 2012). The linguistic comprehension variable encompasses student vocabulary knowledge as well as sentence- and discourse-level processing skills (Tunmer & Chapman, 2012). The multiplicative nature of the equation implies a certain synergy or interaction between its two constructs. Skilled word reading amplifies the impact of linguistic comprehension (and vice versa), rather than merely adding to it. The SVR and slight variations of the SVR model have been validated as a useful framework for understanding reading development and reading difficulties in numerous studies conducted with students in preschool through young adulthood, including monolingual English speakers (e.g., Catts, Adlof, & Weismer, 2006; Johnston & Kirby, 2006; Vellutino, Tunmer, Jaccard, & Chen, 2007) and ELs

(Cho, Capin, Roberts, Roberts, & Vaughn, in press; Droop & Verhoeven, 2003; Erdos et al., 2014; Hoover & Gough, 1990; Lesaux, Kieffer, Faller, & Kelley, 2010; Mancilla-Martinez, Kieffer, & Biancarosa, 2011; Proctor, Carlo, August, & Snow, 2005; Verhoeven & van Leeuwe, 2012).

Just as the predictive utility of component skills of reading within the SVR depends on the way the variables in the equation are measured,⁸ so too do relations between component skills in the SVR vary based on student characteristics, including student age and learning/reading ability. For example, word reading makes a larger contribution to reading comprehension for younger students than for older students (e.g., Hoover & Tunmer, 1993; Keenan, Betjemann, & Olson, 2008; Vellutino et al., 2007). In their meta-analysis of 110 studies investigating the relation between word reading and comprehension, García and Cain (2014) found that the strength of the decoding–reading comprehension relationship not only decreased with increasing age, but that this decrease was not linear across development: At age 10 (i.e., the age when word reading becomes automatic for most typically developing readers [Wimmer & Goswami, 1994] and also the age at which texts that students are expected to read in school become substantially more complex and content-heavy [Lee & Spratley, 2010]), there was a significant reduction in the contribution of word reading to reading comprehension. The exception is students with reading disabilities. Word reading continues to predict substantial variance in reading comprehension even for adolescents with reading disabilities (e.g., Braze et al., 2007), owing primarily to the continued variability in word reading skills for struggling readers (Francis, Fletcher, Catts, & Tomblin, 2005; for counter-evidence, see Cutting & Scarborough, 2006).

English language proficiency might also be expected to impact the associations between variables in the SVR. However, longitudinal research suggests that the degree to which word recognition and linguistic comprehension in kindergarten and/or Grade 1 predict reading comprehension in the later elementary grades are largely similar for EL and EO students. In a large-scale study conducted in Canada with EL and EO students with and without reading difficulties, Lesaux, Rupp, and Siegel (2007) determined that there were no significant differences in the degrees to which decoding and linguistic comprehension in Grades K–3 predicted reading comprehension in Grade 4 for EL participants compared with monolingual English speaker participants. This was true for students with reading difficulties as well as for those without reading difficulties. Similarly, Kieffer and Vukovic (2012) determined that decoding and linguistic comprehension skills in Grades 1 and 2 were similarly predictive of Grade 3 reading comprehension for low-SES ELs and monolingual English speakers.

Results from cross-sectional studies conducted with monolingual and language-learning upper elementary students in Canada (Grant, Gottardo, & Geva, 2011), the United Kingdom (Babayigit, 2014), the Netherlands (e.g., Droop & Verhoeven, 2003), and the United States (Cho et al., in press) tell a different story, suggesting that there may be some differences in the relative contribution of decoding and linguistic comprehension to reading comprehension for EL students beyond the primary grades. Grant et al. (2011) examined concurrent predictors of reading comprehension for third-graders who were (a) Spanish-speaking ELs, (b) Portuguese-speaking ELs, and (c) native English speakers. In both EL groups, vocabulary remained a significant contributor to reading comprehension, even after controlling for word reading skill (and vocabulary predicted a greater amount of variation in reading comprehension than

did word reading skill for both EL groups); for monolingual English speakers, vocabulary did not explain unique variance in reading comprehension with word reading in the model. Similarly, Babayiğit (2014) found that linguistic comprehension (as measured by vocabulary and sentence-processing tasks) played a more significant role in reading comprehension in Grade 4 for ELs than for native English speakers. Droop and Verhoeven (2003) reported that oral language proficiency (measured via receptive vocabulary, expressive vocabulary, morphological-syntactic knowledge, and oral text comprehension tasks) explained more variance in reading comprehension for language learners than for native Dutch speakers in Grades 3 and 4.⁹ In a final study, Cho et al. (in press) determined that, for EL participants with reading comprehension difficulties, linguistic comprehension variables made a greater contribution to reading comprehension than word reading variables, whereas the opposite pattern held true for EO students. In line with previously cited studies (e.g., Babayiğit, 2014; Droop & Verhoeven, 2003), listening comprehension for these EL participants with reading difficulties not only made a direct contribution to reading comprehension but it also mediated the relation between vocabulary and reading comprehension.

Although the patterns of results reported in longitudinal and cross-sectional studies vary, we do not interpret them as contradictory findings because of the differences in grade levels and research methodologies. The longitudinal work suggests that the same early (K and Grade 1) indicators of reading risk status predict later reading performance equally well for EL and EO students. The cross-sectional research suggests that, in the upper elementary grades, there are differences in the relative contributions of word reading and linguistic comprehension to reading comprehension for EL compared with EO students, with vocabulary and other linguistic comprehension variables on average making a larger contribution to reading comprehension for EL than for EO students. These cross-sectional findings align with other research suggesting that ELs experience specific comprehension difficulties at higher rates than their EO counterparts (e.g., see Lesaux, 2006 for a review; Nakamoto et al., 2007).

IMPLICATIONS OF THEORY FOR PRACTICE

The frameworks and theories outlined above (i.e., the RSF [Perfetti & Stafura, 2014], the underlying common cognitive processes hypothesis [Geva & Ryan, 1993], and the SVR [Gough & Tunmer, 1986]) have some key implications for practice. The RSF highlights the importance of semantic knowledge as a key “pressure point” (Perfetti & Stafura, 2014, p. 26) during reading, impacting both word reading and reading comprehension. Because ELs by definition lack semantic knowledge in English, all ELs can thus be expected to struggle with reading comprehension while they are developing language proficiency. When an EL student demonstrates difficulties with reading comprehension relative to EO peers, it does not necessarily provide evidence that the student has an LD (Geva, Xi, Massey-Garrison, & Mak, 2018). For this reason, it is advisable for educators to compare EL students with their EL peers when assessing reading comprehension achievement and response to reading comprehension interventions. It is also desirable that psychometricians establish norms on standardized tests of reading comprehension for ELs of various levels of language proficiency. At the same time, there is no evidence that interventions designed to improve reading comprehension in students with specific reading or linguistic comprehension difficulties

do *not* benefit typically developing ELs with comprehension difficulties to the same or similar extent that they benefit monolingual students with comprehension difficulties. For this reason, it may be less important to accurately identify the *source* of semantic knowledge deficits than it is to identify deficits in semantic knowledge and intervene to support development in this area.

The RSF holds that, in addition to semantic knowledge, orthographic and phonological knowledge play important roles in word reading, and thus also in reading comprehension. As noted above, the importance of phonological processing to reading comprehension has been demonstrated remarkably reliably across time and samples of both EO and EL students. Research demonstrates that typically developing ELs quickly catch up to their peers in measures of phonological and orthographic knowledge.¹⁰ Therefore, if an EL student displays deficits in English phonological and/or orthographic knowledge after evidence-based, systematic instruction (even relative to more language-proficient EO peers), this can be construed as evidence of a word reading disability. Because phonological awareness deficits measured in a student's first language can be used to predict word reading difficulties in English (Bialystok, McBride-Chang, & Luk, 2005; Branum-Martin et al., 2006; Durgunoğlu, 2002; Durgunoğlu et al., 1993; Nakamura, Koda, & Joshi, 2014), it is possible to identify and support ELs in need of intensive word reading interventions even when they are still in the early stages of English language learning.

The studies validating the SVR with ELs support similar conclusions. First, the SVR encourages educators and psychologists to interrogate the source of reading difficulties, identifying the degree to which word recognition difficulties and linguistic comprehension difficulties each explain reading comprehension difficulties in individual students. The longitudinal studies validating the SVR across time indicate that deficits in English decoding/word recognition in K and Grade 1 (best assessed via non-word measures in the earliest stages of reading development and using context-free word recognition measures during later stages of reading growth) and English linguistic comprehension (best assessed via measures of both vocabulary and sentence- or discourse-level listening comprehension) will predict later reading difficulties for EL students in the same way that they predict reading difficulties for EO students. It is possible to measure phonological awareness (using L1 or English language measures) and English language non-word decoding skills with relative accuracy, even with EL students who are still developing English proficiency. Because difficulties in these areas are highly predictive of later reading difficulties, it is imperative to do so.

The cross-sectional studies cited above found semantic knowledge/linguistic comprehension variables to contribute more significantly to reading comprehension for upper elementary grade ELs than for their EO peers. It is difficult to establish whether an EL student has less English language semantic knowledge because he or she is an EL (i.e., a child without an LD) or whether an EL student has less English language semantic knowledge because he or she has a language-learning or linguistic comprehension disability (i.e., a child with an LD). However, regardless of the source of linguistic comprehension deficits (i.e., whether they derive purely from the student's status as a language learner or from a language learning disorder) in EL students, it is important to address them because of their role in explaining word reading and reading comprehension deficits.

*Reading Instructional Interventions for English Learners
with or at Risk for Learning Disabilities*

Until recently, it has been very challenging to make research-based decisions about instruction for ELs with LD because there has been so little research investigating the impact of instruction or responses to instruction for this population. However, within the last 15 years, there has been an increase in studies, syntheses, and meta-analyses investigating the effects of academic interventions for ELs (e.g., Baker et al., 2014; Cheung & Slavin, 2012; Genesee, Lindholm-Leary, Saunders, & Christian, 2006; Hall et al., 2017; Shanahan & Beck, 2006). There has also been an increase in studies investigating the effects of instruction for ELs with LD, or ELs who demonstrate academic difficulties despite receiving high-quality Tier 1 instruction. The majority of these studies have examined the impact of supplemental, small-group language and literacy instruction on language and literacy outcomes.

In this section, we will summarize the findings of four research syntheses published within the last two decades that address the effects of academic language and/or reading interventions on language and reading outcomes for ELs in Grades K–12 who have or are at risk for learning difficulties (August & Siegel, 2006; Klingner, Artiles, & Barletta, 2006; Richards-Tutor, Baker, Gersten, Baker, & Smith, 2016; Rivera, Moughamian, Lesaux, & Francis, 2009). These syntheses included a total of 32 studies that had as participants ELs with or at risk for LD and investigated the effects of English language instruction on a language- or reading-related outcome. Of the 32, 3 employed primarily qualitative methods; 5 had single case designs; 2 were single group pre- to post-test designs; 18 employed experimental or quasi-experimental treatment-comparison group designs. It should be noted that, although there was significant overlap between studies included in these four syntheses, Richards-Tutor et al. (2016) employed more stringent inclusion standards (e.g., they included only experimental or quasi-experimental group design studies that measured and reported implementation fidelity) than their predecessors and thus had a different interpretation of the research than did the authors of the prior syntheses of research on reading instruction for English learners with learning difficulties. For example, although all four syntheses highlighted evidence as to the effectiveness of explicit, systematic phonological awareness and phonics instruction in the early grades, Richards-Tutor et al. (2016) departed from the prior syntheses in emphasizing conflicting evidence and a dearth of support for a number of instructional approaches recommended in previous syntheses.

THE EFFECTS OF INSTRUCTION ON PHONOLOGICAL AWARENESS AND PHONICS OUTCOMES

As mentioned previously, authors of *all four* reviews emphasized the benefit of providing phonological awareness and/or word identification instruction as part of early reading instruction. Phonological awareness instruction included oral language rhyme detection, onset detection, phoneme segmentation, and phoneme blending instruction. Phonics instruction consisted of explicit, systematic instruction in letter–sound correspondences. Richards-Tutor et al. (2016) qualified this finding by noting that rigorous, experimental and/or quasi-experimental group design studies demonstrated

much stronger benefits for phonological awareness and phonics instruction when participants were students in kindergarten and Grade 1. Rivera et al. (2009) recommended that instruction target a combination of early reading skills, including phonological awareness, knowledge of letter-sound correspondence, and other word identification skills.

Syntheses all cited a large body of experimental and/or quasi-experimental research that suggests robust effects of comprehensive early reading interventions that include phonological awareness instruction for ELs with or at risk for reading disabilities on measures of phonological awareness and word reading. Numerous studies report statistically significant effects on measures of phonological awareness in favor of multiple-component early reading instruction that includes phonological awareness instruction (Gerber et al., 2004; Kamps et al., 2007; Leafstedt, Richards, & Gerber, 2004; Lovett et al., 2008; O'Connor, Bocian, Beebe-Frankenberger, & Linklater, 2010; Vadasy & Sanders, 2010; Vaughn, Cirino et al., 2006; Vaughn, Linan-Thompson, et al., 2006). With the exception of one study (Lovett et al., 2008), all of these studies were conducted with students in kindergarten or first grade.

Syntheses also cited a large body of research that demonstrated positive, statistically significant effects of reading instruction that included systematic, explicit instruction in phonics on word reading outcomes for ELs with or at risk for reading disabilities (Gerber et al., 2004; Kamps et al., 2007; Leafstedt et al., 2004; Vadasy & Sanders, 2010; Vaughn, Cirino et al., 2006). Two studies revealed statistically significant effects in favor of treatment on measures of non-word decoding, but not on measures of word identification (Gunn, Biglan, Smolkowski, & Ary, 2000, Year 1; Wanzek & Roberts, 2012). Again, this research suggests that effect sizes are likely to be smaller or non-existent for interventions conducted with students in Grade 2 and above, emphasizing the crucial importance of early identification and intervention for ELs with or at risk for reading disabilities.

THE EFFECTS OF INSTRUCTION ON READING FLUENCY OUTCOMES

The four research syntheses did not draw any broad conclusions about the effects of word or passage reading fluency instruction on word or passage reading fluency outcomes for EL students with or at risk for reading disabilities, mostly owing to the scarcity of experimental or quasi-experimental research investigating student response to intervention in the context of these outcomes. Kamps et al. (2007) determined that a multiple-component intervention including word reading fluency instruction (e.g., timed practice reading word lists consisting of regular and irregular words, decoding practice with an emphasis on speed) had positive, statistically significant effects on measures of word reading fluency for participants in Grades 1 and 2. Vadasy and Sanders (2010) determined that multiple-component interventions including passage reading fluency instruction (i.e., repeated reading, partner reading with a paraprofessional educator, and echo reading line by line with a tutor or paraprofessional) had positive, statistically significant effects on measures of passage reading fluency for kindergarten-aged participants. Together, these suggest that early fluency intervention can positively impact fluency outcomes for ELs with reading difficulties.

EFFECTS OF INSTRUCTION ON READING COMPREHENSION OUTCOMES

Although authors of three reviews cited research evidence in favor of reading comprehension strategy instruction (August & Siegel, 2006; Klingner et al., 2006; Rivera et al., 2009), Richards-Tutor et al. (2016), in reviewing the most methodologically rigorous studies on this topic, noted the rarity of statistically significant effects in favor of reading interventions on reading cloze and reading comprehension measures. Among the seven studies in their meta-analysis that provided English language instruction and included a reading comprehension cloze measure, only two studies reported statistically significant effects in favor of treatment (Vadasy & Sanders, 2010; Vaughn, Linan-Thompson et al., 2006). Studying kindergarten-aged ELs at risk for LD, Vadasy and Sanders (2010) determined that students assigned to a treatment condition that included one-on-one, systematic, explicit phonics instruction (including decodable text reading instruction but no explicit instruction in reading comprehension) performed better on a comprehension cloze measure than peers who did not receive any supplemental instruction. The latter study conducted by Vaughn et al. included Grade 1 ELs at risk for LD; it investigated the impact of the multiple-component *proactive reading* intervention, for which there was a comprehension instruction component in addition to vocabulary and oral language development. During comprehension instruction, students were taught to activate knowledge related to the topic of the text using a modified K-W-L procedure (during the K-W-L procedure, students identified prior to reading what they already *knew* [K] about the topic of the text, what they *wanted* [W] to learn about the topic, and then, after reading, what they *learned* [L]). They were also taught how to retell and sequence story events in narrative texts, identify main ideas, and summarize the text (using story grammar elements for narrative text or simple content webs for expository text).

Only two studies included in the Richards-Tutor et al. (2016) meta-analysis measured passage reading comprehension, with one of the two studies reporting a statistically significant effect in favor of students in the treatment condition (Begeny, Ross, Greene, Mitchell, & Whitehouse, 2012). In this study, there were statistically significant effects in favor of a reading fluency-focused intervention (i.e., one that included repeated readings, modeled reading by an adult, systematic error-correction procedures, goal-setting, and performance feedback through graphing) on standardized, norm-referenced measures of passage reading comprehension for ELs at risk for LD in Grades 1 and Grades 1–2, respectively.

EFFECTS OF INSTRUCTION ON LISTENING COMPREHENSION OUTCOMES

Richards-Tutor et al. (2016) reported more promising findings in the domain of listening comprehension. Among the studies they cited that found statistically significant effects in favor of treatment on an assessment of listening comprehension was one conducted by Wanzek and Roberts (2012), who reported a significant effect in favor of a multiple-component (word reading, vocabulary, fluency, and comprehension) treatment on their listening comprehension outcome measure when the intervention was tailored to fourth grade participants' skill profiles (i.e., emphasizing word recognition

if students had relative weaknesses in word recognition and comprehension if students had relative weaknesses in comprehension). Solari and Gerber (2008) also found significant effects on both researcher-developed and standardized measures of listening comprehension in favor of a treatment in which kindergarten-aged participants spent the vast majority (70%) of intervention time engaged in listening comprehension and vocabulary instruction, with smaller portions of intervention time devoted to phonological awareness (20%) and alphabetic knowledge (10%) instruction.

EFFECTS OF INSTRUCTION ON VOCABULARY OUTCOMES

Again, although the authors of three reviews (August & Siegel, 2006; Klingner et al., 2006; Rivera et al., 2009) suggested the benefit of instructional approaches focused on vocabulary and oral language instruction, Richards-Tutor et al. (2016) reported that they could not locate any rigorous experimental or quasi-experimental studies with participants that were ELs with learning difficulties that specifically targeted vocabulary instruction/acquisition, and only four studies measured vocabulary as an outcome. Vaughn, Linan-Thompson, et al. (2006) investigated the effects of a multiple-component reading instruction intervention (including phonological awareness, phonics, word reading fluency, vocabulary, and comprehension instruction) on reading outcomes for students in Grade 1; they reported a significant effect in favor of this treatment on the verbal analogies subtest of the Woodcock Language Proficiency Battery (Woodcock, 1991), but not for the picture vocabulary subtest. In the intervention developed by Vaughn and colleagues, there was a comprehension component (described earlier) and also a vocabulary and oral language development component: Students were taught the meanings of two or three key vocabulary words prior to listening to a passage from a book; teachers then asked students questions about key ideas in the passage, as well as discussing the meanings of pre-taught vocabulary words. After reading the passage aloud, teachers used probes to guide students in story retelling and intentionally provided opportunities for each student to participate in dialogue with the teacher about the story using complete sentences and new vocabulary words. In a quasi-experimental study with a relatively small sample size, Bos, Allen, and Scanlon (1989) determined that upper elementary-aged ELs with LD who (a) developed semantic maps showing the relationships between words and (b) completed cloze sentences did statistically significantly better on multiple choice vocabulary tests and on a text recall measure than did a comparison group who received instruction only in pronunciation and memorization of the vocabulary words.

RESPONSIVE INTERVENTIONS

Rivera et al. (2009) and Richards-Tutor et al. (2016) both cite evidence that responsive interventions (i.e., explicit, systematic interventions targeting the particular skills that are a source of difficulty for individual students) are associated with improved reading outcomes. Rivera et al. (2009) based this recommendation on a pair of studies of the Early Reading Project conducted by Gerber et al. (2004) and Leafstedt et al. (2004), which provided supplemental, explicit phonological awareness instruction to small groups of EL students in kindergarten and/or first grade. Richards-Tutor et al. (2016)

cited as evidence the study reported by Wanzek and Roberts (2012) for which the intervention condition with significant effects was tailored to each student individually, thereby being highly responsive to the needs of individual students.

RECENT RESEARCH

We identified only two experimental or quasi-experimental group studies published since the Richards-Tutor et al. (2016) meta-analysis with participants who were ELs with or at risk for disabilities. Baker, Burns, Kame'enui, Smolkowski, and Baker (2016) investigated the effects of a small-group supplemental vocabulary- and comprehension-focused reading intervention that supported the transfer of skills from Spanish to English reading instruction for first-grade Spanish-speaking ELs at risk for reading disabilities. Students were randomly assigned to 30 minutes of explicit vocabulary- and comprehension-focused supplemental reading instruction provided daily for 12 weeks ($n = 39$) or business-as-usual reading instruction from a variety of commercially available programs that focused on phonics, word work, and sentence reading ($n = 39$). There were no statistically significant differences between groups at post-test on measures of word reading, oral reading fluency, depth of vocabulary knowledge, or reading comprehension. There were also no statistically significant differences between groups a year after the end of intervention (i.e., at the end of second grade). In this study, students in the business-as-usual comparison condition were receiving evidence-based instruction similar to the effective multiple-component interventions described above. The results of this study may indicate that shifting the focus from explicit phonics/word recognition instruction to vocabulary and comprehension in Grade 1 is not advisable in the context of ELs at risk for reading disabilities.

Williams (2017) examined the impact of an intensive, year-long phased reading intervention (targeting advanced word reading skills, fluency, vocabulary, and comprehension strategies in Phase 1 and then guiding students in the application of comprehension strategies within content area texts in Phase 2) on reading outcomes (word reading, vocabulary, and comprehension) for ninth-grade ELs with learning disabilities ($n = 95$), investigating the degree to which intervention effects varied by limited English proficiency status. At post-test, there were no significant differences between students assigned to the intervention and a business-as-usual comparison group. Small effects were observed on measures of word reading, comprehension, and proximal vocabulary, with Hedge's g values ranging from 0.08 to 0.40. Intervention effects did not differ based on English language proficiency. The results of this study echo the synthesis findings reported by Richards-Tutor et al. (2016), who determined that the effects of intervention on older ELs (Grade 4 and above) were minimal: Only one of the four included studies (Wanzek & Roberts, 2012) showed significant effects of intervention on a reading-related outcome measure (that of listening comprehension).

SUMMARY

The syntheses reviewed here provide clear evidence that multiple-component instruction including explicit, systematic instruction in phonological awareness and phonics

has the potential to significantly accelerate phonological awareness and phonics knowledge for ELs at risk for reading disabilities in kindergarten and first grade. It is less clear that research has determined an effective course of action for improving reading outcomes for ELs with reading difficulties in Grade 2 or above.

Across the board, interventions that focused on improving the foundational skills of phonological awareness, phonics, and word reading fluency obtained more consistent statistically and practically significant effects on foundational reading outcomes than did reading comprehension-focused interventions on outcomes of reading comprehension. For example, only three studies included in the synthesis reported by Richards-Tutor et al. (2016) reported positive effects on measures of reading comprehension. Notably, two of these studies (Vaughn, Cirino et al., 2006) focused on activating knowledge, an approach to instruction that is aligned with the RSF (Perfetti & Stafura, 2014) and its description of the pivotal role that semantic knowledge plays in establishing comprehension of text. Vocabulary- and listening comprehension-focused interventions were shown to be effective in improving listening comprehension outcomes but *not* in improving reading comprehension outcomes, an outcome that is surprising given the importance of semantic knowledge/linguistic comprehension to reading comprehension in the RSF and the SVR (Gough & Tunmer, 1986). It may be that the reading/listening comprehension interventions tested in the studies cited did not cultivate the sort of “stronger semantic connection” that Perfetti and Stafura (2014) hypothesize is necessary to compensate for the “lower orthographically initiated activation” of semantic information during reading (p. 31), relative to the more automatically initiated activation of word meanings that occurs while listening to spoken language.

Implications for Practitioners

We can now return to our research questions in light of the reading comprehension theoretical frameworks described in the first section combined with these findings from reading intervention research for ELs with reading difficulties: (a) How does status as an English language learner change the course of reading development for ELs with reading difficulties, compared with reading development and instruction for monolingual English speakers with reading difficulties? (b) How should we intervene to remediate reading difficulties for EL students?

Based on the longitudinal research cited in the first section of this chapter, it appears that the kindergarten and Grade 1 predictors of later (i.e., upper elementary grade) reading difficulties for EO students are similarly predictive of reading difficulties among ELs. In fact, after tracking a large sample of ELs and EOs from kindergarten through Grade 4 enrolled in Canadian public schools, Lesaux et al. (2007) postulated that, “differences in the reading development for ELLs and L1 speakers are negligible.” However, findings from several studies with upper elementary students suggest that linguistic comprehension processes may be a more prominent source of reading problems for EL than EO students (Babayigit, 2014; Cho et al., in press; Grant et al., 2011). These findings, coupled with research showing that ELs lag behind their EO peers in vocabulary despite similar word reading performance (e.g., Farnia & Geva, 2013), underscore the importance of supporting the language skills of ELs.

EFFECTIVE PRACTICES FOR ELS WITH READING DIFFICULTIES

The intervention research summarized above, in combination with theoretical and empirical accounts of the importance of word recognition for reading comprehension, suggests that ELs with reading difficulties in the early grades will benefit from explicit, systematic instruction in phonics and phonological awareness. Phonological awareness instruction should enable students to segment and blend the sounds in oral language. Phonics instruction should focus on developing students' knowledge of sound-symbol relationships and strategies for decoding first monosyllabic then polysyllabic words.

The syntheses reviewed above also found evidence for the effectiveness of word and passage reading fluency interventions on word and passage reading fluency outcomes for ELs with reading difficulties. Kamps et al. (2007) determined that (a) timed practice reading word lists consisting of regular and irregular words and (b) decoding practice with an emphasis on speed had positive, statistically significant effects on measures of word reading fluency for students in the primary grades. Vadasy and Sanders (2010) determined that a multiple-component intervention that included passage reading fluency instruction (i.e., repeated reading, partner reading with a paraprofessional educator, and echo reading line by line with a tutor or paraprofessional) had positive, statistically significant effects on measures of passage-reading fluency for kindergarten-aged participants.

Although there is much theoretical and cross-sectional evidence that semantic knowledge contributes to reading comprehension (including, and maybe particularly, for ELs in the upper elementary and middle grades), evidence from intervention research suggests that it may be inadvisable for educators of young ELs with reading difficulties to shift the educational focus away from explicit word reading instruction and onto vocabulary and listening comprehension instruction (see results reported by Baker et al., 2016).¹¹ It is crucial for educators to determine the degree to which students' reading difficulties reflect word reading difficulties or linguistic comprehension difficulties (or a combination of the two). Kindergarten and primary-grade assessments of phonological awareness and word reading (administered in students' L1 if they have received no English language instruction or in English if they have received adequate English language instruction in the construct being measured, even when English language proficiency is still developing) should provide an accurate picture of students' risk for word reading difficulties. These early assessments are critical to determining the best course of intervention for students who are ELs with reading difficulties.

When reading comprehension difficulties in ELs are not due to phonological awareness or phonics deficits, then it makes sense for educators to focus more heavily on vocabulary and comprehension instruction. Unfortunately, research provides little guidance as to interventions that might be effective in improving reading comprehension outcomes for ELs with reading difficulties. As previously noted, there is a dearth of rigorous experimental studies demonstrating significant effects of reading interventions on reading comprehension for ELs with reading difficulties (Richards-Tutor et al., 2016). Those that were effective in accelerating gains for this population of students taught primary-grade students to activate knowledge, set a purpose for

reading, retell and sequence story events in narrative texts, identify main ideas, and summarize the text (using story grammar elements for narrative text or simple content webs for expository text). Given the relative paucity of research exploring the effects of reading comprehension interventions on reading comprehension outcomes for ELs with reading difficulties, it may be most prudent to adhere to reading comprehension protocols that have been shown to be effective with non-EL students with reading comprehension difficulties. Research suggests that it is beneficial for teachers of students with reading comprehension difficulties to spend some instructional time activating (and, if necessary, building) background knowledge, including vocabulary, relevant to the text that students will read (Carr & Thompson, 1996; Elbro & Buch-Iversen, 2013; Elleman & Compton, 2017). Research also suggests the effectiveness of explicit instruction in reading comprehension strategies (e.g., summarization, question generation, graphic representation, visualization; Ciullo, Lo, Wanzek, & Reed, 2016; Scammacca, Roberts, Vaughn, & Stuebing, 2015; Shanahan et al., 2010). It will likely be helpful for teachers to model and think aloud in order to show students how to use a strategy or engage in a particular type of comprehension-facilitating thinking (Fisher, Frey, & Lapp, 2011; Schunk & Zimmerman, 2007). Additionally, teachers may use scaffolds (e.g., graphic organizers, mnemonics) to help students learn strategies or organize information in text (Hall, Kent, McCulley, Davis, & Wanzek, 2013; e.g., a teacher might guide students in using graphic organizers associated with a particular narrative or expository text structure). During reading comprehension instruction, it will be helpful for the teacher to provide opportunities for students to build oral language proficiency by providing opportunities to engage in rich discussions of text in partnerships/small groups (Vaughn et al., 2013).

It would be wise for teachers of ELs with reading difficulties to integrate academic vocabulary instruction explicitly across both English language arts and content-area instruction. Research suggests that linguistic comprehension deficits for ELs primarily stem from deficits in vocabulary knowledge (Droop & Verhoeven, 2003), and academic vocabulary instruction that is embedded within reading comprehension and content acquisition instruction has been found to enhance outcomes for typically developing ELs (e.g., Lesaux, Kieffer, Kelley, & Harris, 2014; Vaughn et al., 2017). Considering the large number of lower-frequency academic words found in upper elementary grade texts (words that are likely to be unfamiliar to many students, even those who are not ELs), we advise educators of upper elementary and secondary-grade ELs with reading difficulties to employ multiple word meaning instructional approaches, including (a) emphasizing “word consciousness,” whereby students are taught to listen and look for new words and new uses of words so that they wonder about their use and meaning to extend their vocabularies independently; (b) providing ongoing instruction in key words throughout the school day and as an integrated part of instruction; and (c) teaching word learning strategies (Beck & McKeown, 2007; Blachowicz, Fisher, Ogle, & Watts-Taffe, 2006; Graves, 2006; Stahl & Nagy, 2006).

Finally, we recommend assuring students have many opportunities to read and listen to a range of text types throughout the school day and across all content areas. Students are likely to expand their background knowledge, vocabulary, and understanding of text when provided multiple and varied opportunities to engage in thinking and discussion around text. Although the temptation is to avoid text when students

demonstrate reading challenges, students with reading difficulties are the ones who require more extensive opportunities to interact with text.

Directions for Future Research

There are many aspects of instruction for students who are ELs with reading-related LDs that would benefit from further research. The cross-sectional and longitudinal research cited in the “Theory” section of this chapter suggests that vocabulary- and linguistic comprehension-focused reading interventions for ELs with or at risk for LD hold promise. It is noteworthy, then, that Richards-Tutor et al. (2016) were unable to locate any rigorous experimental or quasi-experimental studies that specifically targeted vocabulary instruction/acquisition for ELs with learning difficulties. Future research investigating the effects of oral language and/or vocabulary interventions for this population of students will enable practitioners and policymakers to identify vocabulary and oral language development components of academic interventions that have the potential to benefit ELs with or at risk for LD. As Richards-Tutor et al. (2016) point out, there is also a need to develop and employ in intervention research better measures of vocabulary acquisition (i.e., instruments that are not over-aligned with vocabulary instruction but nevertheless are sensitive to growth in response to vocabulary instruction interventions). Measures such as these would enable researchers to better ascertain the benefit of approaches to vocabulary and/or oral language instruction for ELs with learning difficulties.

As noted above, the effects of previously researched interventions on reading outcomes for students in Grade 2 and above have been mixed at best (Richards-Tutor et al., 2016), suggesting opportunities for further investigation of innovative approaches to interventions for ELs with learning difficulties in Grade 2 and above. Two studies examining the effects of extensive (i.e., 2-year) interventions for older monolingual students with significant reading difficulties may provide guidance for intervention research with older EL students with LDs. Vaughn, Wexler, et al. (2011) randomly assigned seventh- and eighth-grade students with state reading assessment scale scores approximately at or below the 30th percentile to one of three conditions: a standardized supplemental reading instruction intervention, an individualized supplemental reading instruction intervention, and business-as-usual instruction provided during special elective blocks. The reading interventions were delivered to students in small groups of five students across 2 full years, for 50 minutes daily. The standardized reading intervention included (a) Phase I, emphasizing word study (REWARDS; Archer, Gleason, & Vachon, 2003), (b) Phase II, which had vocabulary and text comprehension strategies as primary foci, and (c) Phase III, wherein students were encouraged to apply text comprehension and vocabulary learning skills and strategies while reading expository texts. During the individualized reading instruction intervention, tutors used assessment data to learn about students’ relative strengths and weaknesses in phonics, word reading, fluency, vocabulary, and comprehension. For example, for students with a standard score of 95 or above on a word reading test, reading instruction focused on upper-level multisyllabic word reading as well as vocabulary and comprehension strategies; students who scored below a standard score of 95 received intensive phonics instruction focusing on more foundational skills, as well as vocabulary and comprehension strategy instruction. Tutors documented these relative emphases for

each student within their groups and then used weekly progress monitoring to adjust the emphasis of instruction. The progress made by students in both treatment conditions was remarkable, given what is known about the (generally small) effects of reading interventions on reading comprehension outcomes for students with reading difficulties at this grade level. Students in the reading instruction treatment conditions made significant gains in reading comprehension ($ES = 0.56$), gains suggesting that treatment students were on a path to closing the gap between their current reading performance and grade-level expectations.

In a separate study, Vaughn et al. (2015) investigated the effects of a 2-year intensive reading intervention for EO students in Grades 9 and 10 who failed the state accountability test in reading. Students in the treatment condition received phased, small-group reading instruction similar to what was received by treatment students in the 2-year study reported by Vaughn, Wexler, et al. (2011): Phase I emphasized word study using the REWARDS (Archer et al., 2003) program, but also introduced an explicit, six-step vocabulary instruction component (Vaughn Gross Center for Reading and Language Arts at The University of Texas at Austin, 2010) and a multi-step comprehension strategy based on *collaborative strategic reading* (Vaughn, Klingner, et al., 2011; Vaughn, Wexler, et al., 2011). Phase II encouraged students to apply newly learned strategies while reading content-area texts (application of the multi-step comprehension strategy was managed within each unit using a standardized six-step summary writing strategy; Brown & Day, 1983; Cordero-Ponce, 2000; Klingner, Morrison, & Eppolito, 2011). The intervention also incorporated practices to increase student engagement and self-regulated learning, including (a) the alignment of selected passages with topics in students' social studies and science classes, (b) the development of specific content learning goals for each unit (Boardman et al., 2008), (c) the incorporation of student-developed questions into post-reading discussions, and (d) 10 minutes of student free-choice silent reading in each instructional session. In this second study reported by Vaughn et al. (2015), treatment students demonstrated significant gains on reading comprehension ($ES = 0.43$) compared with students in the business-as-usual comparison condition, and improved reading was associated with better grades in social studies. Findings from both studies suggest that daily, small-group (5–10 students per group) instruction provided across multiple years to students with significant reading problems can yield statistically and practically significant findings on standardized reading comprehension measures. It would be useful to investigate the effects of similar daily, small-group instruction provided across multiple years to students with significant reading problems who are ELs. It is also likely that a more robust and extensive approach to supporting the development of language and vocabulary throughout the school day (i.e., during all academic class periods, including content-area instruction) is fundamental to improving language and comprehension outcomes for ELs with LD. We are particularly interested in instructional practices or models that examine school-wide practices for enhancing language and literacy in a broad and systematic manner.

Similarly, it may be useful to embark on research that examines the effects of English language and literacy instruction that is integrated with students' experiences before and/or after school. It is very difficult to imagine how most students with significant language, literacy, and learning needs can improve substantially without more intensive supports provided both within and outside the traditional school day. It may

be instructive to examine the effects of language and literacy learning opportunities provided after school or during the summer; similarly, it will likely be worthwhile to further examine, particularly for young children, the effects of innovative ways to support language and literacy learning in the home.

The field would also benefit from future research that examines (a) the nature and development of working memory, self-regulation, and other components of executive function in ELs with learning difficulties; and (b) the degree to which reading interventions that incorporate training in these non-academic cognitive and social-emotional skills lead to improved reading comprehension outcomes. It is unclear whether EL status confers advantages or disadvantages in the realm of executive function (Antoniou, 2019; Bialystok, 2009; Lesaux, 2015), and we hope that future research will illuminate the relations across development between executive function, self-regulation, and literacy skills for EL students. Meanwhile, because much research attests to the association between learning difficulties and deficits in executive function (Fletcher et al., 2018; note also that a large meta-analysis conducted by Follmer, 2018, reveals a moderate, positive correlation between executive function skills and reading comprehension), it seems important to investigate approaches to reading instruction for ELs with reading difficulties that incorporate executive function and/or self-regulation training components. The few studies that have rigorously evaluated interventions solely designed to impact executive function provide some evidence that executive function skills can be influenced by intervention, but no compelling evidence that impacts on executive function lead to increases in academic achievement (Jacob & Parkinson, 2015). That said, there is some evidence as to the effectiveness of reading instruction that incorporates training in self-regulation skills in improving reading outcomes, at least for participants who are monolingual English speakers with reading difficulties (e.g., Berkeley, Mastropieri, & Scruggs, 2011; Mason, 2013). Reading interventions that integrate self-regulation training may prove to be effective in improving reading achievement for EL students with reading difficulties and are thus worthy of further study.

Finally, we believe that it would be valuable for future research to reveal the degree to which EL students with different language and/or learning profiles respond differentially to particular instructional practices. ELs with learning difficulties represent a diverse population of students; they bring to the classroom a broad variety of strengths and needs and varying degrees of proficiency in their native languages as well as in English. We realize that measurement collection is often limited by real constraints that include school district limits of the amount or nature of assessment as well as resources available to collect necessary language measures; nevertheless, future research would benefit from an effort to provide detailed information and disaggregated data based on student language proficiency (in both the native language and in English), SES, LD classification, and other student-level variables.

Further research on student-level variables may examine the effects of self-regulatory ability, motivation, and engagement on reading achievement and response to reading instruction. As discussed in the context of the underlying common core cognitive processes hypothesis, self-regulation has a significant impact on reading achievement. Still, little work has been done examining (a) the relationship between self-regulation and learning/reading achievement for ELs, and/or (b) the effects of self-regulation interventions on learning for EL students. Studies of best practices for both

training and assessing self-regulation in ELs with reading difficulties are called for. The related factors of motivation and engagement are well known to affect students' reading achievement and to promote better self-regulation of reading behaviors (Horner & Shwery, 2002). Research regarding ELs with reading difficulties will need to focus on how to overcome barriers to motivation and engagement stemming from factors such as low parental involvement in education and sense of self-efficacy in English.

Research that isolates some of these characteristics of EL research participants and examines how they influence response to instructional practices will better inform which ELs respond to specific approaches to instruction and under what conditions. For example, students with very low English language and very low literacy may require different interventions than students with moderate English language and very low literacy. Students with language and literacy needs who also demonstrate learning disabilities are likely to be as different from each other as they are from typically developing learners. For this reason, it is crucial that future research address the varied characteristics of EL participants and their impact on response to instructional practices.

CONCLUSION

Theoretical frameworks for understanding how children acquire and gain proficiency in reading (e.g., the RSF [Perfetti & Stafura, 2014] and the SVR [Gough & Tunmer, 1986]) validated with samples of ELs and students with significant reading difficulties posit that there are multiple sources of knowledge (e.g., orthographic and semantic knowledge) related to reading that interact with each other in ways that can facilitate or inhibit reading comprehension. For those aiming to prevent or remediate reading difficulties experienced by ELs, it is crucial to determine whether the reading difficulties experienced by ELs are caused by deficits in (a) phonological processing (and the integration of phonological, orthographic, and semantic information during word recognition), (b) linguistic comprehension, or (c) a combination of the two. There is evidence that phonological processing underlies reading across languages (Geva & Ryan, 1993) such that, when students have received instruction in their native language, native language phonological processing is a good predictor of English language phonological processing, even when English language skill is still developing (Durgunoglu et al., 1993). For this reason, when determining if an EL has an underlying phonological processing deficit, it may be helpful to assess a student's phonological processing skill in their native language, as well as in English, when the student is still developing English proficiency. In addition, if an EL student is still lagging behind EL and EO peers in phonological awareness and/or phonics knowledge after explicit, systematic, engaging instruction in English language phonological awareness and/or phonics, then it is reasonable to assume that the student is at risk for a reading disability (Melby-Lervåg & Lervåg, 2014; O'Connor et al., 2018). The good news is that there is ample research investigating the effects of instructional interventions targeting word reading for ELs with word-level reading disabilities, and the implications of research findings are clear. Many large-scale experimental and quasi-experimental design studies—several of which were described in this chapter—suggest the benefit of multiple-component reading instruction that includes phonological awareness and phonics instruction for kindergarten-aged and Grade 1 ELs with or at risk for word reading disabilities.

Research suggests that linguistic comprehension difficulties and, specifically, vocabulary deficits play a leading role in explaining why ELs with reading comprehension difficulties in the upper elementary and secondary grades struggle to keep pace with their grade-level peers (e.g., Cho et al., in press; Droop & Verhoeven, 2003). It is tremendously difficult to ascertain whether a student's linguistic comprehension difficulties are caused by the student's status as an EL (i.e., the student is learning English and thus, by definition, has less English language knowledge than EO peers) or by an LD. Regardless of their root cause, though, it is important to address deficits in vocabulary knowledge by means of vocabulary instruction that provides opportunities for students to discover nuances in word meaning, understand usage of vocabulary words across multiple contexts, and use vocabulary words during expressive language exercises as well as receptive ones (Vadasy, Sanders, & Nelson, 2015). However, approaches to vocabulary, listening comprehension, and reading comprehension instruction for ELs with reading difficulties are relatively unstudied. Future research would do well to investigate the effects of intensive approaches to vocabulary, listening comprehension, and reading comprehension instruction on reading comprehension for ELs with or at risk for reading disabilities.

NOTES

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- 2 Note, though, that there is some evidence that ELs with LD are identified late in their educational careers relative to EO students with LD. The fact that educators and administrators are increasingly aware of the phenomenon of overidentification and its causes (e.g., biased assessment practices that misconstrue lack of proficiency in English and/or of hegemonic cultural knowledge as constituting an LD) may be associated with the emergence of an under-identification problem in U.S. elementary schools. In many districts, a commitment to minimize bias in assessment has resulted in delayed assessment, identification, and treatment of primary grade ELs who are struggling academically. For example, Artiles, Rueda, Salazar, and Higuera (2005) reported that, in certain California districts, ELs were slightly underrepresented in special education programs in the early elementary school grades at the same time that they were disproportionately represented in such programs after Grade 5. This is problematic because of what we know about the potential for early educational interventions to prevent reading difficulties in students identified as being at risk.
- 3 There is conflicting evidence about the degree to which RAN and phonological processing represent distinct core cognitive processes. Petrill, Deater-Deckard, Thompson, Dethorne, and Schatschneider (2006) determined that RAN and phonological processing were moderately correlated but factorially distinct at a latent variable level (with phonological awareness having both genetic and environmental influences and rapid naming having only genetic influences). Conversely, there is also evidence that RAN difficulties may be a subtype or a manifestation of underlying phonological processing difficulties, and thus that they do not constitute a distinct core cognitive process (e.g., Compton, DeFries, & Olson, 2001; Schatschneider, Carlson, Francis, Foorman, & Fletcher, 2002).
- 4 Some controversy exists regarding whether short-term memory is a subset of or a process distinct from working memory (Baddeley, 1986; Swanson, Sáez, & Gerber, 2006). As is typical for the literature, we use short-term memory to refer to repetition tasks, whereas working memory refers to tasks that require manipulation of information.
- 5 Executive function and self-regulation constructs can be complex to distinguish, and some research has suggested that they may be condensed into one construct (e.g., Zhou, Chen, & Main, 2012). Here, we acknowledge the close relationship between the two concepts but primarily refer to self-regulatory processes in reading.

- 6 Note that some research suggests that the addition of variables such as fluency/processing speed (Braze et al., 2007; Cutting & Scarborough, 2006; Joshi & Aaron, 2000) or morphological knowledge (Shankweiler, Lundquist, Dreyer, & Dickinson, 1996) to the SVR may provide for a more complete model of reading. There is evidence that the addition of a separate vocabulary knowledge variable may have the potential to explain unique variance in students' reading comprehension (e.g., Braze et al., 2007; Ouellette & Beers, 2010), including and perhaps especially for students who are English learners (Cho et al., in press; Proctor et al., 2005).
- 7 See Kirby and Savage (2008), Savage (2006), and Savage and Wolforth (2007) for contrasting evidence that the relationship between word reading and linguistic comprehension is additive rather than multiplicative, at least for EO students.
- 8 The strength of the relations between word reading, linguistic comprehension, and reading comprehension in the SVR will indeed vary based on how the component skills and product term are measured. For example, Keenan et al. (2008) showed that the relative effects of word reading and linguistic comprehension on reading comprehension will vary for the same student based on the reading comprehension test used. Francis et al. (2005) determined through latent trait modeling that there was a stronger relationship between decoding and comprehension when comprehension was assessed with a cloze test than with multiple-choice questions. Cutting and Scarborough (2006) demonstrated that decoding skills accounted for twice as much variance in students' Wechsler Individual Achievement Text (WIAT; Wechsler, 1992) performances (11.9%) than they did for their Gates–MacGinitie Reading Test—Revised (G–M; MacGinitie, MacGinitie, Maria, & Dreyer, 2000) or Gray Oral Reading Test—Third Edition (GORT-3; Wiederholt & Bryant, 1992) performances. Conversely, oral language skill accounted for more variance in G–M performances (15%) than either WIAT or GORT-3 performances (9%). The relationships between word reading, linguistic comprehension, and reading comprehension may also differ depending on the way that word reading skill and linguistic comprehension are assessed (e.g., if word reading is assessed via an untimed non-word reading measure rather than a timed measure of word reading efficiency; if linguistic comprehension is operationalized as breadth of vocabulary knowledge rather than as a latent variable that includes vocabulary knowledge, knowledge of grammar and syntax, listening comprehension, and/or other sentence- and passage-level discourse processing skills).
- 9 Interestingly, in this study, Dutch learners' comprehension of oral text was more dependent on their vocabulary knowledge than monolingual Dutch speakers' was (for monolingual children, morpho-syntactic knowledge was the most important predictor of listening comprehension).
- 10 Upper elementary and middle grade typically developing EL students who have attended school since Grade 1 perform similarly to typically developing EO students on assessments of phonological and orthographic knowledge (e.g., Melby-Lervåg & Lervåg, 2014; O'Connor et al., 2018).
- 11 Even if it is inadvisable to shift the focus too dramatically from word reading to vocabulary/comprehension for ELs with word reading difficulties, it is nevertheless important not to neglect vocabulary development, if only for the reason that semantic knowledge contributes even to word reading (Perfetti & Stafura, 2014). It is useful for ELs to receive support understanding the meanings of words on high-frequency word lists or other lists of words used during reading fluency instruction (note that teachers may be able to draw upon ELs' primary language knowledge by identifying cognates).

REFERENCES

- Adlof, S. M., Catts, H. W., & Little, T. D. (2006). Should the simple view of reading include a fluency component? *Reading and Writing, 19*(9), 933–958.
- Ahmed, Y., Francis, D. J., York, M., Fletcher, J. M., Barnes, M., & Kulesz, P. (2016). Validation of the direct and inferential mediation (DIME) model of reading comprehension in Grades 7 through 12. *Contemporary Educational Psychology, 44*, 68–82.
- Antoniou, M. (2019). The advantages of bilingualism debate. *Annual Review of Linguistics, 5*(1), 395–415.
- Araújo, S., Reis, A., Petersson, K. M., & Faísca, L. (2015). Rapid automatized naming and reading performance: A meta-analysis. *Journal of Educational Psychology, 107*(3), 868–883.
- Archer, A. L., Gleason, M. M., & Vachon, V. L. (2003). Decoding and fluency: Foundation skills for struggling older readers. *Learning Disabilities Quarterly, 26*(2), 89–101.
- Artiles, A. J., Rueda, R., Salazar, J. J., & Higareda, I. (2005). Within-group diversity in minority disproportionate representation: English language learners in urban school districts. *Exceptional Children, 71*(3), 283–300.

- August, D., & Hakuta, K. (1997). *Improving schooling for language-minority children: A research agenda*. Washington, DC: National Academy Press.
- August, D. L., & Siegel, L. S. (2006). Literacy instruction for language-minority children in special education settings. In D. L. August & T. Shanahan (Eds.), *Developing literacy in a second language: Report of the National Literacy Panel* (pp. 1–19). Mahwah, NJ: Lawrence Erlbaum.
- Babayiğit, S. (2014). The role of oral language skills in reading and listening comprehension of text: A comparison of monolingual (L1) and bilingual (L2) speakers of English language. *Journal of Research in Reading*, 37, 22–47.
- Baddeley, A. D. (1986). *Working memory*. London: Oxford University Press.
- Baker, D. L., Burns, D., Kame'enui, E. J., Smolkowski, K., & Baker, S. K. (2016). Does supplemental instruction support the transition from Spanish to English reading instruction for first-grade English learners at risk of reading difficulties? *Learning Disability Quarterly*, 39(4), 226–239.
- Baker, L., & Wigfield, A. (1999). Dimensions of children's motivation for reading and their relations to reading activity and reading achievement. *Reading Research Quarterly*, 34(4), 452–477.
- Baker, S., Lesaux, N., Jayanthi, M., Dimino, J., Proctor, C. P., Morris, J., ... Newman-Gonchar, R. (2014). *Teaching academic content and literacy to English learners in elementary and middle school (NCEE 2014-4012)*. Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from http://ies.ed.gov/ncee/wwc/pdf/practice_guides/english_learners_pg_040114.pdf
- Beck, I. L., & McKeown, M. G. (2007). Increasing young low-income children's oral vocabulary repertoires through rich and focused instruction. *The Elementary School Journal*, 107(3), 251–271.
- Begeny, J. C., Ross, S. G., Greene, D. J., Mitchell, R. C., & Whitehouse, M. H. (2012). Effects of the helping early literacy with practice strategies (HELPS) reading fluency program with Latino English language learners: A preliminary evaluation. *Journal of Behavioral Education*, 21, 134–149.
- Berkeley, S., & Larsen, A. (2018). Fostering self-regulation of students with learning disabilities: Insights from 30 years of reading comprehension intervention research. *Learning Disabilities Research & Practice*, 33(2), 75–86.
- Berkeley, S., Mastropieri, M. A., & Scruggs, T. E. (2011). Reading comprehension strategy instruction and attribution retraining for secondary students with learning and other mild disabilities. *Journal of Learning Disabilities*, 44(1), 18–32.
- Bialystok, E. (2009). Bilingualism: The good, the bad, and the indifferent. *Bilingualism: Language and Cognition*, 12(1), 3–11.
- Bialystok, E., McBride-Chang, C., & Luk, G. (2005). Bilingualism, language proficiency, and learning to read in two writing systems. *Journal of Educational Psychology*, 97(4), 580–590.
- Blachowicz, C. L. Z., Fisher, P. J. L., Ogle, D., & Watts-Taffe, S. (2006). Vocabulary: Questions from the classroom. *Reading Research Quarterly*, 41(4), 524–539.
- Blair, C. (2010). Stress and the development of self-regulation in context. *Child Development Perspectives*, 4(3), 181–188.
- & Raver, C. C. (2012). Child development in the context of adversity: experiential canalization of brain and behavior. *American Psychologist*, 67(4), 309–318.
- Boardman, A. G., Roberts, G., Vaughn, S., Wexler, J., Murray, C. S., & Kosanovich, M. (2008). *Effective instruction for adolescent struggling readers: A practice brief*. Portsmouth, NH: RMC Research Corporation, Center on Instruction.
- Bos, C. S., Allen, A. A., & Scanlon, D. J. (1989). Vocabulary instruction and reading comprehension with bilingual learning disabled students. *National Reading Conference Yearbook*, 38, 173–179.
- Branum-Martin, L., Mehta, P. D., Fletcher, J. M., Carlson, C. D., Ortiz, A., Carlo, M., & Francis, D. J. (2006). Bilingual phonological awareness: Multilevel construct validation among Spanish-speaking kindergarteners in transitional bilingual education classrooms. *Journal of Educational Psychology*, 98(1), 170–181.
- Braze, D., Tabor, W., Shankweiler, D. P., & Mencl, W. E. (2007). Speaking up for vocabulary: Reading skill differences in young adults. *Journal of Learning Disabilities*, 40(3), 226–243.
- Brown, A. L., & Day, J. D. (1983). Macrorules for summarizing texts: The development of expertise. *Journal of Verbal Learning and Verbal Behavior*, 22(1), 1–14.
- Cadima, J., Gamela, A., McClelland, M., & Peixoto, C. (2015). Associations between early family risk, children's behavioral regulation, and academic achievement in Portugal. *Early Education and Development*, 25(4), 1–2.

- Cain, K., Oakhill, J., & Bryant, P. (2000). Phonological skills and comprehension failure: A test of the phonological processing deficit hypothesis. *Reading and Writing, 13*(1), 31–56.
- Cain, K., Oakhill, J., & Bryant, P. (2004). Children's reading comprehension ability: Concurrent prediction by working memory, verbal ability, and component skills. *Journal of Educational Psychology, 96*(1), 31–42.
- Capps, R., Fix, M., Murray, J., Ost, J., Passel, J. S., & Herwantoro, S. (2005). *The new demography of America's schools: Immigration and the No Child Left Behind Act*. Washington, DC: Urban Institute.
- Carr, S. C., & Thompson, B. (1996). The effects of prior knowledge and schema activation strategies on the inferential reading comprehension of children with and without learning disabilities. *Learning Disability Quarterly, 19*(1), 48–61.
- Carroll, J. M., Maughan, B., Goodman, R., & Meltzer, H. (2005). Literacy difficulties and psychiatric disorders: Evidence for comorbidity. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 46*(5), 524–532.
- Catts, H. W., Adlof, S. M., & Weismer, S. E. (2006). Language deficits in poor comprehenders: A case for the simple view of reading. *Journal of Speech, Language, and Hearing Research, 49*(2), 278–293.
- Cheung, A. C., & Slavin, R. E. (2012). How features of educational technology applications affect student reading outcomes: A meta-analysis. *Educational Research Review, 7*(3), 198–215.
- Chiappe, P., Siegel, L. S., & Wade-Woolley, L. (2002). Linguistic diversity and the development of reading skills: A longitudinal study. *Scientific Studies of Reading, 6*(4), 369–400.
- Cho, E., Capin, P., Roberts, G. J., Roberts, G., & Vaughn, S. (in press). Examining sources and mechanisms of reading comprehension difficulties: Comparing English learners and non-English learners within the simple view of reading. *Journal of Educational Psychology, 111*(6), 982–1000.
- Chrysochoou, E., Bablekou, Z., & Tsigilis, N. (2011). Working memory contributions to reading comprehension components in middle childhood children. *The American Journal of Psychology, 124*(3), 275–289.
- Cirino, P. T., Miciak, J., Gerst, E., Barnes, M. A., Vaughn, S., Child, A., & Huston-Warren, E. (2017). Executive function, self-regulated learning, and reading comprehension: A training study. *Journal of Learning Disabilities, 50*(4), 450–467.
- Ciullo, S., Lo, Y.-L. S., Wanzek, J., & Reed, D. K. (2016). A synthesis of research on informational text reading interventions for elementary students with learning disabilities. *Journal of Learning Disabilities, 49*(3), 257–271.
- Collier, C., & Hoover, J. J. (1987). Sociocultural considerations when referring minority children for learning disabilities. *Learning Disabilities Focus, 3*(1), 39–45.
- Compton, D. L., DeFries, J. C., & Olson, R. K. (2001). Are RAN- and phonological awareness-deficits additive in children with reading disabilities? *Dyslexia (Chichester, England), 7*(3), 125–149.
- Cordero-Ponce, W. L. (2000). Summarization instruction: Effects on foreign language comprehension and summarization of expository texts. *Literacy Research and Instruction, 39*(4), 329–350.
- Cosentino de Cohen, C., Deterding, N., & Clewell, B. C. (2005). *Who's left behind? Immigrant children in high and low LEP schools*. Washington, DC: Urban Institute.
- Cromley, J. G., & Azevedo, R. (2007). Testing and refining the direct and inferential mediation model of reading comprehension. *Journal of Educational Psychology, 99*(2), 311–325.
- Currie, N. K., & Cain, K. (2015). Children's inference generation: The role of vocabulary and working memory. *Journal of Experimental Child Psychology, 137*, 57–75.
- Cutting, L. E., & Scarborough, H. S. (2006). Prediction of reading comprehension: Relative contributions of word recognition, language proficiency, and other cognitive skills can depend on how comprehension is measured. *Scientific Studies of Reading, 10*(3), 277–299.
- Dignath, C., Buettner, G., & Langfeldt, H.-P. (2008). How can primary school students learn self-regulated learning strategies most effectively? A meta-analysis on self-regulation training programmes. *Educational Research Review, 3*(2), 101–129.
- Droop, M., & Verhoeven, L. (2003). Language proficiency and reading ability in first-and second-language learners. *Reading Research Quarterly, 38*(1), 78–103.
- Durgunoğlu, A. Y. (2002). Cross-linguistic transfer in literacy development and implications for language learners. *Annals of Dyslexia, 52*, 189–204.
- Durgunoğlu, A. Y., Nagy, W. E., & Hancin-Bhatt, B. J. (1993). Cross-language transfer of phonological awareness. *Journal of Educational Psychology, 85*(3), 453–465.
- Elbro, C., & Buch-Iversen, I. (2013). Activation of background knowledge for inference making: Effects on reading comprehension. *Scientific Studies of Reading, 17*(6), 435–452.

- Elleman, A. M., & Compton, D. L. (2017). Beyond comprehension strategy instruction: What's next? *Language, Speech, and Hearing Services in Schools*, 48(2), 84–91.
- Erdos, C., Genesee, F., Savage, R., & Haigh, C. (2014). Predicting risk for oral and written language learning difficulties in students educated in a second language. *Applied Psycholinguistics*, 35(2), 371–398.
- Farnia, F., & Geva, E. (2011). Cognitive correlates of vocabulary growth in English language learners. *Applied Psycholinguistics*, 32, 711–738.
- Farnia, F., & Geva, E. (2013). Growth and predictors of change in English language learners' reading comprehension. *Journal of Research in Reading*, 36(4), 389–421.
- Fisher, D., Frey, N., & Lapp, D. (2011). Coaching middle-level teachers to think aloud improves comprehension instruction and student reading achievement. *Teacher Educator*, 46(3), 231–243.
- Fletcher, J. M., Lyon, G. R., Fuchs, L. S., & Barnes, M. A. (2018). *Learning disabilities: From identification to intervention*. New York, NY: Guilford Press.
- Follmer, D. J. (2018). Executive function and reading comprehension: A meta-analytic review. *Educational Psychologist*, 53(1), 42–60.
- Francis, D. J., Fletcher, J. M., Catts, H. W., & Tomblin, J. B. (2005). Dimensions affecting the assessment of reading comprehension. In S. G. Paris & S. A. Stahl (Eds.), *Children's reading comprehension and assessment* (pp. 369–394). Mahwah, NJ: Lawrence Erlbaum.
- Fry, R., & Gonzales, F. (2008). *One-in-five and growing fast: A profile of Hispanic public school students*. Washington, DC: Pew Research Center.
- García, J. R., & Cain, K. (2014). Decoding and reading comprehension: A meta-analysis to identify which reader and assessment characteristics influence the strength of the relationship in English. *Review of Educational Research*, 84(1), 74–111.
- Genesee, F., Lindholm-Leary, K., Saunders, W. M., & Christian, D. (2006). Conclusions and future directions. In F. Genesee, K. Lindholm-Leary, W. M. Saunders, & D. Christian (Eds.), *Educating English learners: A synthesis of research evidence* (pp. 223–234). Cambridge: Cambridge University Press.
- Gerber, M., Jimenez, T., Leafstedt, J. M., Villaruz, J., Richards, C., & English, J. (2004). English reading effects of small-group intensive intervention in Spanish K-1 English learners. *Learning Disabilities Research and Practice*, 19(4), 239–251.
- Geva, E., & Ryan, E. B. (1993). Linguistic and cognitive correlates of academic skills in first and second languages. *Language Learning*, 43(1), 5–42.
- Geva, E., Xi, Y., Massey-Garrison, A., & Mak, J. (2018). Assessing reading in second language learners: Development, validity and educational considerations. In D. A. Kilpatrick, R. M. Joshi, & R. K. Wagner (Eds.), *Reading development and difficulties* (pp. 117–158). New York: Springer.
- Gottardo, A., Collins, P., Baciú, I., & Gebotys, R. (2008). Predictors of grade 2 word reading and vocabulary learning from grade 1 variables in Spanish-speaking children: Similarities and differences. *Learning Disabilities Research & Practice*, 23(1), 11–24.
- Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability. *Remedial and Special Education*, 7(1), 6–10.
- Grant, A., Gottardo, A., & Geva, E. (2011). Reading in English as a first or second language: The case of grade 3 Spanish, Portuguese, and English speakers. *Learning Disabilities Research & Practice*, 26(2), 67–83.
- Graves, M. F. (2006). *The vocabulary book: Learning and instruction*. New York, NY: Teachers College Press.
- Gunn, B., Biglan, A., Smolkowski, K., & Ary, D. (2000). The efficacy of supplemental instruction in decoding skills for Hispanic and non-Hispanic students in early elementary school. *The Journal of Special Education*, 34(2), 90–103.
- Hall, C., Kent, S. C., McCulley, L., Davis, A., & Wanzek, J. (2013). A new look at mnemonics and graphic organizers in the secondary social studies classroom. *TEACHING Exceptional Children*, 46(1), 47–55.
- Hall, C., Roberts, G. J., Cho, E., McCulley, L. V., Carroll, M., & Vaughn, S. (2017). Reading instruction for English learners in the middle grades: A meta-analysis. *Educational Psychology Review*, 29, 763–794.
- Hernandez, D. J., Denton, N. A., & Macartney, S. E. (2008). Children in immigrant families: Looking to America's future. *Society for Research in Child Development*, 22, 3.
- Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing*, 2(2), 127–160.
- Hoover, W. A., & Tunmer, W. E. (1993). The components of reading. In G. B. Thompson, W. E. Tunmer, & T. Nicholson (Eds.), *Reading acquisition processes* (pp. 1–19). Clevedon, UK: Multilingual Matters.
- Horner, S. L., & Shwery, C. S. (2002). Becoming an engaged, self-regulated reader. *Theory into Practice*, 41(2), 102–109.

- Hulme, C., Bowyer-Crane, C., Carroll, J. M., Duff, F. J., & Snowling, M. J. (2012). The causal role of phoneme awareness and letter-sound knowledge in learning to read: Combining intervention studies with mediation analyses. *Psychological Science*, 23(6), 572–577.
- Hulme, C., & Snowling, M. J. (2009). *Developmental disorders of language, learning and cognition*. Oxford: Wiley-Blackwell.
- Jacob, R., & Parkinson, J. (2015). The potential for school-based interventions that target executive function to improve academic achievement: A review. *Review of Educational Research*, 85(4), 512–552.
- Jared, D., Cormier, P., Levy, B. A., & Wade-Woolley, L. (2011). Early predictors of biliteracy development in children in French immersion: A 4-year longitudinal study. *Journal of Educational Psychology*, 103(1), 119–139.
- Johnston, T. C., & Kirby, J. R. (2006). The contribution of naming speed to the simple view of reading. *Reading and Writing*, 19(4), 339–361.
- Joshi, R. M., & Aaron, P. G. (2000). The component model of reading: Simple view of reading made a little more complex. *Reading Psychology*, 21(2), 85–97.
- Kamps, D., Abbott, M., Greenwood, C., Arreaga-Mayer, C., Wills, H., Longstaff, J., ... Walton, C. (2007). Use of evidence-based, small-group reading instruction for English language learners in elementary grades: Secondary-tier intervention. *Learning Disability Quarterly*, 30(3), 153–168.
- Keenan, J. M., Betjemann, R. S., & Olson, R. K. (2008). Reading comprehension tests vary in the skills they assess: Differential dependence on decoding and oral comprehension. *Scientific Studies of Reading*, 12(3), 281–300.
- Kieffer, M. J., & Vukovic, R. K. (2012). Components and context: Exploring sources of reading difficulties for language minority learners and native English speakers in urban schools. *Journal of Learning Disabilities*, 45(5), 433–452.
- Kintsch, W. (1988). The role of knowledge in discourse comprehension: A construction-integration model. *Psychological Review*, 95(2), 163–182.
- Kirby, J. R., & Savage, R. S. (2008). Can the simple view deal with the complexities of reading? *Literacy*, 42(2), 75–82.
- Klingner, J. K., Artiles, A. J., & Barletta, L. M. (2006). English language learners who struggle with reading: Language acquisition or LD? *Journal of Learning Disabilities*, 39(2), 108–128.
- Klingner, J. K., Morrison, A., & Eppolito, A. (2011). Metacognition to improve reading comprehension. In R. E. O'Connor & P. F. Vadasy (Eds.), *Handbook of reading interventions* (pp. 220–253). New York, NY: Guilford Press.
- Kudo, M. F., Lussier, C. M., & Swanson, H. L. (2015). Reading disabilities in children: A selective meta-analysis of the cognitive literature. *Research in Developmental Disabilities*, 40, 51–62.
- Language and Reading Research Consortium. (2015). Learning to read: Should we keep it simple? *Reading Research Quarterly*, 50, 151–169.
- Leafstedt, J. M., Richards, C. R., & Gerber, M. M. (2004). Effectiveness of explicit phonological-awareness instruction for at-risk English learners. *Learning Disabilities Research Practice*, 19(4), 252–261.
- Lee, C. D., & Spratley, A. (2010). *Reading in the disciplines: The challenges of adolescent literacy*. Carnegie Corporation of New York. Retrieved from <https://eric.ed.gov/?id=ED535297>
- Lesaux, N. K. (2006). Development of literacy. In D. August & T. Shanahan (Eds.), *Developing literacy in second-language learners: Report of the National Literacy Panel on language-minority children and youth* (pp. 75–122). Mahwah, NJ: Lawrence Erlbaum.
- Lesaux, N. K. (2015). Reading development among English language learners. In C. M. Connor & P. McCardle (Eds.), *Advances in reading intervention: Research to practice to research* (pp. 155–165). Baltimore, MD: Brookes.
- Lesaux, N. K., Kieffer, M. J., Faller, S. E., & Kelley, J. G. (2010). The effectiveness and ease of implementation of an academic vocabulary intervention for linguistically diverse students in urban middle schools. *Reading Research Quarterly*, 45, 196–228.
- Lesaux, N. K., Kieffer, M. J., Kelley, J. G., & Harris, J. R. (2014). Effects of academic vocabulary instruction for linguistically diverse adolescents: Evidence from a randomized field trial. *American Educational Research Journal*, 51(6), 1159–1194.
- Lesaux, N. K., Rupp, A. A., & Siegel, L. S. (2007). Growth in reading skills of children from diverse linguistic backgrounds: Findings from a 5-year longitudinal study. *Journal of Educational Psychology*, 99(4), 821–834.

- Lesaux, N. K., & Siegel, L. S. (2003). The development of reading in children who speak English as a second language. *Developmental Psychology*, 39(6), 1005–1019.
- Lindsey, K. A., Manis, F. R., & Bailey, C. E. (2003). Prediction of first-grade reading in Spanish-speaking English-language learners. *Journal of Educational Psychology*, 95(3), 482–494.
- Lovett, M. W., De Palma, M., Frijters, J., Steinbach, K., Temple, M., Benson, N., & Lacerenza, L. (2008). Interventions for reading difficulties: A comparison of response to intervention by ELL and EFL struggling readers. *Journal of Learning Disabilities*, 41(4), 333–352.
- MacGinitie, W. H., MacGinitie, R. K., Maria, K., & Dreyer, L. G. (2000). *Gates–MacGinitie reading tests, fourth edition*. Itasca, IL: Riverside.
- Mancilla-Martinez, J., Kieffer, M. J., Biancarosa, G., Christodoulou, J. A., & Snow, C. E. (2011). Investigating English reading comprehension growth in adolescent language minority learners: Some insights from the simple view. *Reading and Writing: An Interdisciplinary Journal*, 24(3), 339–354.
- Marinova-Todd, S. H., Zhao, J., & Bernhardt, M. (2010). Phonological awareness skills in the two languages of Mandarin-English bilingual children. *Clinical Linguistics & Phonetics*, 24(4–5), 387–400.
- Mason, L. H. (2013). Teaching students who struggle with learning to think before, while, and after reading: Effects of self-regulated strategy development instruction. *Reading & Writing Quarterly*, 29(2), 124–144.
- McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology*, 43(4), 947–959.
- McClelland, M. M., & Wanless, S. B. (2012). Growing up with assets and risks: The importance of self-regulation for academic achievement. *Research in Human Development*, 9(4), 278–297.
- Melby-Lervåg, M., & Lervåg, A. (2014). Reading comprehension and its underlying components in second-language learners: A meta-analysis of studies comparing first- and second-language learners. *Psychological Bulletin*, 140(2), 409–433.
- Melby-Lervåg, M., Lyster, S.-A. H., & Hulme, C. (2012). Phonological skills and their role in learning to read: A meta-analytic review. *Psychological Bulletin*, 138(2), 322–352.
- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. *Cognitive Psychology*, 41(1), 49–100.
- Moll, K., Kunze, S., Neuhoﬀ, N., Bruder, J., & Schulte-Körne, G. (2014). Specific learning disorder: Prevalence and gender differences. *PLoS One*, 9(7), e103537.
- Nakamoto, J., Lindsey, K. A., & Manis, F. R. (2007). A longitudinal analysis of English language learners' word decoding and reading comprehension. *Reading and Writing*, 20(7), 691–719.
- Nakamura, P. R., Koda, K., & Joshi, R. M. (2014). Biliteracy acquisition in Kannada and English: A developmental study. *Writing Systems Research*, 6(1), 132–147.
- Nation, K., Adams, J. W., Bowyer-Crane, C. A., & Snowling, M. J. (1999). Working memory deficits in poor comprehenders reflect underlying language impairments. *Journal of Experimental Child Psychology*, 73(2), 139–158.
- National Center for Education Statistics (2016). *English language learner (ELL) students enrolled in public elementary and secondary schools, by grade, home language, and selected student characteristics: Selected years, 2008–09 through fall 2014 (Table 204.27)*. Washington, DC: Institute for Education Sciences. Retrieved from: https://nces.ed.gov/programs/digest/d16/tables/dt16_204.27.asp
- National Center for Education Statistics. (2017). *Digest of education statistics*. Washington, DC: Institute for Education Sciences.
- National Clearinghouse for English Acquisition and Instruction Educational Programs. (2017). *Fast facts: Students with disabilities who are language learners*. Retrieved from https://ncela.ed.gov/files/fast_facts/05-19-2017/ELStudentsWithDisabilities_FastFacts_4p.pdf
- O'Connor, M., Geva, E., & Koh, P. W. (2018). Examining reading comprehension profiles of grade 5 monolinguals and English language learners through the lexical quality hypothesis lens. *Journal of Learning Disabilities*, 52(3), 232–246.
- O'Connor, R. E., Bocian, K., Beebe-Frankenberger, M., & Linklater, D. L. (2010). Responsiveness of students with language difficulties to early intervention in reading. *The Journal of Special Education*, 43(4), 220–235.
- Ouellette, G., & Beers, A. (2010). A not-so-simple view of reading: How oral vocabulary and visual-word recognition complicate the story. *Reading and Writing*, 23(2), 189–208.

- Pastor, P. N., & Reuben, C. A. (2008). *Diagnosed attention deficit hyperactivity disorder and learning disability: United States, 2004-2006. Data from National Health Interview Survey. Vital and Health Statistics. Series 10, Number 237*. Atlanta, GA: Centers for Disease Control and Prevention.
- Perfetti, C. (2007). Reading ability: Lexical quality to comprehension. *Scientific Studies of Reading*, 11(4), 357-383.
- & Stafura, J. (2014). Word knowledge in a theory of reading comprehension. *Scientific Studies of Reading*, 18(1), 22-37.
- Perfetti, C. A., & Hart, L. (2001). The lexical bases of comprehension skill. In D. Gorfien (Ed.), *On the consequences of meaning selection* (pp. 67-86). Washington, DC: American Psychological Association.
- (2002). The lexical quality hypothesis. *Precursors of Functional Literacy*, 11, 67-86.
- Perfetti, C. A., Landi, N., & Oakhill, J. (2005). The acquisition of reading comprehension skill. In M. J. Snowling & C. Hulme (Eds.), *The science of reading: A handbook* (pp. 227-247). Malden, MA: Blackwell.
- Petrill, S. A., Deater-Deckard, K., Thompson, L. A., Dethorne, L. S., & Schatschneider, C. (2006). Reading skills in early readers: Genetic and shared environmental influences. *Journal of Learning Disabilities*, 39(1), 48-55.
- Proctor, C. P., Carlo, M., August, D., & Snow, C. (2005). Native Spanish-speaking children reading in English: Toward a model of comprehension. *Journal of Educational Psychology*, 97(2), 246.
- Richards-Tutor, C., Baker, D. L., Gersten, R., Baker, S. K., & Smith, J. M. (2016). The effectiveness of reading interventions for English learners: A research synthesis. *Exceptional Children*, 82(2), 144-169.
- Rivera, M. O., Moughamian, A. C., Lesaux, N. K., & Francis, D. J. (2009). *Language and reading interventions for English language learners and English language learners with disabilities*. Portsmouth, NH: RMC Research Corporation, Center on Instruction.
- Saiegh-Haddad, E., & Geva, E. (2010). Acquiring reading in two languages: An introduction to the special issue. *Reading and Writing*, 23(3), 263-267.
- Savage, R. (2006). Effective early reading instruction and inclusion: Some reflections on mutual dependence. *International Journal of Inclusive Education*, 10(4-5), 347-361.
- Savage, R., & Wolforth, J. (2007). An additive simple view of reading describes the performance of good and poor readers in higher education. *Exceptionality Education Canada*, 17(2), 243-268.
- Scammacca, N. K., Roberts, G., Vaughn, S., & Stuebing, K. K. (2015). A meta-analysis of interventions for struggling readers in grades 4-12: 1980-2011. *Journal of Learning Disabilities*, 48(4), 369-390.
- Schatschneider, C., Carlson, C. D., Francis, D. J., Foorman, B. R., & Fletcher, J. M. (2002). Relationship of rapid automatized naming and phonological awareness in early reading development: Implications for the double-deficit hypothesis. *Journal of Learning Disabilities*, 35(3), 245-256.
- Schunk, D. H., & Zimmerman, B. J. (2007). Influencing children's self-efficacy and self-regulation of reading and writing through modeling. *Reading & Writing Quarterly*, 23(1), 7-25.
- Sektnan, M., McClelland, M. M., Acock, A., & Morrison, F. J. (2010). Relations between early family risk, children's behavioral regulation, and academic achievement. *Early Childhood Research Quarterly*, 25(4), 464-479.
- Shanahan, T., & Beck, I. L. (2006). Effective literacy teaching for English-language learners. In D. L. August & T. Shanahan (Eds.), *Developing literacy in a second language: Report of the National Literacy Panel* (pp. 415-448). Mahwah, NJ: Lawrence Erlbaum.
- Shanahan, T., Callison, K., Carriere, C., Duke, N. K., Persson, P. D., Schatschneider, C., & Torgesen, J. (2010). *Improving reading comprehension in kindergarten through 3rd grade: A practice guide (NCEE 2010-4038)*. Washington, DC: National Center for Education Sciences, US Department of Education. Retrieved from whatworks.ed.gov/publications/practiceguides
- Shankweiler, D., & Crain, S. (1986). Language mechanisms and reading disorder: A modular approach. *Cognition*, 24(1-2), 139-168.
- Shankweiler, D., Lundquist, E., Dreyer, L. G., & Dickinson, C. C. (1996). Reading and spelling difficulties in high school students: Causes and consequences. *Reading and Writing*, 8(3), 267-294.
- Shore, J. R., & Sabatini, J. (2009). English language learners with reading disabilities: A review of the literature and the foundation for a research agenda. *ETS Research Report Series*, 2009(1), i-48.
- Snow, C. (2002). *Reading for understanding: Toward a research and development program in reading comprehension*. Santa Monica, CA: RAND.
- Solari, E. J., & Gerber, M. M. (2008). Early comprehension instruction for Spanish-speaking English language learners: Teaching text-level reading skills while maintaining effects on word-level skills. *Learning Disabilities Research & Practice*, 23(4), 155-168.

- Stahl, S. A., & Nagy, W. E. (2006). *Teaching word meanings*. Mahwah, NJ: Lawrence Erlbaum.
- Swanson, H. L., Sáez, L., & Gerber, M. (2006). Growth in literacy and cognition in bilingual children at risk or not at risk for reading disabilities. *Journal of Educational Psychology*, 98(2), 247–264.
- Swanson, H. L., Sáez, L., Gerber, M., & Leafstedt, J. (2004). Literacy and cognitive functioning in bilingual and nonbilingual children at or not at risk for reading disabilities. *Journal of Educational Psychology*, 96(1), 3–18.
- Tunmer, W. E., & Chapman, J. W. (2012). The simple view of reading redux: Vocabulary knowledge and the independent components hypothesis. *Journal of Learning Disabilities*, 45(5), 453–466.
- Tunmer, W. E., Chapman, J. W., Greaney, K. T., & Prochnow, J. E. (2002). The contribution of educational psychology to intervention research and practice. *International Journal of Disability, Development and Education*, 49(1), 11–29.
- Vadasy, P. F., & Sanders, E. A. (2010). Efficacy of supplemental phonics-based instruction for low-skilled kindergarteners in the context of language minority status and classroom phonics instruction. *Journal of Educational Psychology*, 102(4), 786–803.
- Vadasy, P. F., Sanders, E. A., & Nelson, J. R. (2015). Effectiveness of supplemental kindergarten vocabulary instruction for English learners: A randomized study of immediate and longer-term effects of two approaches. *Journal of Research on Educational Effectiveness*, 8(4), 490–529.
- Vaughn Gross Center for Reading and Language Arts at The University of Texas at Austin. (2010). *Vocabulary and oral language development*. Austin, TX: Texas Education Agency/University of Texas System.
- Vaughn, S., Cirino, P. T., Linan-Thompson, S., Mathes, P. G., Carlson, C. D., Hagan, E. C., ... Francis, D. J. (2006). Effectiveness of a Spanish intervention and an English intervention for English-language learners at risk for reading problems. *American Educational Research Journal*, 43(3), 449–487.
- Vaughn, S., Klingner, J. K., Swanson, E. A., Boardman, A. G., Roberts, G., Mohammed, S. S., & Stillman-Spisak, S. J. (2011). Efficacy of collaborative strategic reading with middle school students. *American Educational Research Journal*, 48(4), 938–964.
- Vaughn, S., Linan-Thompson, S., Mathes, P. G., Cirino, P. T., Carlson, C. D., Pollard-Durodola, S. D., ... Francis, D. J. (2006). Effectiveness of a Spanish intervention for first-grade English language learners at risk for reading difficulties. *Journal of Learning Disabilities*, 39(1), 56–73.
- Vaughn, S., Martínez, L. R., Wanzek, J., Roberts, G., Swanson, E., & Fall, A. M. (2017). Improving content knowledge and comprehension for English language learners: Findings from a randomized control trial. *Journal of Educational Psychology*, 109(1), 22–34.
- Vaughn, S., Roberts, G., Wexler, J., Vaughn, M. G., Fall, A. M., & Schnakenberg, J. B. (2015). High school students with reading comprehension difficulties: Results of a randomized control trial of a two-year reading intervention. *Journal of Learning Disabilities*, 48(5), 546–558.
- Vaughn, S., Swanson, E. A., Roberts, G., Wanzek, J., Stillman-Spisak, S. J., Solis, M., & Simmons, D. (2013). Improving reading comprehension and social studies knowledge in middle school. *Reading Research Quarterly*, 48(1), 77–93.
- Vaughn, S., Wexler, J., Roberts, G., Barth, A. A., Cirino, P. T., Romain, M. A., ... Denton, C. A. (2011). Effects of individualized and standardized interventions on middle school students with reading disabilities. *Exceptional Children*, 77(4), 391–407.
- Vellutino, F. R., Tunmer, W. E., Jaccard, J. J., & Chen, R. (2007). Components of reading ability: Multivariate evidence for a convergent skills model of reading development. *Scientific Studies of Reading*, 11(1), 3–32.
- Verhoeven, L., & van Leeuwe, J. (2012). The simple view of second language reading throughout the primary grades. *Reading and Writing*, 25(8), 1805–1818.
- Verhoeven, L., Voeten, M., & Vermeer, A. (2019). Beyond the simple view of early first and second language reading: The impact of lexical quality. *Journal of Neurolinguistics*, 50, 28–36.
- Wade-Woolley, L., & Geva, E. (2000). Processing novel phonemic contrasts in the acquisition of L2 word reading. *Scientific Studies of Reading*, 4(4), 295–311.
- Wagner, R. K., Torgesen, J. K., & Rashotte, C. A. (1994). Development of reading-related phonological processing abilities: New evidence of bidirectional causality from a latent variable longitudinal study. *Developmental Psychology*, 30(1), 73–87.
- Wagner, R. K., Torgesen, J. K., Rashotte, C. A., Hecht, S. A., Barker, T. A., Burgess, S. R., ... Garon, T. (1997). Changing relations between phonological processing abilities and word-level reading as children develop from beginning to skilled readers: A 5-year longitudinal study. *Developmental Psychology*, 33(3), 468–479.

- Walker, I., & Hulme, C. (1999). Concrete words are easier to recall than abstract words: Evidence for a semantic contribution to short-term serial recall. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 25(5), 1256–1271.
- Wanless, S. B., McClelland, M. M., Acock, A. C., Ponitz, C. C., Son, S.-H., Lan, X., ... Li, S. (2011). Measuring behavioral regulation in four societies. *Psychological Assessment*, 23(2), 364–378.
- Wanzek, J., & Roberts, G. (2012). Reading interventions with varying instructional emphases for fourth graders with reading difficulties. *Learning Disability Quarterly*, 35(2), 90–101.
- Wechsler, D. L. (1992). *Wechsler individual achievement test*. San Antonio, TX: Psychological Corporation.
- Wiederholt, J. L., & Bryant, B. R. (1992). *Gray oral reading tests, third edition (GORT-3)*. Austin, TX: PRO-Ed.
- Wigfield, A., & Guthrie, J. T. (1997). Relations of children's motivation for reading to the amount and breadth or their reading. *Journal of Educational Psychology*, 89(3), 420–432.
- Williams, K. J. (2017). *Effects of an intensive reading intervention on reading outcomes for adolescent English learners with disabilities and comprehension deficits*. Unpublished doctoral dissertation. Austin, TX: University of Texas.
- Wimmer, H., & Goswami, U. (1994). The influence of orthographic consistency on reading development: Word recognition in English and German children. *Cognition*, 51(1), 91–103.
- Woodcock, R. (1991). *Woodcock Language Proficiency Battery-Revised*. Chicago, IL: Riverside.
- Zelazo, P. D., Carlson, S. M., & Kesek, A. (2008). The development of executive function in childhood. *Handbook of Developmental Cognitive Neuroscience*. Retrieved from <https://experts.umn.edu/en/publications/the-development-of-executive-function-in-childhood>
- Zhou, Q., Chen, S. H., & Main, A. (2012). Commonalities and differences in the research on children's effortful control and executive function: A call for an integrated model of self-regulation. *Child Development Perspectives*, 6(2), 112–121.

8

DEVELOPMENTAL DISABILITY

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INTRODUCTION

Developmental disability refers to a heterogeneous class of severe and chronic neurological disorders that significantly affect a person's learning, development, and adaptive behavior functioning (U.S. Department of Health and Human Services, 2000). The learning, developmental, and adaptive functioning deficits associated with developmental disability are related to varying degrees of intellectual and/or physical impairment. A developmental disability is usually present from an early age or becomes clearly manifest during the developmental period, that is, before 22 years of age.

Developmental disability is an umbrella term that covers a number of more specific conditions, primarily autism spectrum disorder (ASD), cerebral palsy, and intellectual disability (Davis, Proulx, & van Schroyen Lantman-de Valk, 2014; Odom, Horner, Snell, & Blacher, 2007). However, a number of additional types of special educational need categories have sometimes been included under the umbrella of developmental disability, including (a) attention deficit hyperactivity disorder, (b) epilepsy, (c) hearing and vision impairments, and (d) spina bifida (U.S. Department of Health and Human Services, 2000). Of course, whether or not these additional conditions fall under the umbrella of developmental disability depends on the severity of the associated intellectual and/or physical impairments and the extent of functional limitations experienced by the individual. Clearly, the term developmental disability encompasses broad and heterogeneous categories of special educational needs.

Developmental disabilities are severe and chronic, and students with a developmental disability require individualized educational programming. That programming will often need to include specialized input from a range of disciplines, such as speech-language pathology, occupational therapy, applied behavior analysis, and special

education. Psychologists in schools also can play a major role in the education and treatment of students with developmental disabilities (New Zealand Psychological Society, 2009). Their roles include conducting assessments and collaborating with teachers to design, implement, and evaluate educational/psychological interventions aimed at advancing the student's learning, development, academic achievement, and adaptive behavior functioning.

Existing research has addressed a range of important issues related to the learning and behavioral characteristics of students with developmental disabilities and has played a major role in informing the education and treatment of students with developmental disabilities (New Zealand Psychological Society, 2009). Educational psychology holds further promise to expand this research and yield important information on the motivational, attentional, and emotional characteristics associated with developmental disabilities, which in turn can inform educational assessments and interventions aimed at advancing the student's learning, development, academic achievement, and adaptive behavior functioning.

Prevalence

Boyle et al. (2011) estimated that approximately 15% of school-aged children have a developmental disability. Their estimate was based on a large, nationally representative survey of U.S. children from 3 to 17 years of age, covering the period from 1997 to 2008. However, the 15% figure could represent an overestimate given that it included children with learning disability and developmental delay, which might not necessarily have been sufficiently severe to warrant a developmental disability label. Prevalence figures for ASD have been estimated to be about 0.7–1.4% (Presmanes Hill, Zuckerman, & Fombonne, 2015; Ramsey, Kelly-Vance, Allen, Rosol, & Yoerger, 2016; Wingate et al., 2014). The estimate for cerebral palsy has been estimated to be about 0.3%, and the estimate for intellectual disability is about 1.2% (Christensen et al., 2014; Maenner et al., 2016; Oskoui, Coutinho, Dykeman, Jetté, & Pringsheim, 2013).

However, even these more modest prevalence estimates are complicated by the fact that major developmental disability subtypes are not mutually exclusive. Cerebral palsy, for example, often co-occurs with ASD and/or intellectual disability. Christensen et al. (2014) reported that 6.9% of children with cerebral palsy also had a diagnosis of ASD, and Delobel-Ayoub et al. (2017) reported that 46.9% of children and young adults with cerebral palsy had mild to severe intellectual disability.

Interestingly, data suggest increasing numbers of children are being identified with developmental disability. Boyle et al. (2011), for example, reported a 2.24% increase (from 12.8 to 15.04%) in the prevalence of developmental disability over a 12-year period (1997–2008). Most of this stemmed from increases in the prevalence of ASD, attention deficit hyperactivity disorder, and developmental delay. The prevalence of hearing impairment, in contrast, significantly decreased over this period. The increased prevalence of ASD, in particular, has been confirmed in numerous epidemiological reports (e.g., Ramsey et al., 2016; Wingate et al., 2014). This increase has been attributed, in part, to recent changes in the definition and diagnostic criteria for autism – in which autism has been conceptualized as a broader spectrum disorder – as well as increased recognition and improved reporting and diagnostic practices

(Hansen, Schendel, & Parner, 2015). In contrast, prevalence figures for cerebral palsy and intellectual disability have remained fairly steady over the past few decades – specifically, at about 0.3% for cerebral palsy (Glinianaia, Best, Lingam, & Rankin, 2017) and about 1.2% for intellectual disability (Westerinen et al., 2017).

Still, even if one were to rely on only the most conservative prevalence estimates, these would still reveal that developmental disability affects a significant number of students. Educational psychology research provides opportunities to advance the knowledge base in relation to the nature of developmental disabilities, including an understanding of the major learning and behavioral characteristics associated with developmental disability. Educational psychologists working in the special education arena will therefore require considerable knowledge of the (a) nature of developmental disabilities, including an understanding of the major learning and behavioral characteristics associated with developmental disability; (b) theoretical models that underpin special education for students with developmental disability; and (c) implications of these models for educational psychology research and practice. One fundamental area of needed knowledge is an understanding of the causes of developmental disability.

Etiology

A myriad of factors have been identified as causing or increasing the risk of developmental disability (Percy, 2007). These factors include (a) genetic anomalies (e.g., Down syndrome and Fragile X syndrome); (b) metabolic disorders (e.g., phenylketonuria and congenital hyperthyroidism); (c) prenatal exposure to infectious diseases (e.g., rubella and toxoplasmosis); (d) malnutrition; (e) Rh incompatibility; (f) prenatal or postnatal exposure to toxins, such as fetal alcohol exposure or lead poisoning; (g) maternal risk factors, such as relatively younger or older maternal age; and (h) childhood accidents and injury (e.g., near-drowning, child abuse, and head trauma from falls or vehicle accidents).

It is important to note that these various causes are not mutually exclusive and often interact in complex ways. The metabolic disorder congenital hyperthyroidism, for example, is more likely to result in developmental disability when the child fails to receive effective thyroid treatment from an early age (Blau, 2016; Lain et al., 2016). As another example, it has long been known that environmental enrichment (or deprivation) can alter neurology (Hebb, 1949; Panlilio & Corr, Chapter 9, this volume), which might then positively (or negatively) impact the learning and development of individuals with certain types of genetic disorders, such as Down syndrome (Martinez-Cué et al., 2002).

Although it is true that the cause(s) of a child's developmental disability will often remain unknown (Maulik & Harbour, 2010), it is still important to attempt to identify etiology as far as is possible. Understanding etiology is important for a variety of reasons. Percy (2007) argued that etiology is crucial to understanding the nature of developmental disability in general. In addition, the design and impact of early intervention or prevention efforts, as well as genetic and family counseling, often depend on identifying factors that are contributing to the child's developmental concerns. Understanding etiology is also important for framing expectations and offering sound prognostic information to families and teachers. Genetic disorders – such as Rett

syndrome, for example – are associated with predictable stages of cognitive and physical regression (Kaufmann, 2017). It is critical for parents and teachers to understand these stages to enable better long-term educational and lifestyle planning. Etiology also can have important implications for understanding the child's learning, development, and behavior. This, in turn, can help in selecting and prioritizing appropriate educational goals and informing the selection of specific educational assessment and instructional procedures aimed at enabling the child to achieve those goals. Finally, etiology is also critically important for advancing educational psychology research aimed at further exploring learning and behavioral characteristics as well as ultimate causes and etiology–treatment interactions.

Given the potential value of understanding etiology, there is corresponding potential value in undertaking research related to various cognitive and motivational processes. Research of this type may help clarify the underlying causes of a child's learning and developmental problems. For example, it would be obviously important to determine whether a child's language delay stemmed from physical impairment or lack of parental responsiveness to the child's emerging speech. The former would indicate the need for direct speech therapy (Pennington, Parker, Kelly, & Miller, 2016), whereas the latter suggests that intervention efforts would be better aimed at training parents to be more responsive communicative partners (Te Kaat-van Den Os, Jongmans, Volman, & Lauteslager, 2017).

LEARNING AND BEHAVIORAL CHARACTERISTICS

In addition to identifying etiological factors whenever possible, it is important to have a comprehensive understanding of the learning and behavioral characteristics associated with developmental disability. Many of these learning and behavioral characteristics are areas where educational psychology theories and research may inform additional research and practice to increase our understanding of developmental disabilities. Generally, children with developmental disability experience significant delays in attaining key developmental milestones (e.g., walking, talking, dressing, feeding, and bladder and bowel control). Indeed, many never gain independence or proficiency in certain critical areas of functioning (Fisher, Griswold, Munkholm, & Kottorp, 2017). In addition to adaptive behavior deficits, children with developmental disability have an increased risk of developing serious problem behaviors, such as aggression, disruption, and self-injurious behavior (Machalicek et al., 2016). At school, students with developmental disabilities also generally experience greater difficulty in learning new skills, and learn at a slower rate than typically developing peers (Nettelbeck & Wilson, 1997). Overall, developmental disability is characterized by a range of developmental and learning problems, including deficits related to (a) learning from experience, (b) adaptive behavior functioning, (c) academic achievement, (d) problem-solving strategies, (e) motivation, (f) attention, and (g) memory. A number of general mental abilities can also be affected when intellectual disability is present, such as diminished capacity for (a) abstract thinking, (b) comprehension, (c) planning and problem-solving, and (d) reasoning (American Association on Intellectual and Developmental Disabilities, 2010). Students with developmental disability also often present with a range of psychological concerns.

Adaptive Behavior Functioning and Problem Behavior

Developmental disabilities are considered severe, in part, because they impair performance in several major activities of daily living (Fisher et al., 2017). Research into the adaptive behavior functioning patterns of individuals with developmental disabilities has indicated that such individuals are likely to experience deficits across a range of areas (Buntinx, 2016; Fisher et al., 2017). The major life domains where individuals with developmental disability will likely experience challenges include skills and abilities related to (a) self-care, (b) receptive and expressive communication, (c) learning, (d) mobility, (e) self-direction, (f) independent living, and (g) employment (Fisher et al., 2017). Additional domains of adaptive behavior functioning, such as accessing the community, interpersonal relationships, and recreational and leisure engagement, are also often compromised in students with developmental disability (Buntinx, 2016; Fisher et al., 2017). In addition to experiencing significant adaptive behavior deficits, students with developmental disability often show frequent and severe problem behavior, such as self-injury, extreme tantrums, property destruction, rumination, and aggression. Indeed, these forms of problem behavior have been reported in about 10–15% of individuals with developmental disability (Holden & Gitlesen, 2006). Given these prevalence figures, effective classroom management of problems behavior will likely be a major educational priority for many students with developmental disability (Bushaw & Lopez, 2010; Kats, 2017).

Generally, the more severe the intellectual and/or physical impairments, the greater the adaptive behavior deficits and the greater the likelihood of severe behavior problems. However, several lines of evidence suggest that the extent of adaptive behavior deficits and the risk of developing frequent and severe problem behavior are not solely a function of the severity of intellectual and/or physical impairment. Horner (1980), for example, showed that adaptive behavior could be increased and problem behavior decreased by enriching the living environments of children with developmental disability. The environment was enriched by providing access to more materials/toys and by providing increased social reinforcement for appropriate use of the newly available toys and materials. Results showed that providing both material and social enrichment had a stronger effect on increasing adaptive behavior and reducing problem behavior than material enrichment alone. More generally, numerous studies have reported adaptive behavior gains among individuals with developmental disability as a result of their moving from the relative austerity of an institutional environment to more enriched community-living environments (Kim, Larson, & Lakin, 2009). One might extrapolate that similar effects could be achieved by enriching the educational environment. In fact, one might conceptualize special education as a type of instructional or educational enrichment for students with disabilities (Brown, Percy, & Machalek, 2007). However, few studies have explicitly evaluated the effects of different classroom environments on the adaptive functioning and academic achievement of students with developmental disability. In a review of the literature related to transitioning students with disabilities from less to more inclusive educational settings, for example, Ruijs and Peetsma (2009) concluded that inclusive placements had mixed effects on the cognitive and social functioning of students with special educational needs. The mixed findings suggest that mere placement in an inclusive education classroom might not be sufficient to improve the students' adaptive behavior functioning. Instead, students

with developmental disability may also require an enriched instructional environment in which effective evidence-based strategies are implemented to directly and explicitly teach adaptive skills, promote positive peer interaction, and improve their academic achievement.

Academic Achievement

It is perhaps not surprising that academic achievement can be significantly affected by the presence of a developmental disability. Generally, such students are likely to learn less than their peers and achieve a lower overall level of academic proficiency (Sermier Desseumontet, Bless, & Morin, 2011). Academic problems are, in turn, a major risk factor for the emergence of problematic classroom behavior (Oldfield, Humphrey, & Hebron, 2017). However, poor academic achievement is not inevitable. Children with physical impairment only, for example, could and should be expected to achieve academically when given proper support. Students with severe and profound intellectual impairment, in contrast, may fail to acquire even basic language, literacy, and numeracy skills. Generally, lower academic achievement is associated with more severe intellectual and/or adaptive behavior impairment (Keen, Webster, & Ridley, 2016; Miller et al., 2017).

Cognitive views of learning represent one framework for considering potential barriers to successful instruction of students with developmental disability (e.g., Ashman & Conway, 2017). For example, attentional processing, executive function, working memory, and long-term memory storage and retrieval processes may be affected. Recent attention has focused on these processes (e.g., Wang et al., 2017), and research suggests that training and instruction focused on attention, executive functions, and working memory hold promise (e.g., de Vries, Prins, Schmand, & Geurts, 2015; Kirk, Gray, Riby, & Cornish, 2015; Peng, Namkung, Barnes, Sun, 2016).

Although studies in this area remain relatively few in number (Spooner & Browder, 2015), there is an emerging database demonstrating promising approaches for teaching a range of academic skills to students with developmental disabilities, including literacy, arithmetic, and science (Bailey, Arciuli, & Stancliffe, 2017; Browder, Wakeman, Spooner, Ahlgrim-Dezell, & Algozzine, 2006; Spooner, Knight, Browder, & Smith, 2012; Spooner, Root, Saunders, & Browder, 2019). Bailey et al. (2017), for example, experimentally tested the effects of literacy instruction on children aged 5–12 and found large effects for those with ASD. In mathematics, Spooner, Root, Saunders, and Browder (2019) recently shared a meta-analysis of effective evidence-based practice for instruction of those with mild and moderate developmental disabilities. Interestingly, as noted by Knight, Smith, Spooner, and Browder (2012) in science instruction, often the same types of systematic instructional procedures that have been successfully used to teach adaptive behavior to students with developmental disabilities have also been effective for academic instruction.

Problem-Solving Strategies

A potential barrier to successful instruction is that students with developmental disability often adopt counterproductive problem-solving strategies (e.g. Diamond, 2018; Grow, Carr, Kodak, Jostad, & Kisamore, 2011). During a two-choice picture-naming

task (e.g., *Point to the picture of the cup*), for example, a student might always select whichever picture is placed to the right (i.e., position-biased responding), or the student might always select one particular picture (i.e., item-biased responding). Other students might randomly select pictures or shift from one picture to another depending on whether their previous response was correct; a strategy referred to as win-stay, lose-shift (Ollendick, Balla, & Zigler, 1971). Another strategy often used by students with developmental disability is to look for cues from the teacher (i.e., outer-directedness), rather than trying to solve the problem directly (Zigler & Hodapp, 1996).

From the students' perspective, these strategies might be seen as potentially efficient solutions to difficult learning tasks (Bybee & Zigler, 1992). That is, these types of problem-solving strategies might help to reduce the cognitive demands of the task while maximizing the probability of success (Sweller, 2016). However, in the long term, the presence of such problem-solving strategies could be counterproductive in that they might delay and/or inhibit the acquisition of important stimulus discriminations and impair concept formation (Solomon et al., 2015). Fortunately, these types of counterproductive problem-solving strategies can be prevented and ameliorated through the application of various errorless and conditional discrimination-teaching strategies (Braga-Kenyon, Guilhardi, Lionello-DeNolf, & Dube, 2017; Grow et al., 2011).

Motivation

Current theories of achievement motivation (e.g., Martin, Chapter 16; Pekrun & Loderer, Chapter 18; Tracey, Merom, Morin, and Maïano, Chapter 24; Wigfield & Ponnock, Chapter 17; Wehmeyer & Shogren, Chapter 12, this volume) may be particularly relevant to leverage when considering students with developmental disability (see also Strnadová, Chapter 4, this volume), as motivational problems are a frequently cited learning characteristic of these students (Hickson & Khemka, 2013; Lovaas, 2003; Shogren, Toste, Mahal, & Wehmeyer, 2017; Switzky, 1997). Consistent with achievement goal theories (e.g., Elliot, 2005) and self-determination theory (e.g., Ryan & Deci, 2000), students with developmental disability often present as if they were completely unmotivated to participate in any type of learning or therapeutic activity. Some might even develop problem behavior or become extremely passive in an attempt to escape from or avoid participating in such activities (Miltenberger, Bloom, Sanchez, & Valbuena, 2016). Further, consistent with research on fear of failure and learned helplessness (e.g., Covington, 2017; Linnenbrink-Garcia, Patall, & Pekrun, 2016), Lovaas (2003) suggested that this seeming lack of motivation could stem from repeated learning failures. Students with developmental disability may experience more failure owing to curriculum demands that are not appropriately matched to their level of intellectual and adaptive behavior functioning. Further, as Hickson and Khemka (2013) suggested, motivation influences the efficiency of information processing, which could in turn affect learning (Hickson & Khemka, 2013).

Switzky (1997) argued that the motivational problems of students with developmental disability make them inefficient learners, but, in contrast to this being related to informational processing problems, he hypothesized that this inefficiency stemmed largely from an extrinsic, rather than an intrinsic, motivational orientation. Specifically, he viewed students with developmental disability as motivated more strongly by task-extrinsic factors (e.g., contrived reinforcers, release from task

demands) than by task-intrinsic factors (e.g., task achievement, challenge of learning, and opportunity to express creativity). In this view, the role of the teacher becomes one aimed at increasing the students' responsiveness to intrinsic motivation (Switzky, 1997, p. 194). This might be accomplished by gradually replacing external (contrived) reinforcement with more intrinsic (natural) reinforcement (Lovaas, 2003; Skinner, 1982). Researchers have also explored the value of teaching self-monitoring and self-reinforcement. These skills have been targeted, in part, under an assumption that they may provide a significant motivational boost to students with developmental disabilities because they enable such students to exercise greater autonomy over the environment, including classroom-based learning activities (Clark, Olympia, Jensen, Tuesday Heathfield, & Jenson, 2003). A number of studies have successfully taught various types of self-management strategies to students with developmental disabilities (see Carr, Moore, & Anderson, 2014, for a review). Results suggest that teaching specific self-management skills can be an effective intervention for increasing a variety of communication, social, and academic skills. However, attributing the learning difficulties of students with developmental disability to extrinsic motivation is difficult to reconcile with the results of numerous intervention studies in which extrinsic (or contrived) reinforcement has been successfully applied to teach a range of adaptive and academic skills to such students (see Singh, 2016, for a comprehensive survey of this literature). In fact, data suggest that initial use of extrinsic reinforcement may enable educators to "build intrinsic motivation" (Witzel & Mercer, 2003, p. 88). For additional discussion of the role of extrinsic rewards on intrinsic motivation, however, see Deci, Koestner, and Ryan (1999).

Attention

Attentional processing is tied to core executive functions and is critical to effective learning (e.g., Follmer, 2018). Students with developmental disabilities often appear to have considerable difficulty paying attention during learning activities. Students with ASD, cerebral palsy, and/or intellectual disability may also have a comorbid diagnosis of attention deficit hyperactivity disorder. Data suggest that attention deficit hyperactivity disorder is perhaps up to three to four times higher for children with developmental disabilities compared with typically developing children (Neece, Baker, Blacher, & Crnic, 2011).

The attention problems evidenced by students with developmental disability can manifest in a variety of forms, such as failing to attend to the critical aspects of a learning task, ignoring instructions, and appearing completely preoccupied by their own thoughts and seemingly unresponsive to any type of external stimulation (Lovaas, 2003). Such attentional problems will likely exacerbate the learning and behavioral problems of students with developmental disabilities (Kirk, Gray, Riby, Taffe, & Cornish, 2017).

Kirk et al. (2017) delineated a number of different types of attentional problems that can affect students with developmental disability. These types include a range of problems related to visual attention skills, such as searching a visual field to encode stimuli as relevant or irrelevant. In a study of 77 children from 4 to 11 years of age, they noted significant problems related to visual attending skills. They also reported that deficits in visual attending skills were related to poor literacy and numeracy achieve-

ment. Their results suggest the potential value of intervention to strengthen the visual attending skills in students with developmental disability. Such an objective might be taught by embedding systematic instructional procedures to teach visual attention within a range of literacy and numeracy activities.

Students might also experience problems sustaining their attention long enough to complete a task. MacLean, Miller, and Bartsch (2001) noted that students with intellectual disability seem to have particular difficulty in shifting their attentional focus in the face of changing task demands. Mundy (1995) suggested that such problems represent an underlying inability to process more than one stimulus input at a time. Lovaas, Koegel, and Schreibman (1979) had previously identified this phenomenon and referred to it as “stimulus overselectivity.” Since then, new evidence suggests that many students with developmental disability do seem to have considerable difficulty attending to more than one stimulus at a time (Dube et al., 2016). And when they do attend, many seem to focus on irrelevant stimuli, such as what the teacher is wearing, rather than attending to what the teacher is actually saying or doing.

The problems outlined above suggest deficits in underlying attentional processes. However, it is also possible that such problems stem from motivational issues (e.g., a lack of interest in stimuli in the environment) and/or limited and ineffective learning experiences, as suggested by Lovaas (2003). Interestingly, Farber, Dickson, and Dube (2016) demonstrated that overselective responding could be reduced by teaching students to first scan or observe all of the relevant stimuli present. The success of this intervention suggests that some of the attentional problems of students with developmental disabilities might be overcome by the teaching of specific observing/attending skills.

Memory

Memory problems, including working memory problems, have long been documented among individuals with developmental disability, and, in fact, such problems appear to be fairly common and wide-ranging in this population (Bower & Hayes, 1994; Gathercole & Alloway, 2006; Henry & Winfield, 2010; O'Reilly & Carr, 2016; Vicari, 2004; Vicari, Carlesimo, & Caltagirone, 1995). Schuchardt, Gebhardt, and Mäehler (2010), for example, found deficits across eight different types of memory tasks (e.g., location span, digit span, and non-word span) among students with mild intellectual disability (IQ = 50–69), compared with students with borderline intellectual disability (IQ = 70–84) and typically developing children (IQ = 90–115).

Memory problems may represent a contributing factor to the degree of intellectual impairment experienced by a student with developmental disability (O'Reilly & Carr, 2016). Such problems could also contribute to the adaptive behavior and academic difficulties of such students. At the classroom level, students with impaired memory might, for example, fail to remember how to operate a computer or quickly forget the instructions a teacher has just given. Thus, some of the academic failures that students with developmental disabilities experience could relate to their memory problems, rather than stemming only from learning problems (Mäehler & Schuchardt, 2016).

Smith, Polloway, Patton, and Dowdy (2011) reasoned that students' memory problems might be addressed by teaching specific remembering strategies, such as rehearsing material, grouping information into meaningful units, and using mnemonic strategies.

Henry and Winfield (2010) argued that strengthening students' short-term memory abilities might help to improve their reading and spelling skills, based on their study showing a relation between reading and spelling and performance on a short-term memory task (e.g., immediately recalling a list of words).

Several intervention studies have evaluated the effectiveness of rehearsal strategies to improve memory (Broadley & MacDonald, 1993; Costa, Purser, & Passolunghi, 2015; Laws, MacDonald, & Buckley, 1996). In an overview of recent studies in this area, Lanfranchi and Caretti (2016) concluded that it does seem possible to improve students' memory skills by specific training exercises. However, consensus is lacking on what works best. In addition, it is not clear whether successful memory training positively impacts other areas of academic performance (e.g., reading and writing) or adaptive behavior functioning.

Psychological Concerns

Compared with their typically developing peers, students with developmental disabilities appear to be at increased risk for a range of psychological problems, such as anxiety, phobia, and obsessive-compulsive disorder (Cassady & Thomas, Chapter 3, this volume; Emerson, 2003; Van Steensel, Bögels, & Perrin, 2011; White, Oswald, Ollendick, & Scahill, 2009).

Poppen, Sinclair, Hirano, Lindstrom, and Unruh (2016), in a survey of 648 professionals involved with secondary school students, found that 48% of the students with disabilities were reported to have some type of mental health concern. Salazar et al. (2015), from an assessment of 101 (4–10-year-old) children with ASD and intellectual disability, reported clinically elevated rates for two types of mental health concern: (a) specific types of phobia (reported for 52.7% of the sample), and (b) generalized anxiety disorder (reported for 66.5% of the sample).

In a review of 11 studies on anxiety disorders among individuals with ASD, White et al. (2009) found prevalence figures that ranged from 11 to 84% depending on sample characteristics. The anxiety symptoms of such students also appeared to worsen during adolescence (White et al., 2009). There appears to be an inverse relation between severity of developmental disability and severity of anxiety symptoms. That is, children with mild intellectual impairment have been rated by teachers as experiencing more severe anxiety symptoms compared with children with severe intellectual impairment (Weisbrot, Gadow, DeVincent, & Pomeroy, 2005). This could, however, reflect the difficulty of assessing psychopathology in children with more severe intellectual and adaptive behavior impairments. Such assessments often rely heavily on self-reports, which may not be valid for children who lack sufficient speech and language.

Other behavioral manifestations of possible mental health concerns include an intense fear or avoidance response to specific stimuli, such as loud noises or even familiar objects. For example, the child might have an intense tantrum at the noise of the bathroom hand dryers at school or the swings on the school playground (Dickerson Mayes et al., 2013). Obsessive-compulsive tendencies – such as frequent and obsessive idiosyncratic monologues or frequently arranging and rearranging one's school materials on the desk – are also commonly reported in students with developmental disabilities (Matson & Dempsey, 2008). Some students might also experience panic

attacks characterized by elevated heart rate, feeling faint/dizzy, rapid difficult breathing, and a general sense of impending doom. Panic attacks occur seemingly without warning, but might relate to significant stressors, such as major changes in school or home life (American Psychiatric Association, 2013). Clearly, these types of psychological concerns are likely to have a major disruptive influence on the student's development, academic achievement, socialization, and general adjustment to life and school (Essau, Lewinsohn, Olaya, & Seeley, 2014). Not surprisingly, the alleviation of the symptoms of psychiatric disorder will be an important educational priority for many students with developmental disabilities.

Treatment of these types of psychological concerns among students with developmental disabilities has largely involved the use of psychotropic medication and cognitive behavior therapy (Deb, 2016). With respect to medication, there is empirical support for the use of antianxiety treatments, antidepressants, and serotonin reuptake inhibitors in the treatment of anxiety, depression, panic disorder, and obsessive-compulsive disorder in individuals with developmental disability (see Deb, 2016, for a comprehensive review). Of course, such treatment is not within the scope of educational psychology research. Still, understanding the effects and side effects of medications is important as these may influence a range of outcomes, such as attention, motivation, memory, and problem-solving.

Cognitive behavior therapy is a widely used intervention approach for addressing various types of psychological and behavioral concern in students with differing types of special educational need and disability (Dagan, Jahoda, & Stenfert Kroese, 2016; Willner & Lindsay, 2016). Cognitive behavior therapy can be an effective approach to addressing a range of concerns in students with disabilities (Dagan et al., 2016; Willner & Lindsay, 2016).

In a systematic review, Lang, Regester, Lauderdale, Ashbaugh, and Haring (2009) identified nine studies that evaluated the efficacy of cognitive behavior therapy for individuals with ASD. The studies provided therapy to a total of 110 participants ranging from 9 to 23 years ($M = 10$ years). These individuals were referred for treatment owing to a range of conditions, including social phobia, generalized anxiety disorder, obsessive-compulsive disorder, separation anxiety disorder, panic disorder, and specific phobias. The outcomes from these nine studies were invariably positive, suggesting that cognitive behavior therapy could be seen as an effective, evidence-based approach for the treatment of anxiety and related disorders in students with ASD. However, effective use of cognitive behavior therapy would seem to depend on the student having sufficient language ability to express their thoughts, behavior, and emotions and articulate more positive problem solutions. This level of language ability is lacking in many students with developmental disability (Sigafos, O'Reilly, Lancioni, & Green, 2016).

Interestingly, Lang et al. (2009) noted that many of these studies employed modified protocols in which cognitive behavior therapy was supplemented with behavioral interventions, such as response prompting and reinforcement. Indeed, a range of behaviorally based procedures – such as graduated exposure, response prompting, and reinforcement, – have been successfully applied to address anxiety and obsessive-compulsive behavior of individuals with developmental disability (Hagopian & Jennett, 2008; Sigafos, Green, Payne, O'Reilly, & Lancioni, 2009). Such additional procedures may be necessary for students with severe communication and

language impairment. Contemporary behavioral approaches aim to replace problematic behavior/symptoms by prompting and reinforcing alternative or incompatible responses that are more adaptive and socially acceptable (Hagopian & Jennett, 2008).

THEORETICAL MODELS AND THEIR EDUCATIONAL IMPLICATIONS

Two theoretical models (i.e., applied behavior analysis and the social model) have had major influences in the field of developmental disabilities. Both models could be seen as stand-alone conceptual foundations that have been used to guide research and practice. However, these two theoretical models are neither incompatible nor mutually exclusive. Rather, each has different emphases. These differing emphases should be seen as complementary, not conflicting. Each model also has differing, yet complementary, educational implications.

Applied Behavior Analysis

Applied behavior analysis (ABA) can be viewed as an applied science focused on the causes of socially significant behavior change (O'Reilly, Gevarter, Falcomata, Sigafos, & Lancioni, 2016). ABA is based on four major tenets derived from operant conditioning research (Catania, 2013). First, academic achievement and adaptive skills are viewed as learned behaviors that are influenced largely by environmental factors, rather than representing some underlying genetic predispositions, innate abilities, cognitive processes, or personality traits (Alberto & Troutman, 2013). Second, learned behavior is seen as being important in its own right, not merely as a symptom of some underlying predisposition, ability, cognitive process, or trait. Obsessive-compulsive behavior, for example, is viewed in terms of the actual problematic response patterns that a person is observed to engage in (e.g., frequent rearrangement of work materials or frequent hand washing) rather than by referencing some more general notion of underlying obsessiveness or compulsiveness (Sigafos et al., 2009). A third tenet of ABA is that behavior is highly malleable. This implies the possibility of increasing or decreasing existing behaviors and developing new behaviors by arranging appropriate learning experiences. A fourth tenet of ABA is that consequences can have powerful and predictable effects on behavior. Certain types of consequences function to increase the future probability of a behavior, whereas other consequences function to decrease the future probability of behavior. The former relation is known as reinforcement, the latter as punishment (Catania, 2013). In the ABA model, it is the relations or contingencies between environments, behavior, and consequences that largely determine a student's behavior and what he or she learns.

The mission of education, from an ABA perspective, is to promote socially significant behavior change. Thus, one mission of educational psychology research is to develop new and more effective ways of promoting socially significant behavior change. The specific targets of change could include any type of observable and measurable behavior that is a priority for stakeholders and that would advance the student's development and overall level of adaptive behavior functioning. In the ABA model, educational instruction focuses on directly changing the student's behavior, rather than trying to change underlying predispositions, abilities, processes, or traits (Alberto

& Troutman, 2013). In addition, the behavioral deficits and excesses of students with developmental disability are conceptualized as arising, in part, from insufficient and ineffective learning experiences.

To produce socially significant behavior change, such as teaching new adaptive skills to students with developmental disability, the ABA model emphasizes the need to create effective learning opportunities and environments (Lovaas, 2003). What makes for effective learning opportunities and environments will depend to some extent on the student's unique needs and characteristics, as well as the specific target behavior of concern. Educational psychology research related to problem-solving, memory, and attentional processes can, therefore, be useful for developing an intervention or modifying instruction to suit the child's unique abilities and characteristics. Generally, effective learning environments for students with developmental disability need to be more highly structured and offer more intensive and frequent learning opportunities than would be needed by typically developing children (Lovaas, 2003). ABA-based teaching follows a systematic instructional approach (Snell & Brown, 2006; Storey & Miner, 2017), which typically consists of: (a) breaking down target behaviors into their component steps (i.e., task analysis), (b) increasing opportunities for the student to perform these steps in a logical sequence, (c) presenting clear and precise instructional cues, (d) prompting correct performance and/or preventing/correcting errors as necessary, (e) systematically fading prompts to promote independence, and (f) scheduling reinforcement to promote acquisition and maintenance of newly acquired skills. This approach has been successfully used to teach a range of academic and adaptive skills to students with developmental disability (Duker, Didden, & Sigafos, 2004; Lovaas, 2003; Snell & Brown, 2006). ABA-based procedures are also effective for reducing the range of problem behaviors (e.g., aggression, tantrums, and self-injury) that are prevalent among students with developmental disability (Singh, 2016; Sturmey & Didden, 2014).

Although one must acknowledge that intellectual and physical impairments impose constraints on what a student might ultimately be able to learn and do, the ABA model implies that educational outcomes depend to a large extent on the amount and type of learning opportunities and the quality of instruction that the student receives. Perhaps the main implication of the ABA model for special education, then, is the need for teachers to gain competence in the application of ABA-based instructional procedures to (a) increase/teach socially significant academic skills/adaptive behavior, and (b) reduce/prevent problematic behaviors that interfere with learning and restrict social inclusion and school and community participation.

Social Model

The social model of developmental disability emphasizes the advancement of human rights and opportunities for people with differing intellectual and/or physical abilities (Rioux, Basser, & Jones, 2011; Strnadová, Chapter 4, this volume). Within this model, the experience of being "disabled" is seen as arising from the discrimination and oppression faced by people with different intellectual and/or physical abilities (Bach, 2017). Using this model, the learning problems experienced by students with developmental disability could be examined in terms of the treatment that these students have received within the educational system, rather than solely in terms

of the nature and severity of their intellectual and/or physical impairments. The relevant questions to ask within a social model are less about the student's learning and behavioral characteristics, diagnoses, or assessment results, and more about whether the school system is disabling or disadvantaging the student, and, if so, what system changes are needed. In this model, educational psychology research on specific impaired learning processes (e.g., attentional and memory problems) is still relevant. However, the social model would emphasize the value of exploring the extent to which contextual factors (e.g., lack of opportunity, poor instruction, unresponsive teachers) may be underlying the child's learning performance deficits. As a simple example, a policy of suspending students who fail to comply with classroom rules would disadvantage students who, perhaps owing to intellectual impairment, have not yet been effectively taught to comprehend, and motivated to follow, those rules. In such cases, research relevant to comprehension and motivation would become highly relevant. The needed change might involve providing more effective instruction and specialized supports that are based on educational research regarding what is known about cognitive processing and motivational characteristics of students with developmental disabilities. Another possibility would be to reconfigure the manner in which rules are presented so as to increase efficient processing by the student. Operating under the social model, one might ask: Are the rules easy to understand and presented in a stimulus mode that can be easily processed by the student?

The social model would seem to have considerable merit in helping to explain the learning and behavioral characteristics associated with developmental disability. To some extent, children's behavioral deficits and excess are no doubt due to lack of opportunity and lack of effective intervention. The lack of effective instruction might, in turn, stem from failure to incorporate evidence from educational psychology research, such as evidence regarding memory and attentional processing. Indeed, it was not that long ago that many children with developmental disability would have been labeled "ineducable" and placed in large custodial institutions that offered no educational or therapeutic programs of any kind (Scheerenberger, 1987). Under these oppressive and discriminatory conditions, it is not surprising that many developed serious problem behavior and showed little adaptive skill (Horner, 1980). Similarly, though perhaps less obviously discriminatory, lack of opportunities for learning may persist. For example, students with developmental disability are often streamed into a purely functional curriculum that focuses on attainment of basic self-care, communication, and social skills. Although acquisition of such skills is clearly important, an exclusively functional curriculum may end up denying these students the opportunity to acquire more advanced and, arguably equally important, literacy and numeracy skills (Spooner & Browder, 2015).

The social model points to a number of barriers that could diminish educational outcomes for students with developmental disabilities. These barriers include negative attitudes, low expectations, and denied opportunity. As noted by McGrew and Evans (2004), low expectations for students with developmental disability may become a self-fulfilling prophecy. Students with relatively low IQ scores, for example, might be viewed as incapable of learning to read and, therefore, they never receive any reading instruction and, therefore, they never learn to read, thus fulfilling the prophecy. Based on McGrew and Evans' review of the literature, such expectancy effects appear to have

a significant impact on a student's overall development and academic achievement, particularly for students with intellectual impairment. Combine this with the fact that some educators might harbor negative attitudes towards students with developmental disability (Vaz et al., 2015; Woodcock, 2013), and one has a perfect storm for ensuring that the educational and social outcomes for students with developmental disability remain low.

Implications of the social model for education and educational research include the need to identify strengths and eliminate exposure to arrangements that will be more difficult for promoting efficient information processing for the student. Educational policies should, therefore, specifically acknowledge that students with developmental disability have the right to equal educational opportunity and the right to effective instruction (Van Houten et al., 1988). There may also be a need for professional development, at both the preservice and in-service level, to promote high expectations and positive attitudes towards students with differing intellectual and/or physical abilities (Vaz et al., 2015; Woodcock, 2013). This may, in turn, help to overcome motivational problems that are common among students with developmental disabilities. Research also points to the value of strengthening basic learning processes (attentional and memory skills) by exposure to an increased number of structured learning opportunities (Hugh-Pennie, Park, Luke, & Lee, 2017).

FUTURE DIRECTIONS

Throughout this chapter, educational psychology theories and research have been connected with characteristics of students with developmental disability. These connections can provide foundations for future research. Along these lines, Wehmeyer and Shogren (2017) identified a number of trends that are emerging in the field of developmental disability research. These trends include the move towards a more strengths-based approach to assessment and intervention. Future educational psychology research could aim to identify the learning strengths associated with different types of developmental disability. Dykens (2006), for example, argued there are often “areas of strength” (p. 189) that can be identified in students with developmental disabilities. An important contribution for educational psychology research would be to provide a framework to help identify any such strengths and to explore the impact of these on areas where there are deficits. As noted, some of these areas may include attention, executive functions, working memory, and other cognitive processes. Further educational psychology research is also needed with special needs populations to also illuminate and examine critical motivational factors. More generally, conceptually aligned with the social model of disability, the emerging trend is to identify, highlight, and make use of the students' existing skills and abilities, rather than focusing solely on their deficits and impairments.

A second trend highlighted by Wehmeyer and Shogren (2017) is the refinement of models of support that are flexible and individualized and that recognize the critical role that the community at large must play in accommodating and supporting individuals with developmental disability. Two additional future directions that seem particularly germane to the education of students with developmental disability and to which educational psychology can contribute relate to (a) assessing students' response to instruction, and (b) use of assistive technologies.

Assessing Response to Instruction

An important consideration is the extent to which the educational tasks set for a student are in line with his or her unique abilities and learning characteristics (Martin, Thorsteinsson, Yu, Martin, & Vause, 2008). Along these lines, Martin and his colleagues (Martin et al., 2008; Martin & Yu, 2000; Vause, Yu, & Martin, 2007) have used several simple tests of (discrimination) learning to assess students' learning abilities. For example, they have assessed the ease and speed with which a student can learn to match shapes and colors. Such tests can reliably predict the types of tasks that students with developmental disability will be able to master under standard instructional conditions (e.g., use of response prompting and reinforcement). An example of an assessment protocol that appears reliable and valid for this purpose is the Assessment of Basic Learning Abilities-Revised (ABL-R; Martin & Yu, 2000).

Numerous activities required in school, home, and community settings require the types of discrimination assessed by the ABL-R, such as discriminating between male and female restrooms, locating one's coat and backpack in the school cloakroom, telling the time on an analogue clock, and naming objects and actions (Jackson, Williams, & Biesbrouck, 2006; Martin et al., 2008; Martin & Yu, 2000). Although current evidence suggests that this type of assessment information can assist instructional planning, an important issue is how best to proceed with students who fail the assessment tasks. An important area for future research would be to seek new and more effective instructional strategies for such students. Some possibilities, informed by educational psychology research, include computer-based instruction, instructional applications for mobile devices, and virtual reality (Jones Ault, Baggerman, & Horn, 2017; Ramdoss et al., 2011; Shepley, 2017; Smith, Cihak, Kim, McMahon, & Wright, 2016).

Assistive Technologies

Rapid advances have occurred in the development of technologies for enabling persons with developmental disabilities to learn more efficiently and participate more actively and independently in a range of functional daily activities. For students with developmental disabilities, assistive technologies are emerging as an effective, evidence-based solution that may enable these individuals to overcome some of the learning difficulties and functional limitations they experience owing to intellectual and/or physical impairments. Indeed, proficient use of a range of assistive technology devices has been successfully taught to individuals with developmental disabilities, including (a) microswitches for accessing preferred sources of stimulation and environmental control, (b) speech-generating devices for communicating wants and needs, (c) auditory signaling and messaging systems for facilitating orientation and mobility, and (d) robot interventions for promoting adaptive skills (Conti, Di Nuovo, Buono, & Di Nuovo, 2017; Lancioni, Sigafoos, O'Reilly, & Singh, 2013).

These rapid advances in this field have been fueled in part by the iPad, smartphone, and mobile technology revolution (McNaughton & Light, 2013). Indeed, advances have been so substantial in this area that Wehmeyer and Shogren (2017) proposed the need for a new discipline of "applied cognitive technologies" (p. 741). Research activity to develop, apply, and evaluate the use of assistive technologies in the educa-

tion of students with developmental disability will no doubt continue to expand in the future, leading to new technologies, new applications of technologies, and new and more effective ways of teaching students to make use of assistive technology. One challenge in the field is to create technology that is sufficiently universal to ensure availability and affordability, as well as being sufficiently customizable to accommodate individual students' unique needs and characteristics. As professionals learn to be more successful in understanding the cognitive processing of students with developmental disability, there could emerge a greater appreciation of these students' abilities and potential for using new learning technologies.

SUMMARY AND CONCLUSION

Developmental disability arises when intellectual and/or physical impairment results in significant limitations in learning and adaptive behavior functioning. Students with developmental disability will often experience considerable difficulty in profiting from a traditional academic curriculum and typical instructional procedures, necessitating an alternative/adapted curriculum and specialized teaching tactics. Teaching such students can be difficult owing to the learning and behavioral characteristics associated with developmental disability. Applied behavior analysis and the social model represent two major theoretical orientations that have influenced services for students with developmental disability. Both of these models have implications for conceptualizing and operationalizing educational aims and services for students with developmental disability. Education for students with developmental disability will no doubt evolve in line with emerging trends and developments related to educational assessment and instructional practices.

REFERENCES

- Alberto, P. A., & Troutman, A. C. (2013). *Applied behavior analysis for teachers* (9th ed.). Boston: Pearson.
- American Association on Intellectual and Developmental Disabilities. (2010). *Intellectual disability: Definition, classification, and systems of support* (11th ed.). Washington, DC: Author.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: American Psychiatric Publishing.
- Ashman, A. F., & Conway, R. N. (2017). *Cognitive strategies for special education: Process-based instruction*. London: Routledge.
- Bach, M. (2017). Changing perspective on intellectual and developmental disabilities. In M. Wehmeyer, I. Brown, M. Percy, K. A. Shogren, & W. L. A. Fung (Eds.), *A comprehensive guide to intellectual and developmental disabilities* (2nd ed., pp. 35–45). Baltimore: Paul H. Brookes.
- Bailey, B., Arciuli, J., & Stancliffe, R. J. (2017). Effects of ABRACADABRA literacy instruction on children with autism spectrum disorder. *Journal of Educational Psychology*, 109, 257–268.
- Blau, N. (2016). Genetics of phenylketonuria: Then and now. *Human Mutation*, 37, 508–515. doi:10.1002/humu.22980
- Bower, A., & Hayes, A. (1994). Short-term memory deficits and Down syndrome: A comparative study. *Down Syndrome Research and Practice*, 2, 47–50. doi:10.3104/reports.29
- Boyle, C. A., Boulet, S., Schieve, L., Cohen, R. A., Blumberg, S. J., Yeargin-Allsopp, M., ... Kogan, M. D. (2011). Trends in the prevalence of developmental disabilities in US children, 1997–2008. *Pediatrics*, 127, 1034–1042. doi:10.1542/peds.2010-2989
- Braga-Kenyon, P., Guilhardi, P., Lionello-DeNolf, K. M., & Dube, W. V. (2017). Teaching visual conditional discrimination using errorless learning: The role of prompts requiring simple and conditional discriminative control. *European Journal of Behavior Analysis*, 18, 180–194. doi:10.1080/15021149.2017.1309624

- Broadley, I., & MacDonald, J. (1993). Teaching short term memory skills to children with Down syndrome. *Down Syndrome Research and Practice*, 1, 56–62. doi:10.3104/reports.11
- Browder, D. M., Wakeman, S. Y., Spooner, F., Ahlgrim-Dezell, L., & Algozzine, B. (2006). Research on reading for students with significant cognitive disabilities. *Exceptional Children*, 72, 392–408. doi:10.1177/001440290607200401
- Brown, I., Percy, M., & Machalek, K. (2007). Education for individuals with intellectual and developmental disabilities. In I. Brown & M. Percy (Eds.), *A comprehensive guide to intellectual and developmental disabilities* (pp. 489–510). Baltimore: Paul H. Brookes.
- Buntinx, W. (2016). Adaptive behaviour and support needs. In A. Carr, C. Linehan, G. O'Reilly, P. Noonan Walsh, & J. McEvoy (Eds.), *The handbook of intellectual disability and clinical psychology practice* (pp. 107–135). Abingdon, UK: Routledge.
- Bushaw, W. J., & Lopez, S. J. (2010). A time for change: The 42nd Annual Phi Delta Kappa/Gallup Poll of the public's attitudes toward the public schools. *Kappan*, 92, 9–26.
- Bybee, J., & Zigler, E. (1992). Is outerdirectedness employed in a harmful or beneficial manner by students with and without mental retardation? *American Journal on Mental Retardation*, 96, 512–521.
- Carr, M. E., Moore, D. W., & Anderson, A. (2014). Self-management interventions for students with autism: A meta-analysis of single-subject research. *Exceptional Children*, 81, 28–44. doi:10.1177/0014402914532235
- Catania, A. C. (2013). *Learning* (5th ed.). Cornwall on Hudson, NY: Sloan.
- Christensen, D., Van Naarden Braun, K., Doernberg, N. S., Maenner, M. J., Arneson, C. L., Durkin, M. S., ... Yeargin-Allsopp, M. (2014). Prevalence of cerebral palsy, co-occurring autism spectrum disorders, and motor functioning – Autism and developmental disabilities monitoring network, USA, 2008. *Developmental Medicine and Child Neurology*, 56, 59–65. doi:10.1111/dmcn.1226
- Clark, E., Olympia, D. E., Jensen, J., Tuesday Heathfield, L., & Jensen, W. R. (2003). Striving for autonomy in a contingency-governed world: Another challenge for individuals with developmental disabilities. *Psychology in the Schools*, 41, 143–153. doi:10.1002/pits.10146
- Conti, D., Di Nuovo, S., Buono, S., & Di Nuovo, A. (2017). Robots in education and care of children with developmental disabilities: A study of acceptance by experienced and future professionals. *International Journal of Social Robotics*, 9, 51–62. doi.org/10.1007/s12369-016-0359-6
- Costa, H. M., Purser, H. R. M., & Passolunghi, M. C. (2015). Improving working memory abilities in individuals with Down syndrome: A treatment case study. *Frontiers in Psychology*, 6, 1331. Article doi:10.3389/fpsyg.2015.01331
- Covington, M. V. (2017). Motivated cognitions. In S. G. Paris, G. M. Olson, & H. W. Stevenson (Eds.), *Learning and motivation in the classroom* (pp. 139–164). London: Routledge.
- Dagan, D., Jahoda, A., & Stenfert Kroese, B. (2016). Cognitive behavior therapy. In A. Carr, C. Linehan, G. O'Reilly, P. Noonan Walsh, & J. McEvoy (Eds.), *The handbook of intellectual disability and clinical psychology practice* (2nd ed., pp. 264–279). London: Routledge.
- Davis, R., Proulx, R., & van Schroyen Lantman-de Valk, H. (2014). Health issues for people with intellectual disabilities: The evidence base. In L. Taggart & W. Cousins (Eds.), *Health promotion for people with intellectual and developmental disabilities* (pp. 7–14). Maidenhead, UK: McGraw-Hill Education.
- de Vries, M., Prins, P. J., Schmand, B. A., & Geurts, H. M. (2015). Working memory and cognitive flexibility-training for children with an autism spectrum disorder: A randomized controlled trial. *Journal of Child Psychology and Psychiatry*, 56, 566–576.
- Deb, S. (2016). Psychopharmacology. In N. N. Singh (Ed.), *Handbook of evidence-based practices in intellectual and developmental disabilities* (pp. 347–381). Cham, Switzerland: Springer.
- Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, 125, 627–668.
- Delobel-Ayoub, M., Klapouszczak, D., van Bakel, M. M. E., Horridge, K., Sigurdardottir, S., Himmelmann, K., & Arnaud, C. (2017). Prevalence and characteristics of autism spectrum disorders in children with cerebral palsy. *Developmental Medicine and Child Neurology*, 59, 738–742. doi:10.1111/dmcn.13436
- Diamond, L. L. (2018). Problem solving using visual support for young children with autism. *Intervention in School and Clinic*, 54, 106–110.
- Dickerson Mayes, S., Calhoun, S. L., Aggarwal, R., Baker, C., Mathapati, S., Molitoris, S., & Mayes, R. D. (2013). Unusual fears in children with autism. *Research in Autism Spectrum Disorders*, 7, 151–158. doi:10.1016/j.rasd.2012.08.002

- Dube, W. V., Farber, R. S., Mueller, M. R., Grant, E., Lorin, L., & Deutsch, C. K. (2016). Stimulus overselectivity in autism, Down syndrome, and typical development. *American Journal on Intellectual and Developmental Disabilities, 121*, 219–235. doi:10.1352/1944-7558-121.3.219
- Duker, P., Didden, R., & Sigafos, J. (2004). *One-to-one training: Instructional procedures for learners with developmental disabilities*. Austin, TX: Pro-Ed.
- Dykens, E. M. (2006). Toward a positive psychology of mental retardation. *American Journal of Orthopsychiatry, 76*, 185–193. doi:10.1037/0002-9432.76.2.185
- Elliot, A. J. (2005). A conceptual history of the achievement goal construct. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 52–72). New York: Guilford.
- Emerson, E. (2003). Prevalence of psychiatric disorders in children and adolescents with and without intellectual disability. *Journal of Intellectual Disability Research, 47*, 51–58. doi:10.1046/j.1365-2788.2003.00464.x
- Essau, C. A., Lewinsohn, P. M., Olaya, B., & Seeley, J. R. (2014). Anxiety disorders in adolescents and psychological outcomes at age 30. *Journal of Affective Disorders, 163*, 125–132. doi:10.1016/j.jad.2013.12.033
- Farber, R. S., Dickson, C. A., & Dube, W. V. (2016). Reducing overselective stimulus control with differential observing responses. *Journal of Applied Behavior Analysis, 50*, 87–105. doi:10.1002/jaba.363
- Fisher, A. G., Griswold, L. A., Munkholm, M., & Kottorp, A. (2017). Evaluating domains of everyday functioning in people with developmental disabilities. *Scandinavian Journal of Occupational Therapy, 24*, 1–9. doi:10.3109/11038128.2016.1160147
- Follmer, D. J. (2018). Executive function and reading comprehension: A meta-analytic review. *Educational Psychologist, 53*(1), 42–60.
- Gathercole, S. E., & Alloway, T. P. (2006). Practitioner review: Short-term and working memory impairments in neurodevelopmental disorders: Diagnosis and remedial support. *Journal of Child Psychology and Psychiatry, 47*, 4–15. doi:10.1111/j.1469-7610.2005.01446.x
- Glinianaia, S. V., Best, K. E., Lingam, R., & Rankin, J. (2017). Predicting the prevalence of cerebral palsy by severity level in children aged 3 to 15 years across England and Wales by 2020. *Developmental Medicine and Child Neurology, 59*, 864–870. doi:10.1111/dmcn.13475
- Grow, L. L., Carr, J. E., Kodak, T. M., Jostad, C. M., & Kisamore, A. N. (2011). A comparison of methods for teaching receptive labeling to children with autism spectrum disorders. *Journal of Applied Behavior Analysis, 44*, 475–498. doi:10.1901/jaba.2011.44-475
- Hagopian, L. P., & Jennett, H. K. (2008). Behavioral assessment and treatment of anxiety in individuals with intellectual disabilities and autism. *Journal of Developmental and Physical Disabilities, 20*, 467–483. doi:10.1007/s10882-008-9114-8
- Hansen, S. N., Schendel, D. E., & Parner, E. T. (2015). Explaining the increase in the prevalence of autism spectrum disorders: The proportion attributable to changes in reporting practices. *Journal of the American Medical Association Pediatrics, 169*, 56–62. doi:10.1001/jamapediatrics.2014.1893
- Hebb, D. O. (1949). *The organization of behavior: A neurophysiological theory*. New York: Wiley.
- Henry, L., & Winfield, J. (2010). Working memory and educational achievement in children with intellectual disabilities. *Journal of Intellectual Disability Research, 54*, 354–365. doi:10.1111/j.1365-2788.2010.01264.x
- Hickson, L., & Khemka, I. (2013). Problem solving and decision making. In M. L. Wehmeyer (Ed.), *The Oxford handbook of positive psychology and disability* (pp. 198–225). New York: Oxford University Press.
- Holden, B., & Gitlesen, J. P. (2006). A total population study of challenging behavior in the country of Hedmark, Norway: Prevalence and risk markers. *Research in Developmental Disabilities, 27*, 456–465. doi:10.1016/j.ridd.2005.06.001
- Horner, R. D. (1980). The effects of an environmental “enrichment” program on the behavior of institutionalized profoundly retarded children. *Journal of Applied Behavior Analysis, 13*, 473–491. doi:10.1901/jaba.1980.13-473
- Hugh-Pennie, A. K., Park, H.-S. L., Luke, N., & Lee, G. T. (2017). Applied behavior analysis as a teaching technology. In V. C. Bryan, A. T. Musgrove, & J. R. Powers (Eds.), *Handbook of research on human development in the digital age* (pp. 330–362). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-2838-8.ch015
- Jackson, M., Williams, W. L., & Biesbrouck, J. (2006). Equivalence relations, the assessment of basic learning abilities, and language: A synthesis of behavioral research and its implications for children with autism. *The Journal of Speech and Language Pathology and Applied Behavior Analysis, 1*, 27–42.
- Jones Ault, M., Baggerman, M. A., & Horn, C. K. (2017). Effects of an app incorporating systematic instruction to teach spelling to students with developmental delays. *Journal of Special Education Technology, 32*, 123–137. doi:10.1177/0162643417696931

- Kats, Y. (Ed.). (2017). *Supporting the education of children with autism spectrum disorders*. Hershey, PA: IGI Global. 10.4018/978-1-5225-0816-8
- Kaufmann, W. E. (Ed.). (2017). *Rett syndrome: Clinics in developmental medicine*. London: Mac Keith Press.
- Keen, D., Webster, A., & Ridley, G. (2016). How well are children with autism spectrum disorder doing academically at school? An overview of the literature. *Autism*, 20, 276–294. doi:10.1177/1362361315580962
- Kim, S., Larson, S. A., & Lakin, K. C. (2009). Behavioural outcomes of deinstitutionalization for people with intellectual disability: A review of US studies conducted between 1980 and 1999. *Journal of Intellectual and Developmental Disability*, 26, 35–50. doi:10.1080/13668250020032750
- Kirk, H. E., Gray, K., Riby, D. M., & Cornish, K. M. (2015). Cognitive training as a resolution for early executive function difficulties in children with intellectual disabilities. *Research in Developmental Disabilities*, 38, 145–160.
- Kirk, H. E., Gray, K., Riby, D. M., Taffe, J., & Cornish, K. M. (2017). Visual attention and academic performance in children with developmental disabilities and behavioural attention deficits. *Developmental Science*, 20, e12468. doi:10.1111/desc.12468
- Knight, V. F., Smith, B. R., Spooner, F., & Browder, D. (2012). Using explicit instruction to teach science descriptors to students with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 42, 378–389. doi:10.1007/s10803-011-1258-1
- Lain, S. J., Bentley, J. P., Wiley, V., Roberts, C. L., Jack, M., Wilcken, B., & Nassar, N. (2016). Association between borderline neonatal thyroid-stimulating hormone concentrations and educational and developmental outcomes: A population-based record-linkage study. *The Lancet Diabetes & Endocrinology*, 4, 756–765. doi:10.1016/S2213-8587(16)30122-X
- Lancioni, G. E., Sigafoos, J., O'Reilly, M. F., & Singh, N. N. (2013). *Assistive technology interventions for individuals with severe/profound and multiple disabilities*. New York: Springer.
- Lanfranchi, S., & Caretti, B. (2016). Editorial: Improving working memory in learning and intellectual disabilities. *Frontiers in Psychology*, 7, 725. Article 0.3389/fpsyg.2016.00725
- Lang, R., Regester, A., Lauderdale, S., Ashbaugh, K., & Haring, A. (2009). Treatment of anxiety in autism spectrum disorder using cognitive behavior therapy: A systematic review. *Developmental Neurorehabilitation*, 13, 53–63. doi:10.3109/17518420903236288
- Laws, G., MacDonald, J., & Buckley, S. (1996). The effects of a short training in the use of a rehearsal strategy on memory for words and pictures in children with down syndrome. *Down Syndrome Research and Practice*, 4, 70–78. doi:10.3104/reports.65
- Linnenbrink-Garcia, L., Patall, E. A., & Pekrun, R. (2016). Adaptive motivation and emotion in education: Research and principles for instructional design. *Policy Insights from the Behavioral and Brain Sciences*, 3, 228–236.
- Lovaas, O. I. (2003). *Teaching individuals with developmental delays: Basic intervention techniques*. Austin, TX: Pro-Ed.
- Lovaas, O. I., Koegel, R. L., & Schreibman, L. (1979). Stimulus overselectivity in autism: A review of research. *Psychological Bulletin*, 86, 1236–1254. doi:10.1037/0033-2909.86.6.1236
- Machalicek, W., Raulston, T., Nowles, C., Ruppert, T., Carnett, A., & Alresheed, F. (2016). Challenging behavior. In J. L. Matson (Ed.), *Komorbid conditions among children with autism spectrum disorders* (pp. 137–170). Cham, Switzerland: Springer.
- MacLean, Jr., W. E., Miller, M. L., & Bartsch, K. (2001). Mental retardation. In C. E. Walker & M. C. Roberts (Eds.), *Handbook of clinical child psychology* (3rd ed., pp. 542–560). New York: John Wiley.
- Mäehler, C., & Schuchardt, K. (2016). The importance of working memory for school achievement in primary school children with intellectual or learning disabilities. *Research in Developmental Disabilities*, 58, 1–8. doi:10.1016/j.ridd.2016.08.007
- Maenner, M. J., Blumberg, S. J., Kogen, M. D., Christensen, D., Yeargin-Allsopp, M., & Schieve, L. A. (2016). Prevalence of cerebral palsy and intellectual disability among children identified in two U.S. national surveys, 2011–2013. *Annals of Epidemiology*, 26, 222–226. doi:10.1016/j.annepidem.2016.01.001
- Martin, G. L., Thorsteinsson, J. R., Yu, C. T., Martin, T. L., & Vause, T. (2008). The assessment of basic learning abilities test for predicting learning of persons with intellectual disabilities: A review. *Behavior Modification*, 32, 228–247. doi:10.1177/0145445507309022
- Martin, G. L., & Yu, C. T. (2000). Overview of research on the assessment of basic learning abilities test. *Journal on Developmental Disabilities*, 7, 10–36.

- Martinez-Cué, C., Baamonde, C., Lumbreras, M., Paz, J., Davisson, M. T., Schmidt, C., ... Flórez, J. (2002). Differential effects of environmental enrichment on behavior and learning of male and female Ts65Dn mice, a model for Down syndrome. *Behavioural Brain Research*, 134, 185–200. doi:10.1016/S0166-4328(02)00026-8
- Matson, J. L., & Dempsey, T. (2008). Stereotypy in adults with autism spectrum disorders: Relationship and diagnostic fidelity. *Journal of Developmental and Physical Disabilities*, 20, 155–165. doi:10.1007/s10882-007-9086-0
- Maulik, P. K., & Harbour, C. K. (2010). Epidemiology of intellectual disability. In J. H. Stone & M. Blouin. (Eds.), *International encyclopedia of rehabilitation*. Retrieved from <http://cirrie.buffalo.edu/encyclopedia/en/article/144/>
- McGrew, K. S., & Evans, J. (2004). *Expectations for students with cognitive disabilities: Is the cup half empty or half full? Can the cup flow over?* (Synthesis Report 55). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes. Retrieved on 16 November 2017 from: <http://files.eric.ed.gov/fulltext/ED518644.pdf>
- McNaughton, D., & Light, J. (2013). The iPad and mobile technology revolution: Benefits and challenges for individuals who require augmentative and alternative communication. *Augmentative and Alternative Communication*, 29, 107–116. doi:10.3109/07434618.2013.784930
- Miller, L. E., Burke, J. D., Troyb, E., Knoch, K., Herlihy, L. E., & Fein, D. A. (2017). Preschool predictors of school-age academic achievement in autism spectrum disorder. *The Clinical Neuropsychologist*, 31, 382–403. doi:10.1080/13854046.2016.1225665
- Miltenberger, R. G., Bloom, S. E., Sanchez, S., & Valbuena, D. A. (2016). Functional assessment. In N. N. Singh (Ed.), *Handbook of evidence-based practices in intellectual and developmental disabilities* (pp. 69–97). Cham, Switzerland: Springer.
- Mundy, P. (1995). Joint attention and social-emotional approach behavior in children with autism. *Development and Pathology*, 7, 63–82. doi:10.1017/S0954579400006349
- Neece, C. L., Baker, B. L., Blacher, J., & Crnic, K. A. (2011). Attention-deficit/hyperactivity disorder among children with and without intellectual disability: An examination across time. *Journal of Intellectual Disability Research*, 55, 623–635. doi:10.1111/j.1365-2788.2011.01416.x
- Nettelbeck, T., & Wilson, C. (1997). Speed of information processing and cognition. In W. E. MacLean, Jr. (Ed.), *Ellis' handbook of mental deficiency, psychological theory and research* (3rd ed., pp. 245–274). Mahwah, NJ: Erlbaum.
- New Zealand Psychological Society (2009). *Briefing to the Minister of Education*. Wellington: Author. Retrieved on 3 November 2017 from: www.psychology.org.nz/wp-content/uploads/2014/04/Briefing-for-the-Minister-of-Education-May-2009.pdf
- O'Reilly, G., & Carr, A. (2016). Intelligence. In A. Carr, C. Linehan, G. O'Reilly, P. Noonan Walsh, & J. McEvoy (Eds.), *The handbook of intellectual disability and clinical psychology practice* (2nd ed., pp. 81–106). London: Routledge.
- O'Reilly, M. F., Gevarter, C., Falcomata, T., Sigafoos, J., & Lancioni, G. E. (2016). Applied behaviour analysis and positive behaviour supports. In A. Carr, C. Linehan, G. O'Reilly, P. Noonan Walsh, & J. McEvoy (Eds.), *The handbook of intellectual disability and clinical psychology practice* (2nd ed., pp. 240–263). London: Routledge.
- Odom, S. L., Horner, R. H., Snell, M. E., & Blacher, J. (2007). *Handbook of developmental disabilities*. New York: Guilford Press.
- Oldfield, J., Humphrey, N., & Hebron, J. (2017). Risk factors in the development of behaviour difficulties among students with special educational needs and disabilities: A multilevel analysis. *British Journal of Educational Psychology*, 87, 146–169. doi:10.1111/bjep.12141
- Ollendick, T., Balla, D., & Zigler, E. (1971). Expectancy of success and the probability learning of retarded children. *Journal of Abnormal Psychology*, 77, 275–281. doi:10.1037/h0030920
- Oskoui, M., Coutinho, F., Dykeman, J., Jetté, N., & Pringsheim, T. (2013). An update on the prevalence of cerebral palsy: A systematic review and meta-analysis. *Developmental Medicine and Child Neurology*, 55, 509–519. doi:10.1111/dmcn.12080
- Peng, P., Namkung, J., Barnes, M., & Sun, C. (2016). A meta-analysis of mathematics and working memory: Moderating effects of working memory domain, type of mathematics skill, and sample characteristics. *Journal of Educational Psychology*, 108, 455–473. doi:10.1037/edu0000079

- Pennington, L., Parker, N., Kelly, H., & Miller, N. (2016). Speech therapy for children with dysarthria acquired before three years of age. *Cochrane Database of Systematic Reviews*, Art. No.: CD006937 7. doi: 10.1002/14651858.CD006937.pub3
- Percy, M. (2007). Factors that cause or contribute to intellectual and developmental disabilities. In I. Brown & M. Percy (Eds.), *A comprehensive guide to intellectual and developmental disabilities* (pp. 125–148). Baltimore: Paul H. Brookes.
- Poppen, M., Sinclair, J., Hirano, K., Lindstrom, L., & Unruh, D. (2016). Perceptions of mental health concerns for secondary students with disabilities during transition to adulthood. *Education and Treatment of Children*, 39, 221–246. doi:10.1353/etc.2016.0008
- Presmanes Hill, A., Zuckerman, K., & Fombonne, E. (2015). Epidemiology of autism spectrum disorders. In M. Robinson-Agramonte (Ed.), *Translational approaches to autism spectrum disorder* (pp. 13–38). New York: Springer.
- Ramdoss, S., Mulloy, A., Lang, R., O'Reilly, M. F., Sigafoos, J., Lancioni, G. E., ... El Zein, F. (2011). Use of computer-based interventions to improve literacy skills in students with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorder*, 5, 1306–1318. doi:10.1016/j.rasd.2011.03.004
- Ramsey, E., Kelly-Vance, L., Allen, J. A., Rosol, O., & Yoerger, M. (2016). Autism spectrum disorder prevalence rates in the United States: Methodologies, challenges, and implications for individual states. *Journal of Developmental and Physical Disabilities*, 28, 803–820. doi:10.1007/s10882-016-9510-4
- Rioux, M., Basser, L. A., & Jones, M. (Eds.). (2011). *Critical perspectives on human rights and disability law*. Leiden, The Netherlands: Martinus Nijhoff.
- Ruijs, N. M., & Peetsma, T. T. D. (2009). Effects of inclusion on students with and without special educational needs reviewed. *Educational Research Review*, 4, 67–79. doi:10.1016/j.edurev.2009.02.002
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55, 68–78.
- Salazar, F., Baird, G., Chandler, S., Tseng, E., O'Sullivan, T., Howlin, P., ... Simonoff, E. (2015). Co-occurring psychiatric disorders in preschool and elementary school-aged children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 45, 2283–2294. doi:10.1007/s10803-015-2361-5
- Scheerenberger, R. C. (1987). *A history of mental retardation: A quarter century of promise*. Baltimore: Paul H. Brookes.
- Schucardt, K., Gebhardt, M., & Mäehler, C. (2010). Working memory functions in children with different degrees of intellectual disability. *Journal of Intellectual Disability Research*, 54, 346–353. doi:10.1111/j.1365-2788.2010.01265.x
- Sermier Dessefontet, R., Bless, G., & Morin, D. (2011). Effects of inclusion on the academic achievement and adaptive behaviour of children with intellectual disabilities. *Journal of Intellectual Disability Research*, 56, 579–587. doi:10.1111/j.1365-2788.2011.01497.x
- Shepley, S. B. (2017). Self-instructing with mobile technology: Considerations and applications to increase independence. *Teaching Exceptional Children*, 50, 59–65. doi:10.1177/0040059917704971
- Shogren, K. A., Toste, J., Mahal, S., & Wehmeyer, M. L. (2017). Intrinsic motivation. In K. Shogren, M. L. Wehmeyer, & N. Singh (Eds.), *Handbook of positive psychology in intellectual and developmental disabilities* (pp. 285–295). Cham, Switzerland: Springer.
- Sigafoos, J., Green, V. A., Payne, D., O'Reilly, M. F., & Lancioni, G. E. (2009). A classroom-based antecedent intervention reduces obsessive-repetitive behavior in an adolescent with autism. *Clinical Case Studies*, 8, 3–13. doi:10.1177/1534650108327475
- Sigafoos, J., O'Reilly, M. F., Lancioni, G. E., & Green, V. A. (2016). Communication difficulties and the promotion of communication skills. In A. Carr, C. Linehan, G. O'Reilly, P. Noonan Walsh, & J. McEvoy (Eds.), *The handbook of intellectual disability and clinical psychology practice* (2nd ed., pp. 534–571). London: Routledge.
- Singh, N. N. (Ed.). (2016). *Handbook of evidence-based practices in intellectual and developmental disabilities*. Cham, Switzerland: Springer.
- Skinner, B. F. (1982). Contrived reinforcement. *The Behavior Analyst*, 5, 3–8. doi:10.1007/BF03393135
- Smith, C. C., Cihak, D. F., Kim, B., McMahon, D. D., & Wright, R. (2016). Examining augmented reality to improve navigational skills in postsecondary students with intellectual disability. *Journal of Special Education Technology*, 32, 3–11. doi:10.1177/0162643416681159
- Smith, T. E., Polloway, E. A., Patton, J. R., & Dowdy, C. A. (2011). *Teaching students with special needs in inclusive settings* (6th ed.). New York: Pearson.

- Snell, M. E., & Brown, F. (Eds.). (2006). *Instruction of students with severe disabilities* (6th ed.). Upper Saddle River, NJ: Pearson.
- Solomon, M., Frank, M. J., Ragland, D., Smith, A. C., Niendam, T. A., Lesh, T. A., ... Carter, C. S. (2015). Feedback-driven trial-by-trial learning in autism spectrum disorders. *The American Journal of Psychiatry*, 172, 173–181. doi:10.1176/appi.ajp.2014.14010036
- Spooner, F., & Browder, D. M. (2015). Raising the bar: Significant advances and future needs for promoting learning for students with severe disabilities. *Remedial and Special Education*, 36, 28–32. doi:10.1177/0741932514555022
- Spooner, F., Knight, V. F., Browder, D. M., & Smith, B. R. (2012). Evidence-based practice for teaching academics to students with severe disabilities. *Remedial and Special Education*, 33, 374–387. doi:10.1177/0741932511421634
- Spooner, R., Root, J. R., Saunders, A. F., & Browder, D. M. (2019). An updated evidence-based practice review on teaching mathematics to students with moderate and severe developmental disabilities. *Remedial and Special Education*, 40, 150–165.
- Storey, K., & Miner, C. (2017). *Systematic instruction of functional skills for students and adult with disabilities* (2nd ed.). Springfield, IL: Charles C. Thomas.
- Sturme, P., & Didden, R. (Eds.). (2014). *Evidence-based practice and intellectual disabilities*. Chichester, UK: Wiley Blackwell.
- Sweller, J. (2016). Cognitive load theory, evolutionary educational psychology, and instructional design. In David C. Geary and Daniel B. Berch (Eds.), *Evolutionary perspectives on child development and education* (pp. 291–306). Cham, Switzerland: Springer.
- Switzky, H. N. (1997). Mental retardation and the neglected construct of motivation. *Education and Training in Mental Retardation and Developmental Disabilities*, 32, 194–196. www.jstor.org/stable/23879148
- Te Kaat-van Den Os, D. J. A., Jongmans, M. J., (Chiel) Volman, M. J. M., & Lauteslager, P. E. M. (2017). Parent-implemented language interventions for children with a developmental delay. *A systematic review Journal of Policy and Practice in Intellectual Disabilities*, 14, 129–137. doi:10.1111/jppi.12181
- U.S. Department of Health and Human Services. (2000). *The Developmental Disabilities Assistance and Bill of Rights Act of 2000*. Washington, DC: Author. Retrieved from www.acl.gov/sites/default/files/about-acl/2016-12/dd_act_2000.pdf on 5 October 2017.
- Van Houten, R., Axelrod, S., Bailey, J. S., Favell, J. E., Foxx, R. M., & Lovaas, O. I. (1988). The right to effective behavioral treatment. *Journal of Applied Behavior Analysis*, 21, 381–384. doi:10.1901/jaba.1988.21-381
- Van Steensel, F. J. A., Bögels, S. M., & Perrin, S. (2011). Anxiety disorders in children and adolescents with autistic spectrum disorders: A meta-analysis. *Clinical Child and Family Psychology Review*, 14, 302–317. doi:10.1007/s10567-011-0097-0
- Vause, T., Yu, C. T., & Martin, G. L. (2007). The assessment of basic learning abilities test for persons with intellectual disability: A valuable clinical tool. *Journal of Applied Research in Intellectual Disabilities*, 20, 483–489. doi:10.1111/j.1468-3148.2007.00351.x
- Vaz, S., Wilson, N., Falkmer, M., Sim, A., Scott, M., Cordier, R., & Falkmer, T. (2015). Factors associated with primary school teachers' attitudes towards the inclusion of students with disabilities. *PLoS ONE*, 10(8), e0137002. doi:10.1371/journal.pone.0137002
- Vicari, S. (2004). Memory development and intellectual disabilities. *Acta Paediatrica*, 93(Supplement s445), 60–63. doi:10.1111/j.1651-2227.2004.tb03059.x
- Vicari, S., Carlesimo, A., & Caltagirone, C. (1995). Short-term memory of persons with intellectual disabilities and down syndrome. *Journal of Intellectual Disability Research*, 39, 532–537. doi:10.1111/j.1365-2788.1995.tb00574.x
- Wang, Y., Zhang, Y. B., Liu, L. L., Cui, J. F., Wang, J., Shum, D. H., ... Chan, R. C. (2017). A meta-analysis of working memory impairments in autism spectrum disorders. *Neuropsychology Review*, 27, 46–61.
- Wehmeyer, M. L., & Shogren, K. A. (2017). Future trends and advances in intellectual and developmental disabilities. In M. L. Wehmeyer, I. Brown, M. Percy, K. A. Shogren, & W. L. A. Fung (Eds.), *A comprehensive guide to intellectual and developmental disabilities* (pp. 737–743). Baltimore: Paul H. Brookes.
- Weisbrot, D. M., Gadow, K. D., DeVincent, C. J., & Pomeroy, J. (2005). The presentation of anxiety in children with pervasive developmental disorders. *Journal of Child and Adolescent Psychopharmacology*, 15, 477–496. doi:10.1089/cap.2005.15.477
- Westerinen, H., Kaski, M., Virta, L. J., Kautiainen, H., Pitkälä, K. H., & Iivanainen, M. (2017). The nationwide register-based prevalence of intellectual disability during childhood and adolescence. *Journal of Intellectual Disability Research*, 61, 802–809. doi:10.1111/jir.12351

- White, S. W., Oswald, D., Ollendick, T., & Scahill, L. (2009). Anxiety in children and adolescents with autism spectrum disorders. *Clinical Psychology Review, 29*, 216–229. doi:10.1016/j.cpr.2009.01.003
- Willner, P., & Lindsay, W. R. (2016). Cognitive behavior therapy. In N. N. Singh (Ed.), *Handbook of evidence-based practices in intellectual and developmental disabilities* (pp. 283–310). Cham, Switzerland: Springer.
- Wingate, M., Kirby, R. S., Pettygrove, S., Cunniff, C., Schulz, E., Ghosh, T., ... Wright, V. (2014). Prevalence of autism spectrum disorder among children aged 8 years – Autism and developmental disabilities monitoring network, 11 sites, United States, 2010. *Morbidity and Mortality Weekly Report: Surveillance Summary, 63*, 1–21.
- Witzel, B. S., & Mercer, C. D. (2003). Using rewards to teach students with disabilities: Implications for motivation. *Remedial and Special Education, 24*, 88–96. doi:10.1177/07419325030240020401
- Woodcock, S. (2013). Trainee teachers' attitudes toward students with specific learning disabilities. *Australian Journal of Teacher Education, 38*, 16–29. <http://ro.ecu.edu.au/ajte/vol38/iss8/2>
- Zigler, E., & Hodapp, R. M. (1996). *Understanding mental retardation*. New York: Cambridge University Press.

9

CHILD MALTREATMENT

Pathways to Educational Achievement through Self-Regulation and Self-Regulated Learning

Carlomagno C. Panlilio and Catherine Corr

According to the U. S. Department of Health & Human Services, Administration for Children and Families (U.S. DHHS, 2017), more than 600,000 children were victims of child maltreatment in 2015. More than 60% of victims were young children between birth and 8 years of age. Children between the ages of 5 and 8 years comprised about 24% of total victims, representing a group of children entering kindergarten and continuing into elementary and secondary education. These early experiences of abuse and neglect are a form of complex trauma, which typically involves adversity that is chronic, begins in early childhood, and occurs with the child's primary caregiver (Cook, Blaustein, Spinazzola, & van der Kolk, 2003). Unfortunately, these experiences negatively impact development and cascade into vulnerabilities in functioning later in life that include developmental delays and disabilities. Moreover, young children's disability status may serve as a risk factor for an increased likelihood of experiencing maltreatment. This further complicates our understanding of individual differences in subsequent development and learning. Taken together, these early maltreatment and developmental problems place students at a disadvantage upon school entry that often continues across elementary and secondary education.

The goal of this chapter, therefore, is to provide a framework with which to understand how development and learning proceed for children who have experienced early maltreatment. We begin this chapter by defining the concept of maltreatment and further discuss it as a risk factor across development and learning. We then examine the literature related to maltreatment and both disability and academic competence. Next, we outline our conceptual framework to explicate mechanisms that potentially underlie the often-studied direct relationship between early adversity and later academic problems. Specifically, we offer our framework that is guided by the principles of self-regulation (conceptualized from the field of developmental science) and self-regulated

learning (conceptualized from the field of educational psychology), which is followed by a section on the impact of early maltreatment and disability on self-regulation (SR) and self-regulated learning (SRL) processes. Next, we discuss implications for practice, particularly relating to early intervention, educational access, and inclusive classrooms. Finally, we offer directions for future research and practice specifically guided by our conceptual model, highlighting components and pathways that need further empirical support.

DEFINING MALTREATMENT

A report by the Institute of Medicine and National Research Council (2014) provided a detailed description of the issues related to how child maltreatment is defined across legal and research purposes. Foremost of these definitional issues has been the use of federal legislation that allows states to adopt a minimum definition, while providing autonomy in specific standards. According to Section 3 of the Child Abuse Prevention and Treatment Act of 2010 (CAPTA), child abuse and neglect is defined as:

Any recent act or set of acts or failure to act on the part of a parent or caretaker, which results in death, serious physical or emotional harm, sexual abuse or exploitation, or an act or failure to act, which presents an imminent risk of serious harm.
www.childwelfare.gov/topics/can/defining/federal/

Across multiple states, these acts of maltreatment are often divided into four broad categories that include physical abuse, neglect, sexual abuse, and emotional or psychological abuse. State variation in maltreatment standards includes the incorporation of a *harm standard*, which indicates demonstrable harm resulting from abuse and neglect, or an *endangerment standard*, which indicates endangerment or risk for abuse and neglect (Sedlak et al., 2010).

A widely used definitional system in research to understand the differential effects of maltreatment subtypes is captured by the use of the Maltreatment Classification Scheme (MCS; Barnett, Manly, & Cicchetti, 1993). The MCS was devised to examine information from Child Protective Services (CPS) records with the goal of integrating multiple sources of information within a developmental psychopathology framework. The MCS approach captures the impact of maltreatment on children's development and includes operational definitions for each category of maltreatment and additional dimensions such as frequency or chronicity, age of onset or developmental period, co-occurrence with other maltreatment types, severity, and relationship with perpetrators (Manly, 2005).

MALTREATMENT AND DISABILITY

According to federal child maltreatment and disability¹ data from 2015, 14.1% of total child maltreatment victims had a reported disability, whereas only 5.2% of school-aged children (ages 5–17) were identified with a disability (U.S. DHHS, 2017). Despite difficulties obtaining information about children with disabilities in the child welfare system, these statistics suggest that children with disabilities are overrepresented in the child welfare system. Further, research has estimated that

children with disabilities are at least three times more likely to experience maltreatment than their peers without disabilities (Jones et al., 2012) and are more likely to be seriously injured or harmed by maltreatment (Sedlak et al., 2010). Among children with disabilities, the risk of maltreatment varies by disability type (Jones et al., 2012; Lightfoot, 2014; Turner, Vanderminden, Finkelhor, Hamby, & Shattuck, 2011). For example, compared with children born without medical complications, those with congenital anomalies such as spina bifida or Down syndrome have an increased likelihood of experiencing maltreatment during the first month of life (Van Horne et al., 2018). Additionally, the type of maltreatment (e.g., physical abuse, sexual abuse, neglect) children experience will likely be related to their disabilities. For example, medical neglect is a common form of maltreatment for children with complex medical diagnoses.

While having a disability can pose a risk for experiencing maltreatment, there is a bidirectional relationship wherein early adverse experiences (i.e., maltreatment) can also increase the risk for developing a disability. For example, Bright, Knapp, Hinojosa, Alford, and Bonner (2016) found that children who experienced at least one early adversity² were 1.23 times more likely to have at least one developmental condition compared with children without prior adversity. Moreover, children who experience three or more early adverse events were 1.93 times more likely to have one or more developmental conditions. For young children who experience maltreatment specifically, these delays were evident in the cognitive, behavioral, language, and socio-emotional domains of development (Pears & Fisher, 2005; Zimmer & Panko, 2006). Furthermore, developmental delays may cascade into disability if children do not receive adequate resources and early intervention services (Committee on Child Abuse and Neglect and Committee on Children with Disabilities, 2001).

MALTREATMENT AND ACADEMIC OUTCOMES

Studies that examine the associations among early maltreatment, disability status, and academic outcomes often focus on important academic achievement and performance measures that have implications for children's future success. For youth aging out of foster care, in particular, academic outcomes in secondary education are important for securing a high school diploma or GED in order to enter the job market or pursue postsecondary education. Unfortunately, only about 38% of youth aging out of foster care earn a high school diploma, with an additional 10% earning a GED, and about 25% enroll in college, with only 0.1% earning a degree (Courtney, Dworsky, Lee, & Rapp, 2010). Given these abysmal rates of completion, it is important to understand how best to intervene and improve students' academic outcomes, particularly in the areas of *attendance*, *grade point averages* (GPAs), and *standardized achievement test scores*. Challenges in these academic outcomes have been strongly associated with early maltreatment (Ryan et al., 2018; Stone, 2007). These negative effects become particularly evident at the transition point to formal schooling (Rouse & Fantuzzo, 2009) and then further cascade into academic problems over time. The association between early maltreatment and later academic problems has been found to be robust, even after controlling for other known educational risk factors such as poverty (Perlman & Fantuzzo, 2010).

Physical presence in school is important for learning and engagement to occur. Unfortunately, for children who experience early maltreatment, attendance rates severely decline immediately after the initial CPS report is filed (Leiter, 2007; Leiter & Johnsen, 1997; Perlman & Fantuzzo, 2010; Rouse & Fantuzzo, 2009). This decline is then exacerbated by placement disruptions as children move between foster home and biological parents' home or between foster placements (Zorc et al., 2013). There is also evidence to suggest that maltreatment has a negative influence on children's GPAs across elementary and high school. For example, Slade and Wissow (2007) studied sibling pairs of U.S. middle and high school students and found that, prior to 6th grade, severity of childhood maltreatment was significantly associated with lower GPA. In addition to severity, type of maltreatment has been shown to affect students' GPAs (Eckenrode, Laird, & Doris, 1993; Kendall-Tackett & Eckenrode, 1996). In terms of early maltreatment effects on children's academic achievement, studies have found that maltreated students score lower on standardized reading and mathematics achievement tests (Coohey, Renner, Hua, Zhang, & Whitney, 2011; Crozier & Barth, 2005) and are more likely to be held back a grade (Rouse & Fantuzzo, 2009) compared with non-maltreated students.

When considering the effects of maltreatment subtypes, however, evidence for variability in *attendance*, *GPAs*, and *standardized achievement test scores* appears to be mixed. For example, substantiated neglect has been associated with lower grades (Kendall-Tackett & Eckenrode, 1996) and poor performance on standardized assessments of reading, language, and science (Fantuzzo, Perlman, & Dobbins, 2011). Others have found significant relationships between early maltreatment and later poor academic outcomes regardless of maltreatment type (Bell, Bayliss, Glauert, & Ohan, 2018; Cage, 2018; Crozier & Barth, 2005). Furthermore, variability in academic outcomes was more significantly related to unsubstantiated reports of maltreatment than to substantiated findings (Bell et al., 2018; Leiter, 2007), highlighting the importance of considering at-risk contexts rather than relying on investigative outcomes for pursuing prevention and intervention efforts.

Taken together, these studies highlight a direct relationship between early experiences of maltreatment and subsequent academic challenges faced by students. What is less clear, however, is the identification of specific learning-related psychological processes that mediate this relationship. Although important, most of the research that focuses on these broad, static, and distal academic outcomes makes it difficult to identify malleable mechanisms that can serve as intervention targets, especially in the classroom. Moreover, research on these distal academic problems mostly focuses on domain-general outcomes, which necessitates further investigation of more domain-specific content (e.g., mathematics, science, social studies) and processes (e.g., reading, calculations). This requires a shift in our understanding and conceptualization of academic problems from these static, distal outcomes to incorporation of more dynamic, proximal, or intermediate learning processes. Specifically, we consider SR and SRL as important proximal learning processes, given that learning is a recursive dynamic activity wherein students orient toward their goals, manage their thoughts and behavior, and monitor progress toward these goals (Schunk & Zimmerman, 2003). By addressing this gap in the literature, testing of hypothesized proximal learning processes can provide educators with the means to help promote positive development and learning for these at-risk stu-

dents. Therefore, the next sections outline our proposed conceptual model guided by SR and SRL to further understand variability in academic outcomes as a result of early maltreatment.

SELF-REGULATION

Given our chapter's focus on maltreatment, SR was conceptualized from Blair's (2010) model wherein it is important to consider early experiences of psychosocial stress and context in order to understand the development of children's regulatory capacities. This is particularly relevant for understanding development in the context of early maltreatment, as individual differences in SR are partly a result of variations in intrinsic (e.g., temperament, psychobiology) and extrinsic (e.g., caregiver socialization, early adversity) factors that highlight the constitutional nature of this construct (Fox & Calkins, 2003; Posner & Rothbart, 2000). SR is defined as the "primarily, but not necessarily, volitional management of attention and arousal, including stress physiology and emotional arousal, for the purpose of goal-directed action" (Blair & Ursache, 2010, p. 305). Within Blair's (2010) dual process model, SR is the bidirectional, interactive feedback loop that occurs between *bottom-up* (i.e., automatic processes related to stress physiology, emotional arousal, or reactivity) and *top-down* (i.e., active or volitional processes needed for directing attention, organizing cognitive resources, and regulating emotions) processes. Experiencing early psychosocial stress results in changes across domains of functioning that are reflected in alterations across neurophysiological structures, connectivity, and functions that affect the balance between top-down and bottom-up processes. Although a thorough review of the neurophysiological structures and functions related to SR and maltreatment is beyond the scope of this chapter, a summary has been provided as a reference for subsequent discussions (see Table 9.1). See Byrnes and Eaton (Chapter 27, this volume) for discussion of neuroscience and special needs children.

Table 9.1 Neurophysiological Structures Affected by Early Adversity that Impact the Bottom-Up and Top-Down Processes of Self-Regulation

Neurophysiological Structures	Normative Function in Relation to Emotion Processing	Alterations due to Adversity
Amygdala	– Coordinates behavioral, autonomic, and endocrine reactions – Processes emotional facial reactions – Critical role in fear conditioning – Emotional memory encoding and consolidation – Part of the limbic system	– Connectivity alterations across the hippocampus and prefrontal cortex – Initial volume increase in early childhood with substantial reduction in adolescence and beyond – Amplified attention or attentional bias to threat
Hippocampus	– Critical role in encoding and recall, particularly declarative memory functions – Controls corticosteroid production – Part of the limbic system	– Graded reduction in volume – Impaired memory retrieval – Behavior problems – Mental health issues

(Continued)

Table 9.1 (Continued)

Hypothalamus	– Mediates autonomic, emotional, and endocrine functions – Part of an extensive reward–motivation network that includes the prefrontal cortex, amygdala, and hippocampus – Part of the limbic system	– Alterations across the reward network can lead to differential susceptibility to reward or punishment – Increased pervasiveness of risky behaviors – Diminished response to anticipated rewards
Limbic hypothalamic–pituitary–adrenal (HPA) axis	– Part of the stress response system that controls the release of stress hormones to manage a real or perceived environmental threat	– Prolonged activation of the stress response system can lead to damaging effects on multiple organ systems, including the brain and higher-order cognitive functions
Parietal lobe	– Associated with orienting responses such as disengaging focus and shifting attention to a new event or voluntary shift in attention	– Surface area reduction, changes in gyrification, and decreased activity – Increased P3b activation that indicates attention to non-relevant target stimuli – Attentional bias toward emotionally salient (perceived threat-related) stimuli – Problems with disengaging attention and shifting focus
Anterior cingulate cortex (ACC)	– Associated with working memory, emotion processing, and conflict and error monitoring	– Lower activity levels and smaller volume – Problems with emotional identification and processing (e.g., response bias) – Problems with error monitoring – Decreased spatial working memory capacity
Prefrontal cortex (PFC)	– Exerts a top–down or conscious inhibitory influence on the amygdala when processing emotionally-salient stimuli – Activates when attention to a particular feature of the environment is necessary while inhibiting other non-relevant features – As part of the reward network alongside other limbic structures, involved in approach-related goals and maintenance of goals that require inhibition or withdrawal – Midline and lateral prefrontal areas are associated with persistence	– Volumetric reduction – Changes in functional connectivity that include reduced coupling with the amygdala and hippocampus – Reduced top–down regulation of the amygdala as well as reduced contextual input from the hippocampus that indicate increased reactive, bottom–up responses – Smaller N2 amplitude during inhibitory control tasks as well as smaller ERN during a selective attention and conflict-monitoring task – Problems with inhibitory control and error monitoring – Diminished reward anticipation that becomes a risk factor for depression and substance addiction, as well as shifting an approach-avoidance situation toward avoidance behaviors

BOTTOM-UP PROCESSES: STRESS, EMOTION, AND ATTENTION

Shonkoff and colleagues (Shonkoff, Garner, & The Committee on Psychosocial Aspects of Child and Family Health, 2012) proposed a conceptual taxonomy that describes three distinct types of stress response in children based on the intensity and duration of the response and its potential to cause physical disruptions. These include a *positive stress response* that is mild to moderate in intensity and brief in duration; a *tolerable stress response* that is associated with atypical experiences associated with greater intensity of adversity or threat; and a *toxic stress response* that can result from strong, frequent, or prolonged activation of the stress response system in the absence of available, responsive, and supportive adult caregivers (e.g., complex traumatic events such as child abuse and neglect). Emotions, particularly those from stress-related events, serve to organize feelings, thoughts, attention, and action (Rothbart & Bates, 2006). For children with a history of maltreatment in particular, any observed cognitive, emotional, or behavioral “challenges” might actually reflect an organized pattern of adaptive response due to early adversity (Blair, 2010). Within the classroom setting, however, these adaptive responses may not be optimal and may lead to challenges with learning activities or social interactions. It is, therefore, important to understand how experiencing *toxic stress* relates to neurophysiological changes that might increase children’s emotional reactivity (i.e., *bottom-up* responses) and decrease the efficiency of *top-down* processes, thus negatively affecting self-regulatory capacities.

Neural models of emotional processing that include the limbic system and attentional networks (e.g., parietal lobe, ACC, PFC; see Table 9.1) are important to consider within the context of psychosocial stress. In low-threat situations, attentional systems can be under volitional control and select specific emotions for processing. However, emotional reactivity (e.g., in high stress or threat situations) may also influence automatic or habitual attentional shifting and focus, especially if individuals experience chronic stress or threat (i.e., maltreatment). The process of evaluating salient emotional information within a child’s surrounding is important for social adaptation and learning. When attention is difficult to shift and becomes overly focused on threatening stimuli or on the self, access to information about others or about academic tasks is likely to be less accessible. This reflects automatized, emotionally reactive processes that make it more difficult for students to reflect on their own actions and recruit top-down, volitional regulatory processes. What follows next is a discussion on these specific top-down processes that are necessary to manage emotionally reactive, bottom-up processes in order to engage higher-order cognitive control, particularly important for SRL.

TOP-DOWN PROCESSES: EFFORTFUL CONTROL, EXECUTIVE FUNCTIONS, AND MALTREATMENT

Top-down processes such as *effortful control* and *executive functions* are of key importance in SR. As the self-regulatory dimension of temperament, *effortful control* (EC) is defined as “the efficiency of *executive attention* – including the ability to inhibit a dominant response and/or to activate a subdominant response, to plan, and to detect

errors” (Rothbart & Bates, 2006, p. 129). According to Eisenberg, Valiente, and Eggum (2010), EC includes the components of *inhibitory control* (i.e., capacity to plan and effortfully suppress a dominant response), *attentional control* (i.e., maintain attentional focus or to shift focus as needed), and *activation control* (i.e., capacity to perform an action or persist through a task despite a strong tendency to avoid or give up). EC is important for children’s socio-emotional development, particularly in areas such as conscience development, prosocial behaviors, empathy development, social competence, and social adjustment (Eisenberg, Smith, & Spinrad, 2010), as well as academic success through school readiness (Eisenberg et al., 2010).

Within Blair’s model of SR (e.g., Blair, 2010; Blair & Diamond, 2008; Blair & Ursache, 2010), top-down processes consist of *executive functions* (EFs) that “describe interrelated cognitive abilities that are required when one must intentionally or deliberately hold information in mind, manage and integrate information, and resolve conflict” (Blair & Ursache, 2010, p. 301). According to Diamond (2013), the three core EFs include *working memory*, *inhibitory control*, and *cognitive flexibility*. *Working memory* is the active retention and maintenance of information over a relatively brief period. *Inhibitory control*, defined within an EF framework, is the capacity to suppress a non-optimally prepotent attentional, behavioral, and emotional response in favor of a more effective response. *Cognitive flexibility* is the ability to shift one’s attention or cognitive set in order to adjust to new demands, rules, priorities, or tasks (see Follmer & Sperling, Chapter 5, this volume, for discussion of EF). These core EFs are important precursors to higher-order EFs such as reasoning, problem-solving, and planning, and are important for mental health, social competence, and positive relationships (Diamond, 2013). Similar to EC, EFs are also important for school success through positive development of children’s school readiness skills (Blair & Razza, 2007; Blair, Ursache, Greenberg, & Vernon-Feagans, 2015).

Based on the structural and functional changes in neurophysiology due to maltreatment (see Table 9.1), children may exhibit regulatory problems because of compromised executive control processes. Specifically, conceptualization of executive control as top-down regulatory processes does not preclude the bidirectional influence that bottom-up, reactive processes exert during goal-directed tasks (Blair & Ursache, 2010). If considered within the context of severe psychosocial stress and intense emotional arousal, morphological changes across the limbic system and attentional networks may exert automatic responses that could be considered adaptive but not optimal. In this case, executive control processes may become impaired and decrease the self-reflective and volitional nature of self-regulatory processes.

In relation to academic performance, effective executive control has been positively associated with children’s school readiness domains in early childhood (Blair et al., 2015; Eisenberg et al., 2010). Unfortunately, compromised top-down processes and increased emotional reactivity due to early maltreatment may lead to problems with school readiness that cascade into later academic challenges as students transition into formal schooling. These problems include motor coordination (Wade, Bowden, & Jane Sites, 2018), emotion dysregulation (Panlilio, Jones Harden, & Harring, 2017), poor social development (Bell et al., 2018), decreased motivation and approaches toward learning (Rouse & Fantuzzo, 2009; Vondra, Barnett, & Cicchetti, 1990), lower expressive and receptive language abilities (Eigsti & Cicchetti, 2004; Stacks, Beeghly,

Partridge, & Dexter, 2011), and problems with cognitive functioning (Hong, Rhee, & Piescher, 2018) and general knowledge (Blair & Razza, 2007). These studies highlight the important role that SR capacities play in the understanding of maltreated children's academic readiness as they transition into kindergarten and beyond.

Moving beyond early childhood into school age, it is important to explicate more proximal learning processes in order to understand how distal academic outcomes remain particularly abysmal for children who experience early maltreatment, especially for those with co-occurring developmental disabilities. To address this gap, we incorporated *SRL*, conceptualized from the field of educational psychology, to understand how problems in school readiness due to compromised top-down and bottom-up SR processes might extend into elementary and secondary grades. What follows in the next section is a discussion of *SRL* within our conceptual framework that integrates SR and the impact of early adversity as discussed above. By integrating SR and *SRL*, we hope to offer a perspective that addresses the challenges and future directions outlined by Zeidner, Boekaerts, and Pintrich (2005).

CONCEPTUAL FRAMEWORK

Understanding the effects of maltreatment and disabilities on SR and learning requires multiple disciplinary perspectives in order to tease apart the complexities of students' experiences, particularly as they begin and move through formal schooling. Panlilio, Ferrara, and MacNeill (2019) called for a unifying framework incorporating SR and *SRL* to understand the dynamic processes mediating early adversity and academic challenges. To this end, a specific framework that incorporates theoretical perspectives from developmental science and educational psychology was adopted (see Figure 9.1).

Within this framework, development and learning involve mutually influential or bidirectional relationships between multiple layers of organization in children's cognitive, emotional, and behavioral responses that vary across multiple contexts (Lerner, Theokas, & Bobek, 2005). It is through these dynamic relationships that functional changes in development and learning occur. These changes must be systematic, organized, and successive across multiple domains that serve a specific learning function for students (Figure 9.1, Box b) as a result of interactions with teachers (Figure 9.1, Box d). Relevant to this chapter is the sequelae of maltreatment experiences on children's neurophysiological, cognitive, emotional, and behavioral functioning that affects their development and learning (Figure 9.1, Pathway 2), as well as interaction with environments such as the classroom (Figure 9.1, Box d, with bidirectional influences across Pathways 4a and 4b). What follows next is a discussion on how *SRL* can be expanded and integrated within this conceptual model for further understanding of more proximal learning processes.

SELF-REGULATED LEARNING

SRL consists of proactive and dynamic process where learners systematically orient toward learning goals that involve self-oriented feedback in order to select and employ strategies to monitor, regulate, and control their cognition, emotion, and behavior toward the acquisition of social and academic skills (Perry, Mazabel, & Yee, Chapter 13, this volume; Pintrich, 2000; Pintrich & De Groot, 1990; Schunk & Zimmerman, 2003;

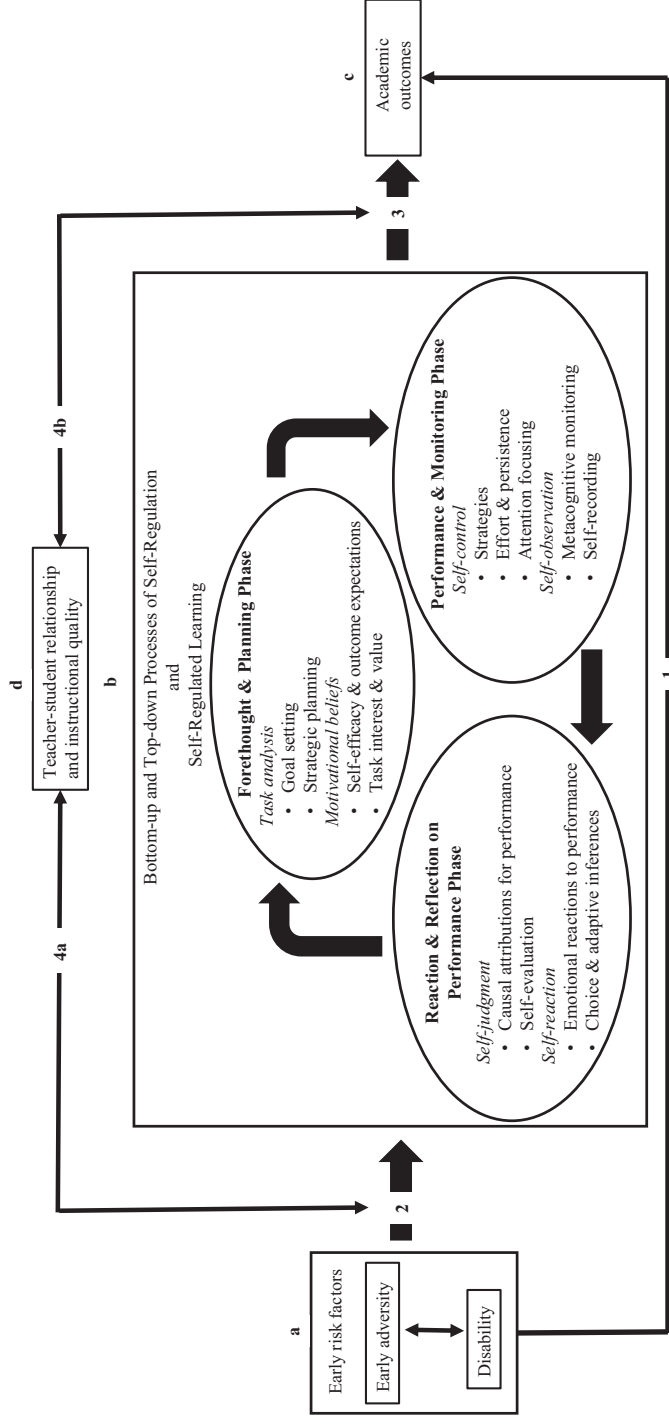


Figure 9.1 Conceptual Framework Showing Direct (Pathway 1) and Indirect (Pathways 2 and 3 through Box b) Paths to Academic Competence (Box c) due to Early Adversity and Disability (Box a) with Moderating Effects (Pathways 4a and 4b) of Teacher–Student Relationship and Instructional Quality (Box d)

Zimmerman, 2005; Zimmerman & Schunk, 2011). According to Zimmerman (2008), SRL processes are important for both academic content learning (e.g., self-directed reading) and social forms of learning (e.g., seeking help from parents, teachers, or peers). The phase model of SRL consists of three interdependent cyclical phases: the *forethought and planning phase*, *performance and monitoring phase*, and the *reaction and reflection on performance phase* (see Figure 9.1, Box b; Zimmerman, 2008). From this perspective, SRL is an *event* that is defined by its temporal qualities “demarcated by a prior event and a subsequent event” (Zimmerman, 2008, p. 169). This highlights the dynamic process involved with learning that assumes a sequential dependency of each phase, as well as the relative influence that any prior events (e.g., early adversity in Box a) may have on the initiation and maintenance of learning activities.

MALTREATMENT AND THE FORETHOUGHT AND PLANNING PHASE

This phase refers to interrelated elements or processes that learners recruit *before* engaging in the learning activities or tasks (Zimmerman & Schunk, 2011). These processes prepare an individual to act or plan the next set of actions based on certain elements of SRL such as task analysis (e.g., goal-setting and strategic planning) and motivational beliefs (e.g., self-efficacy and outcome expectations, and task interest and value). Task analysis is important in order for students to initiate the SRL cycle based on their academic-related goals and desired outcomes related to learning and performance (Elliot & Murayama, 2008; Wolters, Yu, & Pintrich, 1996). Students, therefore, need to formulate their plans of action to achieve these goals, which require the volitional management of attention and allocation of personal resources (Zimmerman & Schunk, 2011). Motivational belief, another element of the forethought and planning phase of SRL, is important for understanding the initiation, direction, and intensity of behaviors toward an outcome such as academic achievement (Pintrich, 2003). Additionally, Wigfield, Eccles, Schiefele, Roeser, and Davis-Kean (2006) stated that conscious cognitive and emotional processes are necessary to influence motivation and subsequent actions during a learning or performance task. This means that motivational beliefs are important in energizing students toward a learning task. Moreover, motivational beliefs are necessary to maintain students’ engagement in the SRL cycle as they move into the performance phase (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996; Liew, McTigue, Barrois, & Hughes, 2008).

For students with a history of maltreatment, problems within this phase of the SRL cycle may be related to compromised SR as discussed in the previous section. For example, structural and functional connectivity alterations in the PFC result in reduced top-down regulation of the amygdala as well as reduced contextual input from the hippocampus (see Table 9.1) that indicate increased reactive, bottom-up responses due to early maltreatment (Insana, Banihashemi, Herringa, Kolko, & Germain, 2016; Teicher & Samson, 2016; Teicher, Samson, Anderson, & Ohashi, 2016). These emotionally reactive responses could be attributed to children’s social defense strategies to maintain emotional security (Davies & Forman, 2002). *Emotional security* is an important goal that functionally organizes working models of a child’s response patterns to regulate their exposure to conflict and stress (Davies & Cummings, 1994; Davies & Martin, 2013). Additional problems for students with a history of maltreat-

ment include organizational and planning deficits (Kavanaugh & Holler, 2015), as well as problems with calibration of perceived and actual competence levels (Barnett, Vondra, & Shonk, 1996; Vondra, Barnett, & Cicchetti, 1989) that affect motivation (Vondra et al., 1990).

Taken together, these studies indicate problems with planning and coordinating the necessary resources to achieve learning goals across task or course, or at the broader school level (e.g., grade repetition, attendance, degree attainment). For example, when attempting to complete homework assignments, students who are more emotionally reactive, exhibit inflated self-competence beliefs, and have planning deficits may inaccurately judge their own level of knowledge and ineffectively allocate personal resources (e.g., time, use of reference materials, asking for homework support from a parent or teacher) when organizing their schedule to complete the task. These students may wait until the last minute to move into the performance phase of SRL and do their homework. If they reach a point of difficulty that increases the intensity of their frustration without having created alternative strategies, they may give up. Indeed, problems within the forethought and planning phase may explain problems with academic engagement (Font & Maguire-Jack, 2013), which often includes homework completion as an indicator (e.g., Coohey et al., 2011).

MALTREATMENT AND THE PERFORMANCE AND MONITORING PHASE

This phase of the SRL cycle refers to interrelated elements or processes that promote SR efforts *during* learning activities or tasks. Within this phase, students attempt to complete these tasks or activities based on certain elements of SRL that include self-control (e.g., strategies, attention-focusing, and effort and persistence) and self-observation (e.g., metacognitive monitoring and self-recording). Self-control, which assumes volitional processes, is important for the SRL cycle because it focuses students' resources on engagement and completion of their learning task or activity (Zimmerman, 2005). This can be accomplished by selection of cognitive (Pressley, Forrest-Pressley, Elliott-Faust, & Miller, 1985) and emotion regulation (Gross & Thompson, 2007) strategies that allow students to shift their attention toward increased effort (Flake, Barron, Hulleman, McCoach, & Welsh, 2015) and persistence (Mägi, Kikas, & Soodla, 2018) to complete the task. Self-observation is an important element of the monitoring phase of SRL that allows students to track particular aspects of their performance, account for the contextual conditions that might affect performance, and observe the resulting effects (Zimmerman, 2005). Metacognitive monitoring is particularly important for self-feedback on the effectiveness of strategy use and is defined as a cognitive process that "generates awareness about the match between a particular instance of metacognitive knowledge to standards for that knowledge" (Winne & Azevedo, 2014, p. 66). One way to measure effective metacognitive monitoring is through the use of calibration, defined as the degree to which judgment about performance corresponds to the actual performance (Winne & Azevedo, 2014). Self-recording is a common self-observational technique that can increase the proximity, informativeness, accuracy, and valence of feedback to improve calibration accuracy for learners (Zimmerman, 2005). Metacognitive mon-

itoring and self-recording provide information about one's current performance on a task, its relation to goals from the previous phase, and where adjustments are needed in order to attain these task goals.

The impact of maltreatment on SRL for this phase coincides with the morphological and functional changes to relevant neural networks associated with higher-order cognitive processes as outlined earlier (i.e., top-down processes; see Table 9.1). Specifically, experiencing early adversity has been associated with volumetric and functional connectivity changes in the ACC (Carrion, Weems, Richert, Hoffman, & Reiss, 2010; Shackman, Wismer Fries, & Pollak, 2008), the PFC (Hanson et al., 2012; Teicher et al., 2016), and the parietal lobe (Kelly et al., 2016). These, in turn, have been associated with EF problems (Roos, Kim, Schnabler, & Fisher, 2016) that limit children's capacity to shift attention as needed (Pollak & Tolley-Schell, 2003; Pollak, Vardi, Putzer Bechner, & Curtin, 2005), persist and complete tasks independently (Jones Harden, Drouin Duncan, Morrison, Panlilio, & Clyman, 2015), manage impulsive responses (Roos, Pears, Bruce, Kim, & Fisher, 2014), and effectively manage emotional reactivity (Jones Harden et al., 2016). Taken together, these studies highlight problems with volitional control for students with early experiences of maltreatment. That is, students' selection of strategies to shift attention and persist through a challenging task may be more reactive and automatic than volitional and reflective.

Additional evidence for functional changes in neurophysiology include displays of smaller N2 amplitude during inhibitory control tasks as well as smaller error-related negativity (ERN) during a selective attention- and conflict-monitoring task (Loman et al., 2013). The N2 component is associated with cognitive control that includes inhibitory control, discriminating between stimuli, and categorization of stimuli (Pollak et al., 2005; Posner & Fan, 2008). The ERN component, on the other hand, is activated immediately following an incorrect response as participants engage in initial response monitoring (Pollak, 2015). When considered in tandem, the amplitude patterns for the N2 and ERN, which are components of event-related potentials within the PFC, indicate deficits in inhibitory control and error monitoring (Loman et al., 2013). This may entail problems with *metacognitive monitoring*, specifically calibration, as maltreated students may have a difficult time monitoring potential errors in their responses. Indeed, a study by Daly, Hildenbrand, Turner, Berkowitz, and Tarazi (2017) found that college students with a history of maltreatment reported increased problems with metacognition compared with their non-maltreated peers.

Similar to the forethought phase, problems within this phase of SRL may be seen across learning-related tasks or course performance, or at the broader school level. For example, consider a reading task where a student will be evaluated for comprehension. If this task proves to be challenging, and the student was not aware of the necessary resource allocation needed prior to engaging in the task, he or she may exhibit reactive responses as a result. More specifically, this example student would need to be able to monitor their own progress toward a comprehension goal and then adjust reading strategies as needed. If the student already exhibits problems with calibration, this may prove to be difficult. Additionally, this student would need to inhibit a prepotent response of reacting negatively when frustrated by comprehension problems and selecting potential emotional security strategies that are not optimal for task comple-

tion, such as classroom disruptions and behavior problems (e.g., Hanson et al., 2015; Pears, Kim, & Fisher, 2008; Roos et al., 2014).

MALTREATMENT AND THE REACTION AND REFLECTION ON PERFORMANCE PHASE

This phase refers to interrelated elements or processes of SRL (e.g., self-judgment and self-reaction) that students engage in *after* the learning activities or tasks. Self-judgment (e.g., causal attribution of performance and self-evaluation) is an important element of this phase of the SRL cycle wherein students evaluate their performance and attribute success or failure to internal or external factors (Zimmerman, 2005). These attributions are often associated with students' sense of self-efficacy and understanding of their effort in performing the learning task (Wolters, Fan, & Daugherty, 2013). As students complete the learning task, they evaluate the quality of their outcome against a particular standard put forth by self or others such as parents or teachers (Cleary & Zimmerman, 2001). This form of evaluative judgment is closely linked with causal attributions wherein errors attributed to ability may discourage learners from increasing effort, whereas errors attributed to ineffective strategies may sustain motivation and help the learner persist (Zimmerman & Kitsantas, 1999).

Self-reaction processes (e.g., emotional reactions and choice) are important in this phase of SRL that informs the next steps that students may take in their learning activity (Zimmerman & Schunk, 2011), whether this is at the task level (e.g., choice to complete a homework task), course selection (e.g., selection of challenging courses), or broader school level (e.g., choice to graduate). Emotional reactions and appraisals of task outcomes are often employed by students to modify these future academic choices (Wigfield, Klauda, & Cambria, 2011). This means that emotional reactions should be managed using effective strategies to promote effective reflection on performance (Gross & Thompson, 2007). Inferences about one's performance are also an important element to consider within the SRL cycle. For example, adaptive inferences direct or energize learners to new ways of approaching a task or in approaching novel learning situations, shifting goals, or shifting strategies, whereas defensive inferences undermine successful adaptation by protecting learners from future negative reactions and include such behaviors as learned helplessness, procrastination, or task avoidance (Zimmerman, 2005). Utilization of an adaptive or a defensive inference mindset could affect learners' subsequent choice of academically related activities. Elements of this phase are important in how students will then approach subsequent learning-related tasks as they move back to the forethought and planning phase (Zimmerman, 2005).

For students with a history of maltreatment, attributional styles (e.g., self-oriented vs. other-oriented) have been linked to problem behaviors (Brown & Kolko, 1999). Problems with self-evaluation are also evident as a result of early maltreatment. Specifically, maltreated students in younger grades tended to exaggerate their positive self-evaluation beyond a self-enhancement bias typically exhibited by young children (Vondra et al., 1989). Similar to the other phases, executive control is important for students in this phase of the SRL cycle to manage their self-reactions. Specifically, managing bottom-up, reactive responses after learning tasks is necessary to accurately evaluate the outcome and make the necessary and optimal adjustments. Problems in this SRL phase may be related to how students make choices in proximal and dis-

tal learning-related activities such as decreased attendance (Leiter, 2007; Zorc et al., 2013), decreased likelihood of graduating (Stone, 2007), or pursuing post-secondary education (Courtney et al., 2010).

IMPLICATIONS FOR PRACTICE

Interventions, specifically those implemented by caregivers and educators in the classroom, can mitigate the effects of early adversity and disabilities. Supporting children's acquisition of self-regulatory skills can positively shape the development and learning trajectories of students with a history of maltreatment as they transition into formal schooling. This transition requires consistency in the academic experiences of students across grade levels, particularly in the availability of responsive and supportive educators. Therefore, vertical continuity, which denotes consistency of experiences across diverse care and education settings from birth to age 8 (Institute of Medicine and National Research Council, 2015), should be maintained for children with a history of maltreatment. Vertical continuity of high-quality learning experiences includes the alignment of learning expectations, curricula, instructional strategies, assessments, and learning environments. For SR in particular, promising interventions for young children implemented consistently across early grade levels have yielded positive outcomes, especially when focused on improving school readiness and socio-emotional learning (Graham, Pears, Kim, Bruce, & Fisher, 2018; Pears et al., 2013; Pears, Kim, & Fisher, 2012). Extending beyond early childhood education, consideration of vertical continuity in implementing SRL-related interventions can provide the backdrop against which to ensure that students with a history of maltreatment gain access to programs across all grade levels that address their complex learning needs.

SELF-REGULATED LEARNING INTERVENTIONS

The Self-Regulation Empowerment Program (SREP) is a promising SRL intervention that could be implemented in schools to support SRL development in children with early maltreatment experiences (Cleary & Zimmerman, 2004). SREP targets middle school and high school students' motivational beliefs, knowledge of strategies, and effective use of these strategies. The program employs SRL coaches who use micro-analytic assessment procedures to assess these key constructs in students. The coaches then help train the students to use effective strategies within a cyclical SRL feedback loop until the students take responsibility for the process. SREP has been shown to improve strategic and regulatory thought processes, self-efficacy, and math achievement across multiple years (Cleary, Velardi, & Schnaidman, 2017). One particular limitation of the SREP, however, is the challenge faced when implementing the program with students who have emotional disabilities (Cleary & Zimmerman, 2004). Therefore, one possible recommendation for future work is the integration of socio-emotional learning and SRL components within an academic environment that could potentially help influence maltreated students' learning processes more positively. Given the importance of SRL and the promising results yielded by the SREP, it is important to consider how implementation can be adapted to fit the needs of children with a history of maltreatment. Unfortunately, there are currently no known interventions to promote the SRL process in this vulnerable population of students.

TEACHER PREPARATION

SRL-based intervention programs are potentially beneficial not just for students, but for teachers as well. As teachers play a prominent role in maltreated students' lives in the classroom, these evidence-based intervention programs could provide the tools necessary to help students succeed. One final point for practice implications is to highlight the need for teachers to be knowledgeable about, and prepared to work with, children with a history of maltreatment. Strengthening the preparation of teachers will be essential to child abuse and neglect prevention and response work (Corr, 2019). In order to do so, efforts can focus on enhancing existing opportunities and collaborate with current systems in place. For example the Council for Exceptional Children (CEC) is the recognized leader in the development of standards for special educators; given that special educators are often the teachers working most closely with maltreated students (Corr & Santos, 2017), it is important to consider how the standards can be better aligned to support these students. CEC has developed initial and advanced standards for the preparation of special education professionals at all levels. CEC's performance-based *Initial Preparation Standards* define what a candidate must know and be able to do to begin teaching (e.g., learner development and individual differences, learning environments, assessment). CEC also expects that professional special educators in new positions undergo a systematic and structured discipline-specific period of induction – this is often the responsibility of the state or school district. As special educators progress in their teaching careers, many seek to develop and deepen their skills and broaden their knowledge base through advanced study in classroom or specialty areas. Others choose to pursue new roles within special education. Therefore, CEC provides *Preparation Standards for Advanced Programs*. These advanced programs should address, when appropriate, assessment; content knowledge; program, services, and outcomes; research and inquiry; leadership and policy; professional and ethical practice; and collaboration.

These special education teaching standards are a logical starting place in which to embed content and opportunities for building skills related to preventing and responding to maltreatment. Within the CEC, the Division for Early Childhood (DEC) has taken the lead on the issue of maltreatment. In response to the developmental risk factors, bidirectional relationship between disability and maltreatment, and the long-term impact on academic functioning, DEC put forth a position statement outlining its position on child maltreatment (DEC, 2016). This position statement reflects the belief that all young children deserve the opportunity to safely develop physically, socially, and emotionally within their family and community. Additionally, the position statement explicitly acknowledges that young children with disabilities who have experienced maltreatment and their families are a population that have not received sufficient attention with regard to research, policy, and practice recommendations. Therefore, the position statement outlines DEC efforts that will span research, policy, practice, collaboration, and leadership in order to improve both the support for young children who have experienced maltreatment and their families, and supports for early childhood special education (ECSE) professionals who work with these children and families. Given the bidirectional risk posed by maltreatment and disability, the DEC could provide advocacy for these recommended practices for ECSE professionals to incorporate SEL and SRL programs similar to the ones highlighted in the beginning of this section.

FUTURE DIRECTIONS

In our chapter, we have attempted to integrate several seemingly disparate fields that are relevant to our understanding of how early adversity alters children's neurophysiology and associated cognitive, emotional, and behavioral functioning. We did so through the lens of SR within the field of developmental science. As early adversity negatively influences maltreated students' academic performance across K–12, including problems with post-secondary completion, we needed to incorporate an SRL framework from the field of educational psychology. Broadly, we hypothesized that SR and SRL processes mediate the relationship between early risk factors and later academic competence. This claim needs to be examined in future research to show the validity of our conceptual model when different components are tested directly. To this end, the DEC, through its position statement, could promote an expanded research agenda that is grounded in our conceptual model in order to understand the mechanisms explaining variability in maltreated students' learning, providing evidence that can help inform intervention and policy programs that target potentially malleable mechanisms for change.

Within the broader area of maltreatment research, future work should incorporate more proximal and dynamic measures of learning to help explain variability in distal learning outcomes. Additionally, consideration for more domain-specific learning outcomes should be examined in conjunction with domain-general outcomes. This is particularly important given the assumption inherent in social-cognitive theory that contextual or situational factors play a role in motivation and SR (Zimmerman, 2005). This means that the SR/SRL processes within a math-related task might look different from those for a literacy-related task. Further, the dynamic nature of SR and SRL warrants the application of more dynamic and person-oriented methodologies that would allow for examination of interindividual differences in intraindividual changes within a domain-specific task. That is, examination of the temporal aspects of SRL might yield between-group differences in change parameters (e.g., slope, intercept, and possibly other higher-order polynomials that represent learners' patterns of change). Related to the notion of change, developmental trends across the constructs outlined in our review should be considered to better understand how patterns of learning may vary depending on the learner's age or developmental period.

Finally, given the prominence of bottom-up, reactive, and automatic processes in response to an emotion-eliciting stimulus for maltreated students, future research should consider employing SRL strategies such as graphing to encourage increased awareness of emotional state and to become more metacognitively aware of strategy use. As graphing techniques portray the dynamics and direction of change, including such techniques when considering dynamic methodologies in future work could potentially shed light in how graphing emotional reactions might help with self-observation and lead to increasing emotion regulatory skills.

CONCLUSION

Early experiences, particularly during sensitive periods of development, are crucial in the formation of neurophysiological structures and related cognitive, behavioral, and emotional functioning. Unfortunately, experiencing toxic stress such as maltreatment

early in development can have lifelong consequences that could result in developmental delays and later problems with learning. Given the high prevalence of young children coming into contact with the child welfare system, it is important to acknowledge the role that early risk factors of maltreatment and disability play in shaping children's developmental trajectories that result in later academic challenges. More importantly, we need to identify mechanisms by which these early risk factors act upon later outcomes in order to provide viable targets for educational interventions. The dual process model of SR provides a perspective from which to understand how early experiences of maltreatment affect bottom-up reactive processes, in relation to volitional self-reflective top-down processes, owing to morphological changes in neurophysiological structures caused by experiencing maltreatment early in life. Another perspective, the phase model of SRL, provides a framework in which to understand specific proximal and dynamic learning processes that could explain how temporally arranged experiences act over time to explain variability in later academic outcomes. Within an integrated framework, which we presented as our conceptual model, it can be argued that neurophysiological changes due to maltreatment influence the strength of more reactive bottom-up responses that affect specific phases across the SRL process. By combining the perspectives of SR and SRL, we hope to be able to identify more specific malleable mechanisms that educators and school-based interventions can target in order to mitigate the effects of early adversity on SR and SRL processes, as well as help students develop effective strategies and supports to manage SR and SRL processes to promote academic competence. In doing so, we hope that we can change the landscape of maltreated students' educational outlook from bleakness to one of hope.

NOTES

- 1 Disability is defined by the Individuals with Disabilities Education Act (IDEA) as: "a child (1) with intellectual disabilities, hearing impairments (including deafness), speech or language impairments, visual impairments (including blindness), serious emotional disturbance (referred to in this chapter as 'emotional disturbance'), orthopedic impairments, autism, traumatic brain injury, other health impairments, or specific learning disabilities and (2) who, by reason thereof, needs special education and related services" (P.L. 111-256).
- 2 Based on the Adverse Childhood Experiences (ACE) study measures that included three categories of maltreatment (i.e., physical, sexual, emotional abuse) and four categories of household dysfunction (i.e., household member with substance abuse problem, mental illness, criminal behavior, intimate partner violence).

REFERENCES

- Bandura, A., Barbaranelli, C., Caprara, G. V., & Pastorelli, C. (1996). Multifaceted impact of self-efficacy beliefs on academic functioning. *Child Development*, 67, 1206-1222. doi:10.1111/j.1467-8624.1996.tb01791.x
- Barnett, D., Manly, J. T., & Cicchetti, D. (1993). Defining child maltreatment: The interface between policy and research. In D. Cicchetti & S. L. Toth (Eds.), *Advances in applied developmental psychology: Child Abuse, child development, and social policy* (pp. 7-74). Norwood, NJ: Ablex.
- Barnett, D., Vondra, J. I., & Shonk, S. M. (1996). Self-perceptions, motivation, and school functioning of low-income maltreated and comparison children. *Child Abuse & Neglect*, 20, 397-410. doi:10.1016/0145-2134(96)00015-4
- Bell, M. F., Bayliss, D. M., Glauert, R., & Ohan, J. L. (2018). School readiness of maltreated children: Associations of timing, type, and chronicity of maltreatment. *Child Abuse & Neglect*, 76, 426-439. doi:10.1016/j.chiabu.2017.12.001

- Blair, C. (2010). Stress and development of self-regulation in context. *Child Development Perspectives*, 4, 181–188. doi:10.1111/j.1750-8606.2010.00145.x
- Blair, C., & Diamond, A. (2008). Biological processes in prevention and intervention: The promotion of self-regulation as a means of preventing school failure. *Development and Psychopathology*, 20, 899–911. doi:10.1017/S0954579408000436
- Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development*, 78, 647–663. doi:10.1111/j.1467-8624.2007.01019.x
- Blair, C., & Ursache, A. (2010). A bidirectional model of executive functions and self-regulation. In K. D. Vohs & R. F. Baumeister (Eds.), *Handbook of self-regulation: Research, theory, and applications* (2nd ed., pp. 300–320). New York, NY: Guilford Press.
- Blair, C., Ursache, A., Greenberg, M., & Vernon-Feagans, L. (2015). Multiple aspects of self-regulation uniquely predict mathematics but not letter-word knowledge in the early elementary grades. *Developmental Psychology*, 51(4), 459–472. doi:10.1037/a0038813
- Bright, M. A., Knapp, C., Hinojosa, M. S., Alford, S., & Bonner, B. (2016). The comorbidity of physical, mental, and developmental conditions associated with childhood adversity: A population based study. *Maternal and Child Health Journal*, 20, 843–853. doi:10.1007/s10995-015-1915-7
- Brown, E. J., & Kolko, D. J. (1999). Child victim's attributions about being physically abused: An examination of factors associates with symptom severity. *Journal of Abnormal Child Psychology*, 27, 311–322. doi:10.1023/A:1022610709748
- Cage, J. (2018). Educational attainment for youth who were maltreated in adolescence: Investigating the influence of maltreatment type and foster care placement. *Child Abuse & Neglect*, 79, 234–244. doi:10.1016/j.chiabu.2018.02.008
- Carrion, V. G., Weems, C. F., Richert, K., Hoffman, B. C., & Reiss, A. L. (2010). Decreased prefrontal cortical volume associated with increased bedtime cortisol in traumatized youth. *Biological Psychiatry*, 68, 491–493. doi:10.1016/j.biopsych.2010.05.010
- Child Abuse Prevention and Treatment Reauthorization Act, P.L. 111-320, 42 U.S.C. 5101 § 3 (2010).
- Cleary, T. J., Velardi, B., & Schnaidman, B. (2017). Effects of the Self-Regulation Empowerment Program (SREP) on middle school students' strategic skills, self-efficacy, and mathematics achievement. *Journal of School Psychology*, 64, 28–42. doi:10.1016/j.jsp.2017.04.004
- Cleary, T. J., & Zimmerman, B. J. (2001). Self-regulation differences during athletic practice by experts, non-experts, and novices. *Journal of Applied Sport Psychology*, 13, 185–206. doi:10.1080/104132001753149883
- Cleary, T. J., & Zimmerman, B. J. (2004). Self-regulation empowerment program: A school-based program to enhance self-regulated and self-motivated cycles of student learning. *Psychology in Schools*, 41, 537–550. doi:10.1002/pits.10177
- Committee on Child Abuse and Neglect and Committee on Children with Disabilities. (2001). Assessment of maltreatment of children with disabilities. *Pediatrics*, 108, 508. doi:10.1542/peds.108.2.508
- Coohey, C., Renner, L. M., Hua, L., Zhang, Y. J., & Whitney, S. D. (2011). Academic achievement despite child maltreatment: A longitudinal study. *Child Abuse & Neglect*, 35, 688–699. doi:10.1016/j.chiabu.2011.05.009
- Cook, A., Spinazzola, J., Ford, J., Lanktree, C., Blaustein, M., Cloitre, M., & Bessel, V. D. K. (2003). Complex trauma in children and adolescents. *Psychiatric Annals*, 35(5), 390–398. doi:10.3928/00485713-20050501-05
- Corr, C. (2019). CEC policy on the prevention of and response to maltreatment. *TEACHING Exceptional Children*, 51(3), 250–252. doi:10.1177/0040059918820259
- Corr, C., & Santos, R. M. (2017). “Not in the same sandbox”: Cross-systems collaborations between early intervention and child welfare systems. *Child & Adolescent Social Work Journal*, 34(1), 9. doi:10.1007/s10560-016-0470-4
- Courtney, M. E., Dworsky, A., Lee, J. S., & Rapp, M. (2010). *Midwest evaluation of the adult functioning of former foster youth: Outcomes at age 23 and 24*. Chicago, IL: Chapin Hall Center for Children at the University of Chicago.
- Crozier, J. C., & Barth, R. P. (2005). Cognitive and academic functioning in maltreated children. *Children & Schools*, 27, 197–206. doi:10.1093/cs/27.4.197
- Daly, B. P., Hildenbrand, A. K., Turner, E., Berkowitz, S., & Tarazi, R. A. (2017). Executive functioning among college students with and without history of childhood maltreatment. *Journal of Aggression, Maltreatment & Trauma*, 26, 717–735. doi:10.1080/10926771.2017.1317685

- Davies, P. T., & Cummings, E. M. (1994). Marital conflict and child adjustment: An emotional security hypothesis. *Psychological Bulletin*, 116, 387–411. doi:10.1037/0033-2909.116.3.387
- Davies, P. T., & Forman, E. M. (2002). Children's patterns of preserving emotional security in the interparental subsystem. *Child Development*, 73, 1880–1903. doi:10.1111/1467-8624.t01-1-00512
- Davies, P. T., & Martin, M. J. (2013). The reformulation of emotional security: The role of children's social defense in developmental psychopathology. *Development and Psychopathology*, 25, 1435–1454. doi:10.1017/S0954579413000709
- DEC. (2016). *Child maltreatment: A position statement of the Division for Early Childhood (DEC)*. Washington, DC: Author.
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64, 135–168.
- Eckenrode, J., Laird, M., & Doris, J. (1993). School performance and disciplinary problems among abused and neglected children. *Developmental Psychology*, 29, 53–62. doi:10.1037/0012-1649.29.1.53
- Eigsti, I., & Cicchetti, D. (2004). The impact of child maltreatment on expressive syntax at 60 months. *Developmental Science*, 7, 88–102. doi:10.1111/j.1467-7687.2004.00325.x
- Eisenberg, N., Smith, C. L., & Spinrad, T. L. (2010). Effortful control: Relations with emotion regulation, adjustment, and socialization in childhood. In K. D. Vohs & R. F. Baumeister (Eds.), *Handbook of self-regulation: Research, theory, and applications* (2nd ed., pp. 263–283). New York, NY: Guilford Press.
- Eisenberg, N., Valiente, C., & Eggum, N. D. (2010). Self-regulation and school readiness. *Early Education and Development*, 21, 681–698. doi:10.1080/10409289.2010.497451
- Elliot, A. J., & Murayama, K. (2008). On the measurement of achievement goals: Critique, illustration, and application. *Journal of Educational Psychology*, 100, 613–628. doi:10.1037/0022-0663.100.3.613
- Fantuzzo, J. W., Perlman, S. M., & Dobbins, E. K. (2011). Types and timing of child maltreatment and early school success: A population-based investigation. *Children and Youth Services Review*, 33, 1404–1411. doi:10.1016/j.childyouth.2011.04.010
- Flake, J. K., Barron, K. E., Hulleman, C., McCoach, B. D., & Welsh, M. E. (2015). Measuring cost: The forgotten component of expectancy-value theory. *Contemporary Educational Psychology*, 41, 232–244. doi:10.1002/hbm.20335
- Font, S., & Maguire-Jack, K. (2013). Academic engagement and performance: Estimating the impact of out-of-home care for maltreated children. *Children and Youth Services Review*, 35, 856–864. doi:https://doi.org/10.1016/j.childyouth.2013.02.010
- Fox, N. A., & Calkins, S. D. (2003). The development of self-control of emotion: Intrinsic and extrinsic influences. *Motivation and Emotion*, 27, 7–26. doi:10.1023/A:1023622324898
- Graham, A., Pears, K., Kim, H., Bruce, J., & Fisher, P. (2018). Effects of a school readiness intervention on hypothalamus–pituitary–adrenal axis functioning and school adjustment for children in foster care. *Development and Psychopathology*, 30, 651–664. doi:10.1017/S0954579417001171
- Gross, J. J., & Thompson, R. A. (2007). Emotion regulation: Conceptual foundations. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 3–24). New York, NY: Guilford Press.
- Hanson, J. L., Chung, M. K., Avants, B. B., Rudolph, K. D., Shirtcliff, E. A., Gee, J. C., ... Pollak, S. D. (2012). Structural variations in prefrontal cortex mediates the relationship between early childhood stress and spatial working memory. *Journal of Neuroscience*, 32, 7917–7925. https://doi-org.ezaccess.libraries.psu.edu/10.1523/JNEUROSCI.0307-12.2012
- Hanson, J. L., Nacewicz, B. M., Sutterer, M. J., Cayo, A. A., Schaefer, S. M., Rudolph, K. D., ... Davidson, R. J. (2015). Behavioral problems after early life stress: Contributions of the hippocampus and amygdala. *Biological Psychiatry*, 77, 314–323. doi:10.1016/j.biopsych.2014.04.020
- Hong, S., Rhee, T. G., & Piescher, K. N. (2018). Longitudinal association of child maltreatment and cognitive functioning: Implications for child development. *Child Abuse & Neglect*, 84, 64–73. doi:https://doi.org/10.1016/j.chiabu.2018.07.026
- Individuals with Disabilities Education Act, P.L. 111–256 (1997).
- Insana, S. P., Banihashemi, L., Herringa, R. J., Kolko, D. J., & Germain, A. (2016). Childhood maltreatment is associated with altered frontolimbic neurobiological activity during wakefulness in adulthood. *Development and Psychopathology*, 28, 551–564. doi:10.1017/S0954579415000589
- Institute of Medicine and National Research Council. (2014). *New directions in child abuse and neglect research*. Washington, DC: The National Academies Press.
- Institute of Medicine and National Research Council. (2015). *Transforming the workforce for children birth through age 8: A unifying foundation*. Washington, DC: The National Academies Press.

- Jones Harden, B., Drouin Duncan, A., Morrison, C., Panlilio, C., & Clyman, R. B. (2015). Compliance and internalization in preschool foster children. *Children and Youth Services Review*, 55, 103–110. doi:10.1016/j.childyouth.2015.04.013
- Jones Harden, B., Panlilio, C., Morrison, C., Drouin Duncan, A., Duchene, M., & Clyman, R. B. (2016). Emotion regulation of preschool children in foster care: The influence of maternal depression and parenting. *Journal of Child and Family Studies*, 26, 1124–1134. doi:10.1007/s10826-016-0636-x
- Jones, L., BSc, Bellis, M. A., Prof, Wood, S., MSc, Hughes, K., PhD, McCoy, E., MSc, Eckley, L., PhD, ... Officer, A., MPH. (2012). Prevalence and risk of violence against children with disabilities: A systematic review and meta-analysis of observational studies. *Lancet, The*, 380, 899–907. 10.1016/S0140-6736(12)60692-8
- Kavanaugh, B., & Holler, K. (2015). Brief report: Neurocognitive functioning in adolescents following childhood maltreatment and evidence for underlying planning & organizational deficits. *Child Neuropsychology*, 21(6), 840–848. doi:10.1080/09297049.2014.929101
- Kelly, P. A., Viding, E., Puetz, V. B., Palmer, A., Samuel, S., & McCrory, E. J. (2016). The sexually dimorphic impact of maltreatment on cortical thickness, surface area, and gyrification. *Journal of Neural Transmission*, 123, 1069–1083. doi:10.1007/s00702-016-1523-8
- Kendall-Tackett, K. A., & Eckenrode, J. (1996). The effects of neglect on academic achievement and disciplinary problems: A developmental perspective. *Child Abuse & Neglect*, 20, 161–169. doi:10.1016/S0145-2134(95)00139-5
- Leiter, J. (2007). School performance trajectories after the advent of reported maltreatment. *Children and Youth Services Review*, 29, 363–382.
- Leiter, J., & Johnsen, J. (1997). Child maltreatment and school performance declines: An event-history analysis. *American Educational Research Journal*, 34, 563–589. doi:10.1016/j.childyouth.2006.09.002
- Lerner, R. M., Theokas, C., & Bobek, D. L. (2005). Concepts and theories of human development: Historical and contemporary dimensions. In M. H. Bornstein & M. E. Lamb (Eds.), *Developmental science: An advanced textbook* (5th ed., pp. 3–43). Mahwah, NJ: Lawrence Erlbaum.
- Liew, J., McTigue, E. M., Barrois, L., & Hughes, J. N. (2008). Adaptive and effortful control and academic self-efficacy beliefs on achievement: A longitudinal study of 1st through 3rd graders. *Early Childhood Research Quarterly*, 4, 515–526. doi:10.1016/j.ecresq.2008.07.003
- Lightfoot, E. (2014). Children and youth with disabilities in the child welfare system: An overview. *Child Welfare*, 93, 23.
- Loman, M. M., Johnson, A. E., Westerlund, A., Pollak, S. D., Nelson, C. A., & Gunnar, M. R. (2013). The effect of early deprivation on executive attention in middle childhood. *The Journal of Child Psychology and Psychiatry*, 54, 37–45. doi:10.1111/j.1469-7610.2012.02602.x
- Manly, J. T. (2005). Advances in research definitions of child maltreatment. *Child Abuse & Neglect*, 29, 425–439. doi:10.1016/j.chiabu.2005.04.001
- Mägi, K., Kikas, E., & Soodla, P. (2018). Effortful control, task persistence, and reading skills. *Journal of Applied Developmental Psychology*, 54, 42–52. doi:10.1016/j.appdev.2017.11.005
- National Research Council and Institute of Medicine (NRC/IOM). (2000). *From neurons to neighborhoods: The science of early childhood development*. Washington, DC: National Academy Press.
- Panlilio, C., Ferrara, A., & MacNeill, L. (2019). Trauma, self-regulation, and learning. In C. C. Panlilio (Ed.), *Trauma informed schools: How child maltreatment prevention, detection, and intervention can be integrated into the school setting* (pp. 61–78). Cham: Switzerland: Springer Nature.
- Panlilio, C., Jones Harden, B., & Haring, J. (2017). School readiness of maltreated preschoolers and later school achievement: The role of emotion regulation, language, and context. *Child Abuse & Neglect*, 75, 82–91. doi:10.1016/j.chiabu.2017.06.004
- Pears, K. C., & Fisher, P. A. (2005). Emotion understanding and theory of mind among maltreated children in foster care: Evidence of deficits. *Development and Psychopathology*, 17, 47–65. doi:10.1017/S0954579405005030
- Pears, K. C., Fisher, P. A., Kim, H. K., Bruce, J., Healey, C. V., & Yoerger, K. (2013). Immediate effects of a school readiness intervention for children in foster care. *Early Education and Development*, 24, 771–791. doi:10.1080/10409289.2013.736037
- Pears, K. C., Kim, H. K., & Fisher, P. A. (2008). Psychosocial and cognitive functioning of children with specific profiles of maltreatment. *Child Abuse & Neglect*, 32, 958–971. doi:10.1016/j.chiabu.2007.12.009
- Pears, K. C., Kim, H. K., & Fisher, P. A. (2012). Effects of a school readiness intervention for children in foster care on oppositional and aggressive behaviors in kindergarten. *Children and Youth Services Review*, 34, 2361–2366. doi:10.1016/j.childyouth.2012.08.015

- Perlman, S., & Fantuzzo, J. (2010). Timing and influence of early experiences of child maltreatment and homelessness on children's educational well-being. *Children and Youth Services Review*, 32, 874–883. doi:10.1016/j.childyouth.2010.02.007
- Pintrich, P. R. (2000). Issues in self-regulation theory and research. *The Journal of Mind and Behavior*, 21, 213–219.
- Pintrich, P. R. (2003). Motivation and classroom learning. In W. M. Reynolds & G. E. Miller (Eds.), *Handbook of psychology: Educational psychology* (Vol. 7, pp. 103–122). Hoboken, NJ: John Wiley.
- Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, 82, 33–40. doi:10.1037/0022-0663.82.1.33
- Pollak, S. D. (2015). Multilevel developmental approaches to understanding the effects of child maltreatment: Recent advances and future challenges. *Development and Psychopathology*, 27, 1387–1397. doi:10.1017/S0954579415000826
- Pollak, S. D., & Tolley-Schell, S. A. (2003). Selective attention to facial emotion in physically abused children. *Journal of Abnormal Psychology*, 112, 323–338. doi:10.1037/0021-843X.112.3.323
- Pollak, S. D., Vardi, S., Putzer Bechner, A. M., & Curtin, J. J. (2005). Physically abused children's regulation of attention in response to hostility. *Child Development*, 76, 968–977. doi:10.1111/j.1467-8624.2005.00890.x
- Posner, M. I., & Fan, J. (2008). Attention as an organ system. In J. Pomerantz (Ed.), *Neurobiology of perception and communication: From synapse to society: The 4th De Lange Conference* (pp. 31–61). Cambridge: Cambridge University Press.
- Posner, M. I., & Rothbart, M. K. (2000). Developing mechanisms of self-regulation. *Development and Psychopathology*, 12, 427–441. doi:10.1017/S0954579400003096
- Pressley, M., Forrest-Pressley, D., Elliott-Faust, D. L., & Miller, G. E. (1985). Children's use of cognitive strategies, how to teach strategies, and what to do if they can't be taught. In M. Pressley & C. J. Brainerd (Eds.), *Cognitive learning and memory in children* (pp. 1–47). New York: Springer-Verlag.
- Roos, L. E., Kim, H. K., Schnabler, S., & Fisher, P. A. (2016). Children's executive function in a CPS-involved sample: Effects of cumulative adversity and specific types of adversity. *Children and Youth Services Review*, 71, 184–190. doi:10.1016/j.childyouth.2016.11.008
- Roos, L. E., Pears, K., Bruce, J., Kim, H. K., & Fisher, P. A. (2014). Impulsivity and the association between the feedback-related negativity and performance on an inhibitory control task in young at-risk children. *Psychophysiology*, 52, 704–713. doi:10.1111/psyp.12389
- Rothbart, M. K., & Bates, J. E. (2006). Temperament. In N. Eisenberg & W. Damon (Eds.), *Handbook of child psychology: Vol. 3. Social, emotional, personality development* (6th ed., pp. 99–166). New York, NY: Wiley.
- Rouse, H. R., & Fantuzzo, J. W. (2009). Multiple risks and educational well being: A population-based investigation of threats to early school success. *Early Childhood Research Quarterly*, 24, 1–14. doi:10.1016/j.ecresq.2008.12.001
- Ryan, J. P., Jacob, B. A., Gross, M., Perron, B. E., Moore, A., & Ferguson, S. (2018). Early exposure to child maltreatment and academic outcomes. *Child Maltreatment*, 23, 365–375. doi:10.1177/1077559518786815
- Schunk, D. H., & Zimmerman, B. J. (2003). Self-regulation and learning. In I. B. Weiner (Ed.), *Handbook of psychology* (pp. 59–78). Hoboken, NJ: Wiley.
- Sedlak, A. J., Mettenburg, J., Basena, M., Petta, I., McPherson, K., Greene, A., & Li, S. (2010). *Fourth National Incidence Study of Child Abuse and Neglect (NIS-4): Report to Congress*. Washington, DC: U.S. Department of Health and Human Services, Administration for Children and Families.
- Shackman, J. E., Wismer Fries, A. B., & Pollak, S. D. (2008). Environmental influences on brain-behavioral development: Evidence from child abuse and neglect. In C. A. Nelson & M. Luciana (Eds.), *Handbook of developmental cognitive neuroscience* (2nd ed., pp. 869–881). Cambridge, MA: MIT Press.
- Shonkoff, J. P., Garner, A. S., & The Committee on Psychosocial Aspects of Child and Family Health. (2012). Committee on early childhood, adoption, and dependent care, and section on developmental and behavioral pediatrics. *The Lifelong Effects of Early Childhood Adversity and Toxic Stress. Pediatrics*, 129, e232–e246. doi:10.1542/peds.2011-2663
- Slade, E. P., & Wissow, L. S. (2007). The influence of childhood maltreatment on adolescents' academic performance. *Economics of Education Review*, 26, 604–614. doi:10.1016/j.econedurev.2006.10.003
- Stacks, A. M., Beeghly, M., Partridge, T., & Dexter, C. (2011). Effects of placement type on the language developmental trajectories of maltreated children from infancy to early childhood. *Child Maltreatment*, 16, 287–299. doi:https://doi.org/10.1177/1077559511427957

- Stone, S. (2007). Child maltreatment, out-of-home placement and academic vulnerability: A fifteen-year review of evidence and future directions. *Children and Youth Services Review*, 29, 139–161. doi:10.1016/j.childyouth.2006.05.001
- Teicher, M., Samson, J. A., Anderson, C. M., & Ohashi, K. (2016). The effects of childhood maltreatment on brain structure, function, and connectivity. *Nature Neuroscience*, 17, 652–666. doi:10.1038/nrn.2016.111
- Teicher, M. H., & Samson, J. A. (2016). Annual research review: Enduring neurobiological effects of childhood abuse and neglect. *Journal of Child Psychology and Psychiatry*, 57, 241–266. doi:10.1111/jcp.12507
- Turner, H. A., Vanderminden, J., Finkelhor, D., Hamby, S., & Shattuck, A. (2011). *Disability and victimization in a national sample of children and youth*. Los Angeles, CA: Sage. doi:10.1177/1077559511427178
- U.S. Department of Health and Human Services, Administration for Children and Families, Administration on Children, Youth and Families, Children's Bureau. (2017). *Child maltreatment 2010*. Retrieved from www.acf.hhs.gov/occ/resource/ccdf-statistics
- Van Horne, B. S., Caughy, M. O., Canfield, M., Case, A. P., Greeley, C. S., Morgan, R., & Mitchell, L. E. (2018). First-time maltreatment in children ages 2–10 with and without specific birth defects: A population-Based study. *Child Abuse & Neglect*, 84, 53–63. doi:10.1016/j.chiabu.2018.07.003
- Vondra, J., Barnett, D., & Cicchetti, D. (1989). Perceived and actual competence among maltreated and comparison school children. *Development and Psychopathology*, 1, 237–255. doi:10.1017/S0954579400000432
- Vondra, J. I., Barnett, D., & Cicchetti, D. (1990). Self-concept, motivation, and competence among preschoolers from maltreating and comparison families. *Child Abuse & Neglect*, 14, 525–540. doi:10.1016/0145-2134(90)90101-X
- Wade, T. J., Bowden, J., & Jane Sites, H. (2018). Child maltreatment and motor coordination deficits among preschool children. *Journal of Child & Adolescent Trauma*, 11, 159–162. doi:10.1007/s40653-017-0186-4
- Wigfield, A., Eccles, J. S., Schiefele, U., Roeser, R., & Davis-Kean, P. (2006). Development of achievement motivation. In N. Eisenberg & W. Damon (Eds.), *Handbook of child psychology: Vol. 3. Social, emotional, personality development* (6th ed., pp. 933–1002). New York, NY: Wiley.
- Wigfield, A., Klauda, S. L., & Cambria, J. (2011). Influences on the development of academic self-regulatory processes. In D. H. Schunk & B. Zimmerman (Eds.), *Handbook of self-regulation of learning and performance* (pp. 33–48). New York, NY: Routledge.
- Winne, P., & Azevedo, R. (2014). Metacognition. In R. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 63–87). Cambridge: Cambridge University Press. doi:10.1017/CBO9781139519526.006
- Wolters, C. A., Fan, W., & Daugherty, S. G. (2013). Examining achievement goals and causal attributions together as predictors of academic functioning. *The Journal of Experimental Education*, 81, 295–321. doi:10.1080/00220973.2012.700498
- Wolters, C. A., Yu, S. L., & Pintrich, P. R. (1996). The relation between goal orientation and students' motivational beliefs and self-regulated learning. *Learning and Individual Differences*, 8, 211–238. doi:10.1016/S1041-6080(96)90015-1
- Zeidner, M., Boekaerts, M., & Pintrich, P. R. (2005). Self-regulation: Directions and challenges for future research. In M. Boekaerts, P. R. Pintrich, & M. Zeider (Eds.), *Handbook of self-regulation* (pp. 749–768). Burlington, MA: Elsevier Academic Press.
- Zimmer, M. H., & Panko, L. M. (2006). Developmental status and service use among children in the child welfare system: A national survey. *Archives for Pediatric and Adolescent Medicine*, 160, 183–188. doi:10.1001/archpedi.160.2.183
- Zimmerman, B. (2005). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeider (Eds.), *Handbook of self-regulation* (pp. 13–39). Burlington, MA: Elsevier Academic Press.
- Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal*, 45, 166–183. doi:10.3102/0002831207312909
- Zimmerman, B. J., & Kitsantas, A. (1999). Acquiring writing revision skill: Shifting from process to outcome self-regulatory goals. *Journal of Educational Psychology*, 91, 1–10. doi:10.1037/0022-0663.91.2.241
- Zimmerman, B. J., & Schunk, D. H. (2011). *Handbook of self-regulation of learning and performance*. New York, NY: Routledge. doi:10.4324/9780203839010
- Zorc, C. S., O'Reilly, A. R., Matone, M., Long, J., Watts, C. L., & Rubin, D. (2013). The relationship of placement experience to school absenteeism and changing schools in young, school-aged children in foster care. *Children & Youth Services Review*, 35, 826–833. doi:10.1016/j.childyouth.2013.02.006

10

BEHAVIORAL DISORDER Theory, Research, and Practice

Ming-tak Hue

The term “behavioral disorder” (BD) refers to a variety of behavioral conditions in youth that may have unfavorable academic and social implications (Coleman & Webber, 2002; Webber, Plotts, & Coleman, 2008). Researchers believe that, at some point in development, all youths suffer from emotional and behavioral disorder (EBD) and related difficulties (Maggin, Wehby, Farmer, & Brooks, 2016). In addition to personal and social consequences, BD affects students’ educational functioning (Sointu, Savolainen, Lappalainen, & Lambert, 2017; Stoutjesdijk, Scholte, & Swaab, 2016; Yang, Sin, & Lui, 2015) and presents potential challenges for parents, teachers, peers, and siblings (Axup & Gersch, 2008; Chan & Lai, 2016; Forlin & Cooper, 2013; Lane, Robertson Kalberg, Lambert, Crnabori, & Bruhn, 2010; Wehby, Lane, & Falk, 2003). Indeed, at times, “teachers encounter disrespectful conduct, classroom disruptive behaviors, and discipline problems on an increasing basis” (Morgan & Sideridis, 2013, p. 193). Parents, and particularly mothers, encounter similar stressful issues (Forlin & Cooper, 2013). Attributing the causes to the personality-related variables (introversion and extraversion), researchers have made different assumptions and put forward various theories and explanations. The complexity of the issue and the multiplicity of its understanding raise questions about existing theory, research, and practice. Consequently, the evaluation of screening tools developed to identify students with EBD, their placement, and interventions to facilitate their learning has attracted considerable attention from researchers in various contexts. Empirical studies have suggested that the selection of appropriate screening tools, the early identification of special education needs (SEN), and collaborative efforts among stakeholders can help to improve the quality of teaching and learning for students with EBD. Researchers have recommended engaging in evidence-based interventions that are culturally and linguistically relevant to the student populations with behavioral challenges. This demands practitioners’ awareness of how teachers and schools can be better prepared to address the individual learning needs of students suffering from EBD.

A conceptual understanding of BD is difficult owing to its lack of clarity. Questions such as “what is BD?” and “how can an ordered behavior be differentiated from a disordered one?” may receive a variety of responses, depending on the respondent’s worldview, personality, theoretical assumptions, professional association, terminology selection, and social context. This means that someone’s behavior may be appropriate, ordered, or acceptable for some but not for others. In any situation, identifying or recognizing the causes of someone’s behavior is pivotal to overcoming behavioral problems. For some, human behaviors have a direct link with mental states—a theory of mind (Gopnik & Wellman, 1992; Premack & Woodruff, 1978). For others, environmental factors inform behavior. For others still, it is the cumulative effect of various factors, as “youth develop as an integrated whole with behavioral, biophysical, cognitive, psychological and sociological variables operating together to contribute to individual functioning” (Maggin, et al., 2016, p. 127). Thus, it is important to have a clear understanding of behavioral disorder; its characteristics, dimensions, causes, and consequences; and the relationships between multiple related factors. Such clarity may support researchers as they focus on advances in understanding the effects of BD on learning and may aid practitioners to take appropriate steps in identifying, assessing, and supporting students with EBD in schools and beyond.

Researchers working in different professions look at the concept of EBD from their respective theoretical perspectives to make sense of behavior. For example, a health professional may define someone’s behavior differently than an educationalist. The use of different terminologies is central to these definitions. Likewise, a parent may not see an issue with a child’s behavior, whereas a teacher, a psychologist, or a psychiatrist may find it highly concerning. These differences not only highlight the diversity in conceptual understanding, but also raise challenges in helping children at risk of or suffering from EBD. As Plotts (2012) noted:

There is disagreement among school professionals and mental health providers outside of schools regarding the identification of children with EBD. It is incumbent upon school professionals, and upon outside health professionals who work with school-age populations, to understand each other’s classification systems and the implication for services.

(p. 58)

Given all youths suffer from EBD and difficulties at some point in their development (Maggin, et al., 2016), judging a person’s behavior without due consideration of its frequency may have long-lasting implications. People uphold different social-behavioral norms across cultures and social settings. Any deviant behavior that persists for a long period of time suggests that BDs may be chronic in nature (Webber et al., 2008). Within the educational setting, DBs are conceptualized as problem behaviors in that they hinder the teaching and learning processes. Accordingly, “problem behaviors are often characterized as those behaviors that interfere with learning and that are harmful or place a person at risk for continued problems in school or in society general” (Morgan & Sideridis, 2013, p. 193).

In the literature, the terms BD and emotional disorder (ED) are often used interchangeably. ED indicates varied emotional conditions such as schizophrenia, autism, psychosomatic disorders, phobias, withdrawal, depression, anxiety, elective mutism,

aggression, and antisocial behavior (Cassady & Thomas, Chapter 3, this volume; Coleman & Webber, 2002; Pekrun & Loderer, Chapter 18, this volume). This may suggest that ED and BD are interrelated. The frequent interchangeability of both terms in the literature confirms that emotional and behavioral disorder are intertwined. Therefore, EBD is conceptualized as a single construct. Accordingly, EBD is “a chronic condition or a condition that seriously impairs present academic, behavioral, emotional, and social functioning at the risk of negatively affecting important adolescent and early adulthood outcomes” (Maggin, et al., 2016, p. 127). It is also associated with limiting “adequate functioning in a regular school setting such as problems with social adaptation, concentration, and motivation” (Stoutjesdijk et al., 2016, p. 199). However, educational researchers prefer to use the term *behavior* over *emotional* owing to the complexity involved in a child’s emotional states. Coleman and Webber (2002) explain why educators prefer to use the term behavioral disorder rather than emotional disorder:

The term *behavior disordered* is often seen as less stigmatizing, less severe, more socially acceptable, and more practical than the term *emotionally disturbed*. The term behavior disordered grew out of the behavioral model which posits that teachers can see and describe disordered behavior but cannot easily describe disturbed emotions. Many educators seem to prefer behavior disordered because it seems more plausible to deal directly with disordered behavior than with disturbed emotions.

(p. 24; emphasis added)

The major factors shaping our understanding of BD are the sociological parameters in which a behavioral pattern is judged or evaluated. For instance, if someone’s behavior does not conform to social or cultural norms, values, and expectations, then that behavior is considered deviant (Webber et al., 2008). In many contexts, behavioral expectations vary across gender and age groups. This means a behavior accepted and valued in one cultural setting may be abnormal, atypical, or deviant in another. Consequently, the definition and conceptual understanding of BD are subjective, elusive, and contentious.

THEORIES OF BEHAVIORAL DISORDER

Researchers and practitioners operating across the fields of inquiry conceptualize BD differently. Health professionals maintain that impaired behavioral and emotional functioning often results from mental health problems (Barksdale, Azur, & Daniels, 2010). Consistent with an ecological systems view (Farmer et al., 2016), sociologists and educationists often look for the causes of behavioral problems in sociocultural factors. Holding different assumptions, researchers have proposed conflicting theories on the phenomenon and suggest different terminologies, procedures, and strategies for helping students with EBD. These various theories have been classified into five major conceptual models: biophysical, behavioral, psychodynamic, ecological, and cognitive. They underscore the extent of the challenges educational practitioners face in supporting children with emotional and behavioral problems. Coleman and Webber (2002) and Webber et al. (2008) briefly summarize each model as follows.

Biophysical Model

The biophysical model assumes that BDs are the result of either physical or brain-related factors that can be treated medically or physically. Biophysical research has used neurotransmitters to examine people suffering from depression, autism, and schizophrenia. In research and practice within this model, the involvement of educational practitioners has remained limited to medication or diet therapy.

Behavioral Model

According to the behavioral model, all human behaviors are learned; as such, any learned maladaptive behavior can be unlearned and replaced by learning new desired behaviors. Moreover, behaviorists believe that no behavior occurs in isolation; rather, behaviors are shaped or influenced by the environment. Therefore, researchers operating in this model account for environmental factors while investigating the disordered behaviors. Behaviorists recommend direct instruction, prompting, and reinforcement techniques for behavior-related interventions. From an educational viewpoint, social skills training is a good example of the application of the behavioral model.

Psychodynamic Model

Psychodynamic theorists focus on personality and emotional development processes, particularly the healthy personality development process. They recommend that educational practitioners develop and promote humanistic and therapeutic school environments, with equal emphasis on students' emotional and personal growth and academic success.

Ecological Model

Theorists adopting this model emphasize various factors external to the individual. They believe deviant behavior results from the interaction of the individual with others within the environment in which he or she lives. Therefore, the environment rather than the individual is considered disturbed or disordered. Various environments may include one's school, home, community, or social system. The ecological model of human behavior requires educational practitioners to work with individuals and organizations across environments to effectively fulfill the learning needs of students suffering BD.

Cognitive Model

Cognitive theory assumes that EBD is the result of dysfunctional thinking patterns. Cognitive psychologists maintain that emotional disturbance can be lessened by changing people's thinking patterns and worldviews. Rational emotive behavior therapy is a frequently used technique for restructuring cognition.

Although the emphasis in the theories mentioned above is on factors either internal or external to an individual, the causes of the behavioral disorder among young people could be the combination of both. Considering the factors internal to children at the cost of external factors may hardly help researchers and practitioners understand the

causes and the consequences of BD and make appropriate interventions. Therefore, it is vital to take into account both the cognitive and the ecological models while helping children suffering from the behavioral disorder. One of the theories belonging to the cognitive model is the “theory of mind,” which can help with understanding of the cognitive dimension of BD and its relationship with educational performance.

THEORY OF MIND AND BEHAVIORAL DISORDER

Children’s ability to understanding the mental states of others has been conceptualized as a theory of mind (ToM; Baron-Cohen, Tager-Flusberg, & Cohen, 2000; Gillies, Chapter 22, this volume; Gopnik & Wellman, 1992). In addition to the role of ToM in understanding BD, children’s ToM is related to a number of other cognitive constructs, such as executive functions, metacognition, and working memory (Carlson, Claxton, & Moses, 2015; Dore, Amend, Golinkoff, & Hirsh-Pasek, 2018; Lecce & Bianco, 2018; Moshman, 2018), as well as to epistemic cognition (Sodian & Kristen, 2016) and academic achievement (e.g., Cantin, Gnaedinger, Gallaway, Hesson-McInnis, & Hund, 2016). ToM is not exclusive to human beings; indeed, apes also have ToM (Premack & Woodruff, 1978). ToM refers to one’s ability to understand the minds of others in a well-structured way in terms of knowledge, beliefs, desires, and intentions (Cheung, Hsuan-Chih, Creed, Ng, Ping Wang, & Mo, 2004; Wang, Devine, Wong, & Hughes, 2016). From a developmental perspective, ToM is an individual’s ability to understand the mental states of others that develop early in life and continue to grow through adulthood. Developments in cognitive and social domains such as language, executive function, cultural practices, family context, and interactional and pedagogical experiences help to enter into an individual’s mental world (Wang, Devine, et al., 2016). A growing body of literature has elucidated how ToM develops across cultures, languages, and age groups. The available findings suggest that ToM is not universal; instead, it is an innate ability often influenced by cultural, social contextual, and age-related factors.

Techniques to Evaluate ToM

One common technique used to evaluate children’s ToM development is a false-belief task. One of its versions is an unseen change in location of objects. An example of a false-belief task provided by Liu, Wellman, Tardif and Sabbagh (2008) is worth considering:

A child sees Maxi put his chocolate in a kitchen cupboard and then leaves. While Maxi is outside, his mother moves the chocolate from cupboard to a drawer. Maxi returns, and the child is asked, “Where does Maxi *think* the chocolate is?” or “Where will Maxi *look* for his chocolate?” Children develop from answering these sorts of questions according to reality to answering according to *false belief*.

(p. 523; emphasis in original)

Although the false-belief task is the most commonly used technique for measuring cognitive ToM, some researchers have attempted to measure ToM through parents’ reports and children’s cognitive and emotional abilities. Wang, Wong, Wong, Ho, &

Cheng (2016) maintained that, “cognitive ToM enables children to interpret other people’s epistemic mental states such as belief and knowledge, whereas emotional ToM focuses on empathetic concern and emotional-perspective-taking ability” (p. 3). Instead of using a false-belief task to measure ToM, Wang, Wong, et al. (2016) used both parent reports on and child measures of cognitive and emotional ToM to explore the relation between 5-year-old preschool children’s mode of participation and negotiation strategies during play and their ToM development, in Hong Kong. Based on the children’s expressive language ability, the researchers assessed their cognitive and emotional ToM in both naturalistic and laboratory settings.

The researchers found that the children were mostly engaged in cooperative and associative modes in their play. Parents’ reports on emotional ToM predicted the children’s play strategies in both naturalistic and laboratory settings, whereas the children’s cognitive ToM predicted their play strategies in the laboratory setting only. The researchers concluded that emotional and cognitive ToM were two independent constructs. Contrary to the research findings in the Western context, only children performed better on the cognitive and academic measures and were highly motivated and well adjusted compared with children with siblings. The higher quality of family interaction and the possibility of maximizing children’s social understanding with their parents may explain the better performance. This suggests that having a single child is an advantage rather than a deficit. However, such an advantage is not without challenges for siblings in families with children suffering from EBD.

To date, research on ToM has predominantly concentrated on Anglo-Saxon countries (Hughes & Devine, 2015; Liu et al., 2008) while highlighting the differences in ToM across these countries. Hughes, Devine, and Wang (2014) posited that attributing these differences merely to individualistic versus collectivistic cultural values was an oversimplification, as cultural differences explained the discrepancies in children’s ToM across nations and cultures. Liu et al. (2008) found that preschoolers in Hong Kong lagged behind their Western counterparts by up to 2 years in their false-belief task performance. Similar variations can be identified among children as old as 8 in Japan (Naito & Koyama, 2006), Korea, the US, and the UK (Wellman, Cross, & Watson, 2001). These findings suggest that the development of ToM among youth is a universal phenomenon triggered by various environmental, social, and cultural factors (Cheung et al., 2004; Wang, Wong, et al., 2016). The following section highlights the various factors that influence ToM.

Social and Cultural Factors Affecting ToM

Research studies on ToM and false-belief understanding offer mixed findings. Liu et al. (2008) conducted a meta-analysis to ascertain how culture and language shaped the developmental trajectories of mental states among children with different cultural and linguistic backgrounds. Using false-belief understanding measures, the researchers compared the mental states of children from mainland China, Hong Kong, Canada, and the US who spoke Mandarin, Cantonese, and English, respectively. They found parallel developmental patterns among the Chinese and North American children, yet noticed significant differences in developmental timing across the samples. They observed that false-belief performance improved dramatically with age among Chinese children, but showed identical developmental trajectories related to the children’s false-belief judgments of themselves and others.

Comparative analysis of mental state developmental trajectories among children from mainland China and Hong Kong revealed that both groups showed similar patterns, but that the Hong Kong children exhibited later timing. Moreover, while comparing all four groups of children, the researchers found a significant main effect without the interaction of age. However, there were significant differences in the patterns of timing across the sampled groups. Children from China and the US followed similar developmental paths, but at a slower pace than the Canadian children. Meanwhile, the children from Hong Kong demonstrated slower developmental trajectories than the children from mainland China and the US. The researchers concluded that ToM was a universal phenomenon that developed among children in similar ways on different timelines. The explanations for these differences may not be so straightforward; differential trajectories of ToM may be influenced by various sociocultural and linguistic factors.

Similarly, Wang, Wong, et al. (2016) investigated the cultural factors affecting ToM by evaluating the executive function in Hong Kong and British children in middle childhood. The executive function refers to the acquisition of false belief during the early childhood period. The relationship between the executive function and ToM can be explained in terms of expression or emergence accounts. Accordingly,

[the] expression account posits that children with the greatest levels of executive function performance should outperform their peers on the measure of theory of mind, whereas the emergence account is more tolerant to a disassociation between theory-of-mind performance and executive function performance.

(Wang, Wong, et al., 2016, p. 9)

The researchers recruited two different middle-aged students' groups attending different schools: one group from a British-based international school and a local school from Hong Kong, and one group from the UK. The main purpose of this comparative study was to determine the impact of different cultures and schooling experiences on students' ToM development and executive function. A comparison of executive function revealed that both groups of children in Hong Kong outperformed the British children, indicating the central role of culture in the students' executive function. However, children attending local schools performed poorer on ToM tests than those attending British-based international schools.

The researchers concluded that pedagogical experiences significantly accounted for ToM development, and that the teaching practices of drilling and rote learning—a dominant educational model of local schools in Hong Kong—significantly influenced the respective students' ToM test performance. Socioeconomic status, parental education, aspiration, and support might have differed significantly between the two different groups of students in Hong Kong. In this sense, it can be inferred that the different variables in the environment-ecological model of behavior may inform students' ToM. See Follmer and Sperling (Chapter 5, this volume) for alternative discussion of executive function.

To investigate the relative roles of general and complementation language in ToM, Cheung et al. (2004) compared the language understanding competency of 4-year-old Cantonese and English-speaking children. The researchers found that neither the meaning of the main verb nor the complement structure of a sentence affected the

correlation between the children's complement understanding of the language and ToM. Based on this finding, the researchers concluded it was not the syntax of the complement but the children's general language comprehension that played a significant role in the development of the children's ToM.

It is clear from the above discussion how students' cognitive deficiencies affect their emotional and behavioral patterns and how sociocultural factors influence their ToM or their cognitive abilities. The following section will discuss the academic consequences for students suffering from EBD.

EBD AND STUDENTS' BEHAVIORAL AND ACADEMIC PERFORMANCE

Given EBD is understood differently across the fields of social inquiry, deviant, problem, or challenging behaviors that teachers confront are conceptualized as internalizing and externalizing behaviors (Cassady & Thomas, Chapter 3, this volume; Lane et al., 2010; Mustian & Cuenca-Sanchez, 2012; Webber et al., 2008). This dichotomy can substantially help educational practitioners better understand the nature of deviant behavior. According to Coleman and Webber (2002), internalizing factors highlight problems that are introverted in nature and related to oneself, including worries, fears, somatic complaints, and social withdrawal. Externalizing factors represent all behaviors that are extroverted and can be observed. These may include, for example, aggression, overactivity, disobedience, temper tantrums, and delinquency.

Externalizers tend to be more impulsive, whereas internalizers tend to be more reflective (Webber et al., 2008). Researchers have reported that internalizing and externalizing behaviors are interrelated, and both predict students' academic achievement (Yang et al., 2015). Mattison and Blader (2013) found that both externalizing and internalizing problem behaviors were likely to affect academic achievement. There is a dearth of empirical evidence clarifying the directionality of interconnectedness between academic difficulties and BD (Morgan & Sideridis, 2013). Therefore, researchers have recommended acquiring a better understanding of the relationship between behavioral and academic difficulties and the mediating or moderating role of other variables before any intervention. Educational psychology scholars can contribute to this increased understanding.

The preceding discussion suggests that EBD is a complex phenomenon, and that a holistic approach is required to improve the learning of students with DB. If EBD affects academic functioning (Mattison & Blader, 2013), then what causes such behaviors? The literature on the subject has suggested multiple causes of problem behaviors, such as bullying, victimization, peer-to-peer interaction, poverty, family dysfunction, ineffective classroom management practices, psychiatric problems, and the interaction of these with any additional unknown factors (Morgan & Sideridis, 2013). This requires school practitioners to have a deeper understanding of EBD and to consider its multivariate causes and complexity.

To ascertain the impact of students' social, emotional, and behavioral difficulties (SEBD), Forlin and Cooper (2013) conducted a study involving 914 school staff members and 573 parents with school-age children in Hong Kong. The researchers developed specific scales to measure students' behavioral traits, including "educational engagement, motivation, co-operativeness and oppositionality" (p. 63). Data were col-

lected on how the identified SEBD affected the emotions, relationships with students, and teaching of the staff members, and the emotions, marital relationships, relationships with extended family, and family outings of the parents. Both the teachers and parents identified children's lack of motivation to learn, difficulties in concentration, and disobedience as SEBDs that caused stress and anxiety and were difficult to manage. The teachers associated difficult-to-manage behaviors with "greater feelings of helplessness, frustration, embarrassment and increased stress such as headaches, depression and fatigue" (p. 63). The study's findings suggest that students' behavioral difficulties significantly affect both teachers' and parents' lives.

It has been suggested that, for students with learning disabilities and emotional disturbances, achievement and behavioral problems are interconnected (Algozzine, Wang, & Violette, 2011; Mustian & Cuenca-Sanchez, 2012; Yang et al., 2015). Plotts (2012) noted that, "in an individual with EBD, emotional and behavioral responses in school settings would be expected to adversely affect performance in a variety of areas, including self-care, social relationships, personal adjustment, academic progress, and/or classroom behavior" (p. 78). For instance, the time spent on acting out students' aggressive behavior may not only reduce the time available for meaningful learning activities, but also lead to unfriendly relationships with teachers and peers, which may, in turn, result in fewer efforts expended on academic work (Algozzine et al., 2011). Thus, the co-occurrence of learning difficulties and behavioral problems may pose challenges for effective instruction and, hence, students' academic achievement.

To examine the relationship between academic achievement and social behavior, Algozzine et al. (2011) conducted a study with a group of students who were at risk of academic failure but had not previously been identified with any learning disabilities or problem behaviors. The study participants were recruited from seven schools in the southern region of the US with diverse ethnic backgrounds, including Black, White, Hispanic, Asian, and American Indian. By analyzing the students' social skills, problem behaviors, academic competence, and reading achievements, the researchers found that social skills were negatively related to problem behaviors. However, social skills, problem behaviors, and reading achievement were highly correlated. The study's findings confirm the earlier findings that behavioral interventions may help to improve behavior but not achievement, and that behavior may play a limited role in academic success. Studies conducted with SEN students in Hong Kong, however, have revealed varied results.

For instance, Zhang, Wong, Chan, and Chiu (2014) examined the relationship between social behaviors, social and emotional competence, and academic functioning among children with SEN in Hong Kong primary schools. Overall, 515 pupils with SEN from Grades 1–6 at 106 primary schools in Hong Kong completed the survey. The authors reported that both social behavior and social and emotional competence significantly predicted children's academic functioning. Children's social relationships with teachers and peers were positively correlated with their academic performance. The results also showed that, although both the social and emotional competence of children significantly predicted their academic functioning, emotional competence had a larger impact.

These research findings from the groups of children at risk of academic failure and developing EBD and children with SEN suggest that children's social and emotional behaviors significantly predict their academic performance. The contrasting

findings may indicate how differently students' social behaviors or BD are conceptualized in the US and Hong Kong. Educators should be mindful of the contextual differences and individualized needs while engaging in interventions for students with EBD. The students' learning needs may require context-specific interventions because, for all students, educational experiences are qualitatively "unique as a result of their ongoing emotional and behavior challenges" (Wehby et al., 2003, p. 196). Therefore, it is important to consider all the possible factors that may create EBD among students and, hence, affect their academic performance. The following section discusses if students' ethnic and racial identity and family functioning have any relation with EBD.

Students' Ethnic and Racial Identity, Family Functioning and EBD

Barksdale et al. (2010) explored the relationship between youths' strengths and functional impairment and the role of ethnic and racial identity. They collected data from 8,129 Caucasian, African-American, Hispanic, and American Indian/Alaskan Native youths aged 5–18 years. The researchers measured functional impairment related to the youths' role performance at home, in school, and the community; their behaviors toward others; their moods and emotions; their self-harmful behavior; their substance use or abuse; and their thinking. The youths' strengths were measured based on their interpersonal strength, family involvement, intrapersonal strength, school functioning, and affective strength.

The multinomial logistic regression with the covariates included in the model revealed that youth with average and above average strengths were significantly less likely to suffer from behavioral and emotional impairment. The researchers found no significant main effect of race and ethnicity on impairment. Nevertheless, ethnic and racial minority youths with average and above average strengths appeared to suffer more impairment than Caucasian youths, and youths with below average strengths suffered less impairment than Caucasian youths. Based on these findings, Barksdale et al. (2010) recommended incorporating strengths-based interventions to address the behavioral and emotional impairment of youths. The variations in impairment across ethnic and racial lines suggest that additional single-case and comparative investigations should be undertaken in various sociocultural settings to explore the role of race and ethnicity in behavioral impairment.

Within a special education setting, Stoutjesdijk et al. (2016) studied the impact of family functioning on the classroom problem behavior of children with EBD. The researchers found a direct association between family functioning and problem behavior in the classroom. Using Bronfenbrenner's ecological model of human behavior, the researchers investigated how family functioning affected problem behavior among children with EBD and which family functioning aspects demonstrated the strongest association with problem behaviors. Data were collected twice, with a time lag of 11 months, through the Teachers' Report Form and the Family Questionnaire for 84 children aged 9.8 years on average.

Quantitative data analysis revealed no change in either internalizing or externalizing problem behaviors over time and a performance equally poor to that of family functioning. Among the different family functioning aspects, the researchers found that poor communication, a discordant partner relationship, and a lack of social support

were strongly associated with future problem behavior of children in the classroom. The researchers also observed a direct association between externalizing behavior in children in the classroom and future poor family functioning. These findings suggest that family circumstance directly affects students' behavior in educational settings, and that unfavorable family situations may result in behavior problems. Interventions that take into account multiple factors that affect students' behavior may yield better results in helping students with EBD.

Interventions for Students with EBD

A meta-analysis of studies on social skills intervention for students with EBD suggests that interventions that focus on teaching and measuring specific social skills are more effective than some generic social skills interventions (Quinn, Kavale, Mathur, Rutherford, & Forness, 1999). Bellini, Peters, Benner, and Hopf (2007) found social skills interventions to be minimally effective for students with autism spectrum disorder. Similar studies have reported on the effectiveness of school-based academic interventions (DuPaul & Eckert, 1997) and behavioral treatments (Fabiano et al., 2009) for students suffering from ADHD. Such analyses suggest that practitioners should identify specific student needs and engage in needs-based interventions.

Studies have suggested that the contexts of specific interventions can be effective for helping students with EBD in educational settings. For instance, Siu (2007) found FRIENDS intervention useful in combating students' internalizing problems among primary-level students. Similarly, Zhang et al. (2014) reported on the benefits of curriculum adaptation in helping intellectually disabled children.

FRIENDS is an intervention that helps children to cope with their internalizing problems. It is an acronym for multiple strategies taught to students to help them develop psychological, cognitive, and behavioral skills. These skills are developed among students through weekly sessions, normally for 10 weeks, during which students are encouraged to be their own friends, treat their bodies as their friends, make friends, and share their feelings with friends during difficult times. Each letter in "FRIENDS" stands for students' specific emotions, thinking, and behavior: F stands for "feeling worried?"; R for "relax and feel good"; I for "inner thoughts"; E for "explore thoughts"; N for "nice work"; D for "don't forget to practice"; and S for "stay calm" (Siu, 2007, p. 14).

Based on a sample of 47 primary-level students in Grades 2–4 identified as at risk of internalizing problems, Siu (2007) measured the impact of FRIENDS intervention. The sample was divided into two groups: a FRIENDS intervention group and a control group. Before the intervention, the researcher measured the symptoms of internalizing problems using various tools including the Child Behaviour Checklist, Reynold's Child Depression Scale, the Screen for Child Anxiety Related Disorders, and Culture-Free Self-Esteem Inventory-III. In a pretest measurement, no significant difference was noted between the two groups. However, post-intervention assessments revealed significant differences between the students in the intervention group. Based on the findings, the researcher found that the FRIENDS intervention program was feasible, with few modifications, for primary-level students in Hong Kong who were suffering from internalizing problems.

Similarly, case studies of curriculum adaptation have proved to be effective for both students' learning and teachers' professional development. Through a project learning activity, Zhang et al. (2014) analyzed the curriculum adaptation process using a qualitative case study approach at a local school in Hong Kong serving students with intellectual disabilities. The researchers noted the substantial potential for adapting curricula to meet instructional goals, contents, strategies, settings, and student behavior needs and thereby helping students with intellectual disabilities and facilitating teachers' professional development. Based on their analyses, the researchers concluded, "Student with ID [intellectual disabilities] can gain benefits and can engage in learning experiences through project at their own level after the curriculum adaptation process" (p. 268).

Maggin and colleagues (2016) have identified potential gaps in the current intervention models and called for developing intensive individualized yet flexible models that would accommodate both developmental and ecological factors. Maggin, Wehby, and Gilmour (2016) suggest educators take an experimental approach while engaging in academic interventions for students with EBD. They believed that "experimental analyses of academic behavior allow practitioners to empirically diagnose the students' specific learning deficit and select the most efficacious intervention components to develop individualized intervention protocols for the student's particular needs" (Maggin, Wehby, and Gilmour, 2016, p. 140). Similarly, Mathur and Jolivet (2012, p. 102) emphasized practices that were "effective," "evidence-based," and "unique" to the individual needs of the students with EBD. This would require schools that cater to students with SEN to adapt their curricula and help them develop their potential optimally.

Researchers investigating the experimental analysis of academic behavior have also posited that brief experimental analyses of behavior can be useful before engaging in any intervention for students with EBD (Maggin, Wehby, and Gilmour, 2016). This would require educators to collect and review students' data on an ongoing basis with the support of potential stakeholders, particularly parents (Lewis & Mitchell, 2012). This link between assessment and intervention may be further strengthened through the collaborative efforts of teachers, parents, communities, and multidisciplinary teams (Plotts, 2012). Therefore, scholars have already highlighted the pivotal importance of screening and assessment tools in the identification, assessment, and evaluation of children with EBD for appropriate interventions and their improved learning (Chafouleas et al., 2013; Glover & Albers, 2007; Lane et al., 2010; Miller et al., 2015; Plotts, 2012).

IDENTIFICATION, ASSESSMENT, AND EVALUATION OF STUDENTS WITH EBD

Researchers have extensively studied the topics of identification, assessment, and evaluation of systematic screening tools and suggested making concerted efforts to address the multifaceted and complex issues of students with challenging behaviors (Bakken, Obiakor, & Rotatori, 2012a, 2012b; Glover & Albers, 2007). However, the comorbidity of behavioral and achievement problems among students with EBD makes the processes of assessment and identification more complex. This complexity surges in situations where the student body is culturally and linguistically diverse. Cases where

students speak a language other than the language of instruction may have implications for academic achievement (Rogers-Adkinson, Ochoa, & Weiss, 2012; Webber et al., 2008). Consequently, the task of developing culturally and linguistically relevant identification and assessment tools is critical.

Glover and Albers (2007) noted that, “correctly identifying individuals in an educational setting who are in need of specific instruction and services requires making use of universal screening tools that are contextually appropriate, technically sound, and usable” (p. 118). A variety of assessment and identification techniques that are appropriate to the specific school setting may be useful. Plotts (2012) contended that, “multimethod, multisource, and multisetting approaches are essential for valid and culturally fair assessment” (p. 82). This suggests that the assessment of children for special education services demands integrated approaches that are sensitive to the context. Thus, it is critical to adopt screening tools that are appropriate and effective in particular situations.

Evaluation of Systematic Screening Tools

Despite the high number of screening tools, the task of formulating specific criteria for making informed decisions about the assessment of students with EBD has recently attracted substantial attention from researchers. Various forms of assessment, such as systematic screening for behavioral disorders (SSBD), the student risk screening scale (SRSS), the direct behavior rating single item scales (DBR-SIS), dynamic indicators of basic early literacy skills, and the behavioral and emotional screening system, have been developed. Glover and Albers (2007) propose *readiness*, *diagnostic*, and *school-based universal screening* assessments for the identification of students with EBD. As the natures of universal screening assessment tools differ substantially from one another owing to the varying assessment purposes, Glover and Albers (2007) have underscored three important criteria for evaluating the universal screeners: “appropriateness,” “technical adequacy,” and “usability” (pp. 118–119).

Likewise, Lane et al. (2010) suggested considering the psychometric soundness, feasibility, reliability, and validity of measures when selecting systematic screening tools to identify students who either had or were at risk of having EBD. The authors cautioned professionals working with students to consider the feasibility and social validity of a systematic screener, which “must be reasonable with respect to core fundamental features: preparation, administration, scoring, interpretation, and cost” (p. 101). Furthermore, it is important to consider the effectiveness of a screener across age groups. A screener that is appropriate for elementary-level children may be inappropriate at the middle level. Different screening tools and assessment measures can produce varied insights into students with EBD across grades and age groups. Similarly, some screeners can better predict externalizing behavior concerns than internalizing ones.

Comparison of Systematic Screening Tools

Various screening tools are available for identifying and placing students with EBD. However, it is important to select the appropriate tools for a targeted student group. This is why researchers have suggested making certain considerations when selecting

the right screening tools (Chafouleas et al., 2013; Glover & Albers, 2007; Lane et al., 2009, 2010). While examining the psychometric soundness, validity, test-retest stability, and predictability of SRSS, Lane et al. (2009) conducted a comparative study of SRSS and SSBD.

SSBD is a multistage screener, considered to be the “gold standard” of screening tools, and is mainly designed to assess the internalizing and externalizing behavior of students up to Grade 6. However, its cost is one of its major limitations. It also requires a considerable amount of time for administration and does not account for the co-occurrence of internalizing and externalizing behaviors. In contrast, SRSS is a one-stage, one-page, cost-effective screener that requires only approximately 10 minutes of administration time. SRSS is mainly designed to identify antisocial behavioral patterns among students, meaning the identification of students with internalizing and externalizing behaviors is not its focus. In a study with a small sample, Lane et al. (2009) found that SRSS was as accurate as SSBD in predicting both externalizing and internalizing problems. Both its sensitivity and specificity for externalizing behavior identification was higher, whereas its specificity for internalizing behavior identification was excellent. In a replication of the same study with a diverse and larger sample, Lane et al. (2010) confirmed the earlier findings and found strong internal consistency and test-retest reliability, with greater accuracy in identifying externalizing behaviors than internalizing ones.

Similarly, Chafouleas et al. (2013) investigated the functioning of the DBR-SIS, which targeted students’ academically engaged, disruptive, and respectful behaviors in a school-based screening assessment. Based on a sample of 831 students in kindergarten through Grade 8, the researchers found different performance scores across the grades. The performance of the DBR-SIS was relatively better among elementary-level students than among middle-level students, particularly concerning academically engaged and disruptive behaviors. Based on their findings, the researchers concluded that “disruptive behavior is highly pertinent toward evaluating risk status in lower grade levels, but academically engaged behavior becomes equally if not more important at higher grades” (p. 382). These findings suggest that selecting appropriate screening and assessment tools to identify the statuses of both externalizing and internalizing behaviors among students with EBD requires critical attention from professionals working in school settings.

Directions for Future Research

Although EBD has drawn considerable attention from varied communities of scholars, given the prevalence of conditions and outcomes for children with emotional and behavioral special needs, there remains much work to do to better understand the complexities of EBD, how best to assess EBD, and the design, development, and testing of interventions. As with research with other special needs population (e.g., Crane, Zusho, Ding, & Cancelli, 2017), educational psychology theories, methods, and research can continue to support these efforts. Although some research has addressed correlations and outcomes for students in educational settings, continued research into profiles of learners that include individual difference variables and academic achievement outcomes is necessary. These variables may include continued research that leverages cognitive views of learning and examines students’ processing variables,

such as executive functions and working and long-term memory processes. As noted, the mediating and moderating effects of these variables should be explored.

Further, much of the existing research with students with behavioral and emotional needs focused on behavioral outcomes and their relation to achievement. Research regarding motivation with these learners is lacking, and future research that extends our knowledge of achievement motivation and EBD is necessary. In addition to research that focuses on self-efficacy and learners with special needs (e.g., Cleary, Velardi, and Schnaidman (2017), recent studies of students with other special needs supports the critical role motivation plays. For example, Lee and Zentall (2017) examined the reading motivation, largely through a self-determination theory lens, and achievement of students with ADHD and reading disabilities in a longitudinal study. Within a social cognitive theory framework, Martin, Burns, and Collie (2017) explored motivation of students with ADHD. More is necessary to explicate the role of varied motivational variables in learners with behavioral and emotional needs. Educational psychology theories and methods can also continue to inform assessment tools and strategies and the design and testing of home- and school-based interventions.

CONCLUSION

Given the complexities inherent in the notion of EBD, addressing the needs of students with internalizing and externalizing problems is a demanding task. Furthermore, given the manifold causes and consequences of students with EBD, it is hardly possible for educational practitioners to address the issues alone. The effects of children's behavioral and emotional challenges are not limited to teachers; parents also suffer from the same burden. Educational practitioners may need to engage in collaborative efforts with parents and other stakeholders to manage behavioral problems. Support from clinicians and psychologists may be of immense value in helping students with EBD.

Forlin and Cooper (2013) have already reported teachers' concerns over their lack of skills and training for managing children's behavioral problems. Similarly, Heung (2006) underscored the lack of intercultural sensitiveness among teachers serving students with ethnic minority backgrounds. The available findings suggest that teachers and schools should be equipped with required resources and training so that they can avoid stressful situations in their classrooms and help students suffering from behavioral challenges (Chong & Ng, 2011). Schools can also engage parents in their efforts, particularly mothers, who often experience stressful situations owing to the behavioral challenges of their children.

Furthermore, generic interventions for youth with EBD may be minimally effective, and social skill interventions may not be equally fruitful either. Curriculum adaptation may be a more useful intervention for students with intellectual disabilities than for students with ADHD. The available evidence underscores the need to pay particular attention to the specific nature and type of EBD before engaging in any interventions. Practitioners may also need to consider contextual differences while conceptualizing EBD across the cultures. It is also essential to take into account the critical role of the context when replicating various interventions. Interventions that prove to be effective in one context may not produce the same results in another context. Thus, culturally and contextually appropriate interventions may yield better outcomes.

Research findings mainly rely on quantitative methodologies. A handful of studies have explored the experiences of the students, teachers, parents, and siblings of children with EBD. Therefore, in addition to other future research recommendations, as Strnadová (Chapter 4, this volume) proposes, studies that engage inclusionary research methods are warranted. Semi-structured interviews with participants and observations should help to clarify how children's behavioral problems affect their lives and work. Given the varied effects of interventions across groups of students with differing forms of EBD, further research is needed to ascertain which types of intervention can be beneficial in helping students with behavioral problems across age groups and schooling contexts. Further research is required to explore the potential role of race and ethnicity in students' behavioral impairment. Single-case and comparative investigations may help extend the existing body of knowledge on educating children suffering from EBD.

REFERENCES

- Algozzine, B., Wang, C., & Violette, A. S. (2011). Reexamining the relationship between academic achievement and social behavior. *Journal of Positive Behavior Interventions*, 13(1), 3–16.
- Axup, T., & Gersch, I. (2008). The impact of challenging student behaviour upon teachers' lives in a secondary school: Teachers' perceptions. *British Journal of Special Education*, 35(3), 144–151.
- Bakken, J. P., Obiakor, F. E., & Rotatori, A. F. (2012a). *Behavioral disorders: Identification, assessment, and instruction of students with EBD*. Bingley, UK: Emerald.
- Bakken, J. P., Obiakor, F. E., & Rotatori, A. F. (2012b). *Behavioral disorders: Practice concerns and students with EBD*. Bingley, UK: Emerald.
- Barksdale, C. L., Azur, M., & Daniels, A. M. (2010). Behavioral and emotional strengths among youth in systems of care and the effect of race/ethnicity. *Journal of Emotional and Behavioral Disorders*, 18(4), 236–246.
- Baron-Cohen, S., Tager-Flusberg, H., & Cohen, D. J. (2000). *Understanding other minds: Perspectives from developmental cognitive neuroscience* (2nd ed.). Oxford: Oxford University Press.
- Bellini, S., Peters, J. K., Benner, L., & Hopf, A. (2007). A meta-analysis of school-based social skills interventions for children with autism spectrum disorders. *Remedial and Special Education*, 28(3), 153–162.
- Cantin, R. H., Gnaedinger, E. K., Gallaway, K. C., Hesson-McInnis, M. S., & Hund, A. M. (2016). Executive functioning predicts reading, mathematics, and theory of mind during the elementary years. *Journal of Experimental Child Psychology*, 146, 66–78.
- Carlson, S. M., Claxton, L. J., & Moses, L. J. (2015). The relation between executive function and theory of mind is more than skin deep. *Journal of Cognition and Development*, 16(1), 186–197.
- Chafouleas, S. M., Kilgus, S. P., Jaffery, R., Riley-Tillman, T. C., Welsh, M., & Christ, T. J. (2013). Direct behavior rating as a school-based behavior screener for elementary and middle grades. *Journal of School Psychology*, 51(3), 367–385.
- Chan, J. Y. N., & Lai, K. Y. C. (2016). Psychological adjustment of siblings of children with autism spectrum disorder in Hong Kong. *East Asian Archives of Psychiatry*, 26(4), 141–147.
- Cheung, H., Hsuan-Chih, C., Creed, N., Ng, L., Ping Wang, S., & Mo, L. (2004). Relative roles of general and complementation language in theory-of-mind development: Evidence from Cantonese and English. *Child Development*, 75(4), 1155–1170.
- Chong, S. S. C., & Ng, K. K. W. (2011). Perception of what works for teachers of students with EBD in mainstream and special schools in Hong Kong. *Emotional and Behavioural Difficulties*, 16(2), 173–188.
- Cleary, T. J., Velardi, B., & Schnaidman, B. (2017). Effects of the Self-Regulation Empowerment Program (SREP) on middle school students' strategic skills, self-efficacy, and mathematics achievement. *Journal of School Psychology*, 64, 28–42.
- Coleman, M. C., & Webber, J. (2002). *Emotional and behavioral disorders: Theory and practice* (4th ed.). Boston, MA: Allyn & Bacon.
- Crane, N., Zusho, A., Ding, Y., & Cancelli, A. (2017). Domain-specific metacognitive calibration in children with learning disabilities. *Contemporary Educational Psychology*, 50, 72–79.
- Dore, R. A., Amend, S. J., Golinkoff, R. M., & Hirsh-Pasek, K. (2018). Theory of mind: A hidden factor in reading comprehension? *Educational Psychology Review*, 30(3), 1067–1089.

- DuPaul, G. J., & Eckert, T. L. (1997). The effects of school-based interventions for attention deficit hyperactivity disorder: A meta-analysis. *School Psychology Review*, 26(1), 5–27.
- Fabiano, G. A., Pelham, W. E., Jr., Coles, E. K., Gnagy, E. M., Chronis-Tuscano, A., & O'Connor, B. C. (2009). A meta-analysis of behavioral treatments for attention-deficit/hyperactivity disorder. *Clinical Psychology Review*, 29(2), 129–140.
- Farmer, T. W., Sutherland, K. S., Talbott, E., Brooks, D. S., Norwalk, K., & Huneke, M. (2016). Special educators as intervention specialists: Dynamic systems and the complexity of intensifying intervention for students with emotional and behavioral disorders. *Journal of Emotional and Behavioral Disorders*, 24(3), 173–186.
- Forlin, C., & Cooper, P. (2013). Student behaviour and emotional challenges for teachers and parents in Hong Kong. *British Journal of Special Education*, 40(2), 58–64.
- Glover, T. A., & Albers, C. A. (2007). Considerations for evaluating universal screening assessments. *Journal of School Psychology*, 45(2), 117–135.
- Gopnik, A., & Wellman, H. M. (1992). Why the child's theory of mind really is a theory. *Mind & Language*, 7(1–2), 145–171.
- Heung, V. (2006). Recognizing the emotional and behavioral needs of ethnic minority students in Hong Kong. *Preventing School Failure: Alternative Education for Children and Youth*, 50(2), 29–36.
- Hughes, C., & Devine, R. T. (2015). Individual differences in theory of mind from preschool to adolescence: Achievements and directions. *Child Development Perspectives*, 9(3), 149–153.
- Hughes, C., Devine, R. T., & Wang, Z. (2018). Does parental mind-mindedness account for cross-cultural differences in preschoolers' theory of mind?. *Child development*, 89(4), 1296–1310.
- Lane, K. L., Little, M. A., Casey, A. M., Lambert, E. W., Wehby, J. H., Weisenbach, J. L., & Phillips, A. (2009). A comparison of systematic screening tools for emotional and behavioral disorders. *Journal of Emotional and Behavioral Disorders*, 17(2), 93–105.
- Lane, K. L., Robertson Kalberg, J., Lambert, E. W., Crnabori, M., & Bruhn, A. L. (2010). A comparison of systematic screening tools for emotional and behavioral disorders: A replication. *Journal of Emotional and Behavioral Disorders*, 18(2), 100–112.
- Lecce, S., & Bianco, F. (2018). Working memory predicts changes in children's theory of mind during middle childhood: A training study. *Cognitive Development*, 47, 71–81.
- Lee, J., & Zentall, S. S. (2017). Reading motivation and later reading achievement for students with reading disabilities and comparison groups (ADHD and typical): A 3-year longitudinal study. *Contemporary Educational Psychology*, 50, 60–71.
- Lewis, T. J., & Mitchell, B. S. (2012). Prevention of and early intervention for students with emotional and behavioral disorders: Systems to support data-based decision making. In J. P. Bakken, F. E. Obiakor, & A. F. Rotatori (Eds.), *Behavioral disorders: Identification, assessment, and instruction of students with EBD* (pp. 129–149). Bingley, UK: Emerald.
- Liu, D., Wellman, H. M., Tardif, T., & Sabbagh, M. A. (2008). Theory of mind development in Chinese children: A meta-analysis of false-belief understanding across cultures and languages. *Developmental Psychology*, 44(2), 523.
- Maggin, D. M., Wehby, J. H., Farmer, T. W., & Brooks, D. S. (2016). Intensive interventions for students with emotional and behavioral disorders: Issues, theory, and future directions. *Journal of Emotional and Behavioral Disorders*, 24(3), 127–137.
- Maggin, D. M., Wehby, J. H., & Gilmour, A. F. (2016). Intensive academic interventions for students with emotional and behavioral disorders: An experimental framework. *Journal of Emotional and Behavioral Disorders*, 24(3), 138–147.
- Martin, A. J., Burns, E. C., & Collie, R. J. (2017). ADHD, personal and interpersonal agency, and achievement: Exploring links from a social cognitive theory perspective. *Contemporary Educational Psychology*, 50, 13–22.
- Mathur, S. R., & Jolivet, K. (2012). Placement of students with emotional and behavioral disorders. In J. P. Bakken, F. E. Obiakor, & A. F. Rotatori (Eds.), *Behavioral disorders: Identification, assessment, and instruction of students with EBD* (pp. 87–105). Bingley, UK: Emerald.
- Mattison, R. E., & Blader, J. C. (2013). What affects academic functioning in secondary special education students with serious emotional and/or behavioral problems?. *Behavioral Disorders*, 38(4), 201–211.
- Miller, F. G., Cohen, D., Chafouleas, S. M., Riley-Tillman, T. C., Welsh, M. E., & Fabiano, G. A. (2015). A comparison of measures to screen for social, emotional, and behavioral risk. *School Psychology Quarterly*, 30(2), 184.
- Morgan, P. L., & Sideridis, G. D. (2013). Academic and behavioral difficulties at school: Introduction to the special issue. *Behavioral Disorders*, 38(4), 193–200.

- Moshman, D. (2018). Metacognitive theories revisited. *Educational Psychology Review*, 30(2), 599–606.
- Mustian, A. L., & Cuenca-Sanchez, Y. (2012). Themes and dimensions of emotional and behavioral disorders. In J. P. Bakken, F. E. Obiakor, & A. F. Rotatori (Eds.), *Behavioral disorders: Identification, assessment, and instruction of students with EBD* (pp. 31–49). Bingley, UK: Emerald.
- Naito, M., & Koyama, K. (2006). The development of false-belief understanding in Japanese children: Delay and difference? *International Journal of Behavioral Development*, 30(4), 290–304.
- Plotts, C. A. (2012). Assessment of students with emotional and behavioral disorders. In J. P. Bakken, F. E. Obiakor, & A. F. Rotatori (Eds.), *Behavioral disorders: Identification, assessment, and instruction of students with EBD* (pp. 51–85). Bingley, UK: Emerald.
- Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioral and Brain Sciences*, 1(4), 515–526.
- Quinn, M. M., Kavale, K. A., Mathur, S. R., Rutherford, R. B., Jr., & Forness, S. R. (1999). A meta-analysis of social skill interventions for students with emotional or behavioral disorders. *Journal of Emotional and Behavioral Disorders*, 7(1), 54–64.
- Rogers-Adkinson, D. L., Ochoa, T. A., & Weiss, S. L. (2012). Chapter 7 english language learners and emotional behavioral disorders. In *Behavioral Disorders: Identification, Assessment, and Instruction of Students with EBD* (pp. 151–171). Bingley, UK: Emerald Group Publishing Limited.
- Siu, A. (2007). Using FRIENDS to combat internalizing problems among primary school children in Hong Kong. *Journal of Cognitive and Behavioral Psychotherapies*, 7(1), 11–26.
- Sodian, B., & Kristen, S. (2016). Theory of mind. In J. A. Greene, W. A. Sandoval, & I. Braten (Eds.), *The handbook of epistemic cognition* (pp. 80–97). London: Routledge.
- Sointu, E. T., Savolainen, H., Lappalainen, K., & Lambert, M. C. (2017). Longitudinal associations of student–Teacher relationships and behavioural and emotional strengths on academic achievement. *Educational Psychology*, 37(4), 457–467. doi:10.1080/01443410.2016.1165796
- Stoutjesdijk, R., Scholte, E. M., & Swaab, H. (2016). Impact of family functioning on classroom problem behavior of children with emotional and behavioral disorders in special education. *Journal of Emotional and Behavioral Disorders*, 24(4), 199–210.
- Wang, Z., Devine, R. T., Wong, K. K., & Hughes, C. (2016). Theory of mind and executive function during middle childhood across cultures. *Journal of Experimental Child Psychology*, 149, 6–22.
- Wang, Z., Wong, R. K. S., Wong, P. Y. H., Ho, F. C., & Cheng, D. P. W. (2016). Play and theory of mind in early childhood: A Hong Kong perspective. *Early Child Development and Care*, 187(9), 1–14.
- Webber, J., Plotts, C. A., & Coleman, M. C. (2008). *Emotional and behavioral disorders: Theory and practice* (5th ed.). Boston, MA: Pearson/Allyn & Bacon.
- Wehby, J. H., Lane, K. L., & Falk, K. B. (2003). Academic instruction for students with emotional and behavioral disorders. *Journal of Emotional and Behavioral Disorders*, 11(4), 194–197.
- Wellman, H. M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: The truth about false belief. *Child Development*, 72(3), 655–684.
- Yang, L., Sin, K., & Lui, M. (2015). Social, emotional, and academic functioning of children with SEN integrated in Hong Kong primary schools. *The Asia-Pacific Education Researcher*, 24(4), 545–555.
- Zhang, J., Wong, L., Chan, T., & Chiu, C. (2014). Curriculum adaptation in special schools for students with intellectual disabilities (SID): A case study of project learning in one SID school in Hong Kong. *Frontiers of Education in China*, 9(2), 250–273.



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Part II

Perspectives from Major Educational Psychology Theories

Andrew J. Martin

For Part II, authors were asked to focus on seminal theories in educational psychology and explore the ways that these theories have contributed or can contribute to knowledge, research, and practice as relevant to students with special needs. Thus, in all Part II chapters, a major educational psychology theory is the focus and is unpacked to give better understanding of and illuminate an area (or areas) of special need. The aim in this part is to highlight how psycho-educational theory is applicable and helpful for educating a diversity of students with special needs.

The conceptual frameworks in this part traverse social cognitive theory, self-determination theory, theories around self-regulation, goal orientation and goal-setting theories, self-worth motivation theory, expectancy-value theory, control-value theory, and cognitive load theory. These theories represent “classic” and influential conceptual frameworks in educational psychology. Whereas these perspectives have been predominantly applied to “mainstream” populations of students, their connection and application to special needs are the emphasis for this section. In Part II, areas of special need included learning disabilities, attention-deficit/hyperactivity disorder (ADHD), intellectual and developmental disability, and emotional and behavioral disorders.

When we consider the major constructs central to many of these theories, it is evident that self-perceptions of competence (in its various forms) are a major presence. Thus, for example, self-efficacy is a focus for Schunk and DiBenedetto (Chapter 11), competence appraisals are a key element in the Wehmeyer and Shogren chapter (Chapter 12), self-worth is the focus for Martin (Chapter 16), and expectancies are central for Wigfield and Ponnock (Chapter 17).

Schunk and DiBenedetto explore social cognitive theory (SCT) among students with disabilities, with particular attention to these students’ self-efficacy. They note that students with disabilities are often low in self-efficacy and that this adversely affects their motivation and learning. They review key principles of SCT and, importantly,

distinguish different types of self-efficacy relevant to students with disabilities (i.e., self-efficacy for: performing, learning, and self-regulation). They apply these concepts to students with neurodevelopmental disorders—specifically, students with learning disabilities, reading disabilities, and ADHD. They also emphasize the role of socio-cultural variables in affecting the self-efficacy of students with disabilities, the role of technology to assist them, and the critical role of out-of-school contexts (e.g., home) to promote these students' self-efficacy.

Expectancy-value theory (EVT) is another perspective in which perceived competence is central to students' motivation, as is the perceived utility, importance, and cost of their choices and actions. In their chapter, Wigfield and Ponnock examine how EVT can contribute to our understanding of students' anxiety and depression. They identify how students' basic belief and value constructs (as articulated under EVT) develop across the school years, and how they shape and are shaped by emotional disorders such as anxiety and depression. They also address the vital influence of parents' own beliefs and values in impacting the development of their child's anxiety and depression. Importantly, Wigfield and Ponnock locate anxiety and depression in the educational space and discuss how teacher–student relationships, teachers' expectancies for students' success, and the school environment can impact the development of students' anxiety and depression. Thus, traversing student, parent/home, and teacher/school factors, Wigfield and Ponnock show that expectancies and values are diversely implicated in students' emotional health and well-being.

Alongside chapters directed at enhancing students' perceived competence, Martin explores more defensive and protective perspectives on perceived competence. He outlines how students can be motivated by a need to protect their self-worth. Drawing on self-worth theory and with particular focus on students with ADHD, Martin explores fear of failure and how it can underpin students' motivation to protect their self-worth. He also describes the diverse strategies they may use in order to do so—including perfectionism, self-handicapping, and disengagement. Although Martin focuses on self-worth theory, he also draws on need achievement theory and attribution theory that have informed self-worth theory. Throughout the chapter, Martin explores implications for students with other disabilities or disorders, making the point that, where fear of failure is present among any of these disabilities and disorders, so too is the potential motivation to protect self-worth.

The notions of control, volition, and autonomy are also central to seminal psycho-educational theorizing, and this clearly comes through in Part II. In their chapter on self-determination theory (SDT), Wehmeyer and Shogren identify self-determination as a pivotal construct under human agentic theories. Alongside the need for competence, they also point to the importance of students—including those with special needs—acting volitionally and as causal agents in their own lives. Given this, they build from SDT to articulate causal agency theory and its role in the development of causal actions and self-determination among students with intellectual, developmental, and specific learning disabilities. Wehmeyer and Shogren draw particular attention to the role of autonomy-supportive teaching practices and how to shape appropriate pedagogy for students with intellectual, developmental, and specific learning disabilities with a view to optimizing their sense of autonomy and volition.

Pekrun and Loderer (Chapter 18) also deal with the critical issue of control and integrate this with the important role of value (e.g., perceived importance, utility,

cost, etc.). They do so by closely considering students who experience excessive negative emotions, a lack of positive emotions, and dysfunctional emotion regulation, particularly as relevant to learning and achievement. They make the point that these emotional problems adversely impact students' educational pathways. The lens through which they consider achievement emotions draws on the control-value theory of achievement emotions (CVT). They describe how biases in control and value appraisals can give rise to emotion disorders in the learning context. In fact, they introduce the term "achievement emotion disorder" to denote problems with these emotions (such as excessive test anxiety and excessive boredom). They also look at how problematic achievement emotions may underpin generalized anxiety disorder, depressive disorders, and behavioral disorders that each have negative implications for students' academic development.

In addressing students' problematic achievement emotions, Pekrun and Loderer emphasize the importance of helping students with emotional and cognitive regulation. Indeed, across all the chapters dealing with perceived competence and control, the notion of self-regulation is implicit. Notably, then, students' capacity to self-regulate is the focus of the chapter by Perry, Mazabel, and Yee (Chapter 13). They detail self-regulation for learning and its focus on metacognition, motivation, and strategic action in the academic and social contexts of school. They suggest that self-regulation has particular application and yield for students with learning disabilities because these students face unique challenges that often manifest as difficulties in executive functioning, motivation, and social functioning (key components of self-regulation for learning). Importantly, they extend their argument from "self-" regulation among students with learning disabilities to consider co-regulation and socially shared regulation for these students.

Perry et al. also discuss the specific ways that students self-regulate for learning. In their discussion, goals and goal-setting are identified as major avenues for action and strategy, especially for students with learning disabilities. Indeed, Bergin and Prewett (Chapter 14) address precisely this. They first discuss goal-setting—a process and plan of action aimed at attaining a specific desired outcome. They describe how students with learning disabilities can benefit from setting and striving towards goals that are specific, broken into proximal subgoals, and appropriately difficult. They then discuss a specific class of goals, known as achievement goals, that are demarcated in terms of mastery goals (striving to learn and master material), performance approach goals (striving to demonstrate ability and to do better than others), and performance avoidance goals (striving to avoid appearing unable and avoid doing worse than others). Bergin and Prewett observe that, because of their history of academic difficulty, students with learning disabilities are disproportionately likely to pursue more maladaptive performance avoidance goals. Importantly, however, they also describe the merits of mastery goals for these students and identify effective strategies teachers can use to help students to pursue these more adaptive goals.

Most chapters in the section have a strong focus on students and student attributes, particularly their self-perceptions of competence, their control and autonomy, their self-regulation, and their goals. It is probably the chapter by Tricot, Vandenbroucke, and Sweller (Chapter 15) where teachers and instruction receive the most direct attention. Their conceptual focus is cognitive load theory (CLT), a theory inherently concerned with instructional design that is grounded in our knowledge of human

cognitive architecture. They describe the cognitive demands imposed on students by learning materials and instruction and detail how CLT informs educators to manage the cognitive burden on the student so they can learn most effectively. They apply this theory to help us better understand students with dyslexia. For these students, reading text and recognizing words are so demanding that they have limited remaining cognitive resources for comprehension. Tricot et al. explain that, by applying CLT principles for students with dyslexia and using explicit instruction, these students' reading can be improved.

Across all the chapters in this part, it is evident that major psycho-educational theories have an important role in understanding and explaining the learning and learning experiences of students with special needs. The authors of these chapters illuminate key factors and processes inherent in the theories that are implicated in these students' learning. In so doing, the authors also provide targets for what to address in psycho-educational research and intervention. Taken together, then, the Part II chapters are powerful demonstrations of how educational psychology theories are an integral part of efforts to enhance the academic outcomes of students with special needs, through school and beyond.

11

SOCIAL COGNITIVE THEORY, SELF-EFFICACY, AND STUDENTS WITH DISABILITIES

Implications for Students with Learning Disabilities, Reading Disabilities, and Attention-Deficit/Hyperactivity Disorder

Dale H. Schunk and Maria K. DiBenedetto

In this chapter we discuss the application of social cognitive theory (SCT)—and especially the role of self-efficacy—to students with disabilities. SCT is a major psychological theory that has been widely applied in education and offers principles highly relevant to educational psychology. Situated within this theoretical framework, self-efficacy is a construct that often has been researched in studies of students with disabilities. Bandura's (1986) SCT presents an agentic view of the learner, one who can exert a large degree of control over important events in his or her life. By helping students develop a sense of personal agency, educators can positively influence their motivation, learning, and achievement in- and out-of-school.

The central focus of this chapter is the role of *self-efficacy*, a key component of agency. Self-efficacy is defined as one's perceived capabilities for learning or performing actions at designated levels (Bandura, 1997). Self-efficacy is predicted to affect various achievement-related outcomes such as choices, effort, persistence, motivation, learning, and self-regulation. Researchers have empirically substantiated these predictions, confirming the vital role of self-efficacy in students' academic development (Fast et al., 2010; Schunk, 2012; Schunk & DiBenedetto, 2016).

This chapter's purpose—to consider self-efficacy among students with disabilities—is important because many students with disabilities hold a low sense of self-efficacy for learning and performing well in educational contexts, which can negatively affect their motivation and learning (Klassen & Lynch, 2007). Although self-efficacy has been applied to students with different types of disability, we concentrate on students with neurodevelopmental needs; specifically, we discuss research on students with learning disabilities, reading disabilities, and attention-deficit/hyperactivity disorder (ADHD; sometimes herein described in terms of executive function disability/disorder; for related discussions, see, in this volume: Bergin & Prewitt, Chapter 14; Follmer & Sperling, Chapter 5;

Graham & Harris, Chapter 20; Hall, Capin, Vaughn, & Cannon, Chapter 7; Martin, Chapter 16; Perry, Mazabel, & Yee, Chapter 13; Strnadová, Chapter 4; Swanson, Chapter 2; Tricot, Vandenbroucke, & Sweller, Chapter 15). Our aim is to demonstrate the relevance of self-efficacy to students with these disabilities, but also, where appropriate, to make observations about self-efficacy and students with disabilities more broadly.

We initially review some key principles of SCT and show how self-efficacy fits in this framework. We also distinguish self-efficacy from other similar constructs and different types of self-efficacy, including self-efficacy for performing, for learning, and for self-regulation. We then summarize some representative self-efficacy research that addresses various aspects of self-efficacy, including its role in learning, motivation, and self-regulation, as well as the influences on it. We also cover calibration, or how well self-efficacy corresponds to actual performances, as we see this as especially relevant to students with disabilities. Implications of the theory and research findings for educational practitioners are discussed, and the chapter concludes with recommendations for future research.

CONCEPTUAL FRAMEWORK OF SCT AND SELF-EFFICACY

SCT

Self-efficacy is situated in SCT (Bandura, 1986), which postulates that individuals' functioning involves reciprocal interactions between personal (e.g., cognitions, feelings, skills), behavioral (e.g., strategy use, help-seeking actions), and environmental (e.g., classrooms, homes, gyms) factors (Usher & Schunk, 2018). Researchers have shown that self-efficacy beliefs influence such behaviors as choice of tasks, persistence, effort, and achievement (Schunk & DiBenedetto, 2016). In turn, students' behaviors can modify their self-efficacy. As students work on tasks, they observe their progress towards their learning goals. Progress indicators such as assignments completed convey to them that they are capable of performing well, which enhances self-efficacy for continued learning (Schunk & DiBenedetto, 2016).

The hypothesized reciprocal influences between self-efficacy and environmental variables have been demonstrated in research on students with learning, reading, and executive function disabilities, many of whom hold low self-efficacy for learning (Licht & Kistner, 1986). Persons in their environments may react to them based on (sometimes stereotyped) attributes associated with them rather than based on their actual behaviors or their potential. For example, a teacher may judge students as less capable than other learners and hold lower academic expectations for them, even in areas where such students with learning disabilities are performing adequately. In turn, teacher feedback can affect self-efficacy, resulting in these students demonstrating lower self-efficacy over time. Positive persuasive statements, such as "I know that you can do this," can raise self-efficacy (for related discussion, see Tracey, Merom, Morin, & Maïano, Chapter 24, this volume).

Under SCT, learners' behaviors and environments can influence one another. For example, when teachers present information, they may ask students to direct their attention to a slide projected on the board. Environmental influence on behaviors occurs when students attend to the visual without much conscious deliberation. In addition, under SCT, students' behaviors are proposed to alter the instructional envi-

ronment. For example, during small group reading instruction, if a teacher asks a question and a student with a reading disability gives an incorrect answer, the teacher may reteach rather than continue with the lesson.

SCT stresses the idea that, through these processes, people strive to develop a sense of *agency* (Bandura, 1997), or the belief that they can exert a large degree of control over important events in their lives. Developing self-efficacy is an integral means for experiencing a sense of agency. Students who feel efficacious about learning and performing well are apt to choose to engage in learning, expend effort, and persist (Schunk, 2012). In turn, their successes bolster their agency beliefs. But students with learning and related disabilities may not feel efficacious about learning, given their history of academic difficulties. Improving their self-efficacy for learning is a critical educational goal.

Self-Efficacy

Effects and Sources of Self-Efficacy

Researchers have shown that self-efficacy can affect choices, effort, persistence, and achievement (Schunk & DiBenedetto, 2016). Compared with less-efficacious students, those with a strong sense of self-efficacy for learning and performing well tend to better engage in learning tasks, expend effort to succeed, persist when they encounter difficulties, and achieve at higher levels. Notably, students with verbal and cognitive functioning disabilities are more likely to report lower levels of self-efficacy than students without disabilities, possibly because of an internalized history of repeated academic failures (Heward, Alber-Morgan, & Konrad, 2017; Lackaye, Margalit, Ziv, & Ziman, 2006). Studies have shown for example, that students with reading and writing disabilities may attribute repeated academic failures to internal causes such as anxiety, nervousness, an inability to comprehend what one is reading, low effort, and feelings of hopelessness and shame, which in turn affect their self-efficacy beliefs (Klassen & Lynch, 2007). In a qualitative study conducted by Klassen and Lynch (2007), specialist teachers and 28 students enrolled in Grades 8 and 9 who were diagnosed with severe learning disabilities participated in focus groups and interviews to examine self-efficacy and motivational beliefs. Findings revealed that teachers believed students with learning disabilities had lower levels of metacognition and self-efficacy and that academic failures were due to an inability that was a result of their disability. Students, on the other hand, while also reporting having lower self-efficacy beliefs than their peers, believed academic failures were due to putting in less effort. They also expressed the importance of teachers' beliefs in them. For example, one student reported: "Well, if the teacher's like, 'I know you can do better, you just have to try harder, and like not get lazy,' then I know I could do better" (p. 498). These findings imply that one important source for students' self-efficacy beliefs is the beliefs teachers have about them.

Bandura (1997) hypothesized that self-efficacy beliefs are formed based on four sources of information: enactive mastery accomplishments, vicarious experiences, forms of social persuasion, and physiological and affective indexes. Enactive mastery accomplishments constitute the most reliable source because they provide learners with authentic evidence of their capability to succeed. Accomplishments require learn-

ers to adapt and adjust to different circumstances, and repeated successes in doing so can enhance self-efficacy. Teachers who provide students with opportunities to learn and perform successfully likely build students' self-efficacy for future similar tasks (Zimmerman & DiBenedetto, 2008). Thus, for example, as students with reading disabilities acquire reading skills, they perceive they are reading better. This perception of progress helps build self-efficacy for continued learning (Schunk & Bursuck, 2013).

Vicarious experiences occur through observing models (Bandura, 1997). In general, observing others succeed raises observers' self-efficacy, whereas observed failures can lower it; however, perceived similarity between model and observer is a key variable. Observers are more swayed when they perceive themselves similar to models in important ways. Students with ADHD who observe similar peers working productively are apt to believe that they can as well, which should build self-efficacy for succeeding in class (Schunk & Bursuck, 2013). It is important, however, that enhanced vicarious self-efficacy be substantiated by subsequent successful performance by observers, because performance difficulties can negate vicarious boosts in self-efficacy.

Forms of social persuasion also can raise self-efficacy, including for students with learning, reading, and other related disabilities (Klassen & Lynch, 2007). Teachers telling students that they can do something is apt to raise the students' self-efficacy for succeeding. However, the effects of persuasive information can be outweighed by actual performances. Even learners told that they are capable will not feel efficacious if they subsequently attempt the task and perform poorly. Simply telling learners with such disabilities that they can learn and perform well may not raise their self-efficacy beliefs unless they subsequently perform well.

Finally, physiological and affective symptoms constitute sources of self-efficacy that may be bidirectional or cyclical (Bandura, 1997). Students who experience anxiety or sweating when taking an exam may have low self-efficacy for success, whereas those who feel calm and anticipate performing well are likely to have higher self-efficacy. Physiological and affective indicators provide information to learners, who monitor these reactions. Students who feel anxious can attempt to gain control over the situation, thereby increasing their sense of agency. It is important that they do so to prevent mild anxiety from developing into a more serious emotional disorder.

Teacher's Belief

Under SCT, self-efficacy applies to teachers as well as students. Teacher self-efficacy is the *teacher's belief* that they can help promote student learning (Klassen, Tze, Betts, & Gordon, 2011). Teachers with higher self-efficacy should be more likely to develop challenging activities, help students succeed, and persist with students who have difficulties. Self-efficacy is important for teachers who work with students who have disabilities. Teachers with higher self-efficacy are more likely to persist, for example, with students who have ADHD and help them develop strategies to use on academic tasks (for related discussion, see Martin, Chapter 16, this volume).

Higher teacher self-efficacy also is associated with creating a positive classroom climate, supporting students' ideas, and meeting the learning needs of all students (Klassen et al., 2011). Research supports the importance of professional development to build self-efficacy for teachers who work with students who have learning and reading disabilities and ADHD (Bernadowski, 2017; Latouche & Gascoigne, 2017). In one study

(Bernadowski, 2017), 15 teachers who taught students with dyslexia were provided training on the implementation of specific strategies for phonetic instruction. Post-test findings revealed that these teachers felt more knowledgeable about students with dyslexia, had increased self-efficacy, and developed more effective instructional planning techniques that they believed would benefit all students in their classes. Training for the teachers included providing them opportunities to work one-on-one with students who have reading disabilities to differentiate instruction for these struggling readers in the classroom. Latouche and Gascoigne (2017) provided in-service training to ten teachers to help increase their knowledge and self-efficacy for teaching students with ADHD. The intervention consisted of a brief training workshop for teachers about ADHD, such as the etiology and neuropsychological and executive functioning impairments, followed by classroom management strategies on making accommodations for students with ADHD, making referrals, talking with parents, and being a liaison with others focused on the students' success. Findings revealed that teachers' knowledge and self-efficacy for teaching students with ADHD significantly increased after the workshop (for related discussion, see Martin, Chapter 16, this volume).

In addition to professional development of teachers, other strategies that may foster self-efficacy in teachers and students with disabilities include providing opportunities for mastery by having instructional tasks that are moderately challenging, using peer models to demonstrate coping skills, teaching specific learning strategies for completing tasks, providing students with disabilities with choices to optimize interest and engagement, and reinforcing effort and correct strategy use (Margolis & McCabe, 2006).

Collective Self-Efficacy

Many educational situations are structured so that people work in groups. *Collective self-efficacy* refers to perceived capabilities of the group, team, or larger social entity (Bandura, 1997). Collective self-efficacy is not the average of individuals' self-efficacy, but rather members' perceived capabilities to attain a common goal by working together. Sometimes, students may feel that the presence of a student with disabilities may negatively affect the group's performance. It is important that teachers be aware of this possibility and reinforce the group's success to build its collective self-efficacy.

Collective Teacher Self-Efficacy

Collective teacher self-efficacy is the belief that, by working together, teachers can enhance students' achievement-related outcomes in the school (Klassen et al., 2011). Collective teacher self-efficacy can be developed when teachers in the school work together to achieve common goals (performance accomplishments), learn from one another and from mentors (vicarious experiences), receive encouragement and support from administrators (forms of persuasion), and work collectively to cope with difficulties and alleviate stress (physiological indexes). Cantrell and Hughes (2008), for example, found that sixth- and ninth-grade teachers' collective self-efficacy improved after a year-long professional development program involving a team approach to teaching literacy. Such an approach may help promote self-efficacy of teachers in inclusive classes for improving students' learning.

Calibration

An important area of self-efficacy research is its *calibration*, or consistency with performance. Researchers have investigated students' calibration by examining their responses to questions about self-efficacy and comparing these responses to their performance scores. For example, DiBenedetto and Zimmerman (2010) examined ethnically diverse high school juniors' self-efficacy for learning and performance by having students study a passage on tornados and then take a test. Participants were either at-risk, average, or high-achieving science students. Findings revealed that high-achieving students underestimated their self-efficacy for learning and performing well on the tornado knowledge test, whereas at-risk students overestimated their self-efficacy. Research suggests that weaker students may overestimate their capabilities owing to a lack of self-understanding, poor metacognition, and/or a misunderstanding of the task requirements, whereas high-achieving students may invest effort in study because of their more accurate estimates of the effectiveness of studying (DiBenedetto & Zimmerman, 2010; Klassen, 2002).

The consequences of inaccurate self-appraisals can affect behavior. Students who underestimate their capabilities may be less motivated to achieve, believing that they will perform poorly. Conversely, students who overestimate their capability to perform well are likely to encounter subsequent failures, which could lower their self-efficacy. Inaccurate assessments of capabilities, which often are found among students with reading and mathematical disabilities (Licht & Kistner, 1986), can hinder the quality and quantity of academic motivation and achievement. Students with learning disabilities may not fully understand task demands, which may lead them to make overly high self-efficacy estimates (Klassen, 2002). These estimates can prove discouraging over time, as students feel they are not capable of learning and become unmotivated to try. In addition, parental perceptions of their children's abilities have also been shown to affect learners' self-appraisals (Phillips, 1987). In a study of 81 third-grade children, 57 fathers, and 71 mothers, children who had low self-appraisals about their competency on general, math, and verbal aptitudes estimated that their parents also held lower perceptions of their capabilities than children who perceived themselves as having average or high competencies. This evidence is concerning, particularly when children with disabilities may experience challenges beyond those experienced by typical learners.

SELF-EFFICACY RESEARCH AMONG STUDENTS WITH DISABILITIES

In this chapter, we present self-efficacy research evidence on students with learning disabilities, reading disabilities, and ADHD (for related discussion, see, in this volume: Bergin & Prewitt, Chapter 14; Follmer & Sperling, Chapter 5; Graham & Harris, Chapter 20; Hall et al., Chapter 7; Martin, Chapter 16; Perry et al., Chapter 13; Strnadová, Chapter 4; Swanson, Chapter 2; Tricot et al., Chapter 15). We focus on these categories of neurodevelopmental disorders because research on learners in these categories shows that many of these students suffer from a history of failures resulting in lower academic self-efficacy beliefs (Klassen & Lynch, 2007). We then discuss research

on sources of self-efficacy and findings on self-efficacy calibration with achievement for these students who often struggle and are at risk for failure.

Students with Learning Disabilities

According to the U.S. federal guidelines for identifying students with learning disabilities, students must meet three criteria: (1) they demonstrate a severe discrepancy between intellectual ability and achievement, (2) the difficulties experienced are not the result of any other known condition, and (3) they demonstrate a need for special education services (Heward et al., 2017). These criteria are important because they are indicative of the learning differences found between students with and without learning disabilities—differences that hold implications for their self-efficacy.

According to SCT, students who are self-efficacious are likely to set high goals, persist, and expend effort when faced with challenges (Schunk & DiBenedetto, 2016). Conversely, students who have not had successful experiences are likely to hold lower self-efficacy beliefs about similar learning experiences (Bandura, 1997; Lackaye et al., 2006; Schunk & DiBenedetto, 2016). These results highlight the challenges faced by students with learning disabilities. Not surprisingly, then, students who are diagnosed with a specific learning disorder typically perform poorly in reading, writing, and mathematics, which are subjects considered critical for school success. They also tend to have lower levels of self-efficacy and lower levels of hopeful feelings, suggesting they are struggling with disappointment and distress (Lackaye et al., 2006). Indeed when compared with peers without learning disabilities, students with learning disabilities are more likely to report lower self-efficacy beliefs, likely a consequence of internalizing a history of repeated failures, frustrations, poor social interactions, and lower levels of performance (Heward et al., 2017; Major, Martinussen & Wiener, 2013).

Lackaye et al. (2006) conducted a study comparing 123 Israeli adolescents with verbal and cognitive functioning disabilities with an equal number of peers without learning disabilities. Students were matched by school results, grade level, and gender. Variables such as academic self-efficacy, effort (self-perception of how much effort is used), hope (beliefs about one's ability to alter strategy use to achieve goals), and mood (students' views of their affect) were assessed using various survey instruments. Mood, for example, was assessed using a 5-point Likert scale ranging from 1 (not at all appropriate) to 5 (very appropriate) to assess positive affect (e.g., happy) and negative affect (e.g., sad). Results showed that students with learning disabilities reported lower levels of academic self-efficacy, which suggested that these students had fewer successful academic experiences than their peers. Students with learning disabilities also were found to have lower levels of effort, hope, and mood. In addition to surveys, Lackaye et al. interviewed students with learning disabilities. They reported being aware of their difficulties and feeling stressed over having to study many more hours than others to obtain passing grades and were less hopeful, with depressive tendencies.

Klassen and Lynch (2007) examined self-efficacy from the perspective of students with reading and writing disabilities and their teachers. Eighth- and ninth-grade students with learning disabilities participated in focus-group interviews; teachers who were specialists in teaching students with learning disabilities were also individually interviewed. Students and teachers acknowledged the role of self-efficacy beliefs

in achievement, specifically indicating that lower levels of self-efficacy can hinder learning and achievement. Of particular interest is that the teachers noted the “fragility of the academic beliefs of their students” (p. 498), indicating teachers’ recognition of the need to put effort into helping students with learning disabilities build and sustain stable self-efficacy beliefs.

Interventions for building academic self-efficacy for students with learning disabilities are essential to foster academic success. Butler (1998) conducted case studies on students with learning disabilities in postsecondary education programs. Participants ranged in age from 19 to 48 and were diagnosed with disabilities in mathematics, reading, short-term auditory memory, abstract reasoning, and ADHD. The intervention consisted of need-based tutoring of 2–3 hours per week for two semesters. Tutoring sessions, which included cognitive coaching and modeling, focused on self-regulated learning by helping students become more metacognitively aware of: task demands and performance criteria; strategy selection, use, and modifications; self-monitoring of performance; and self-evaluations and self-judgments. Results showed that the intervention raised students’ performances, as well as their metacognition and task-specific self-efficacy beliefs. Supplemental tutoring may be beneficial for students with learning disabilities.

Teachers often use processes found within self-regulated learning to build self-efficacy and foster academic success (DiBenedetto, 2018). In a series of case studies, Laud, Patel, Cavanaugh, and Lerman (2018) examined three teachers’ use of self-regulated learning processes (i.e., modeling, self-monitoring, goal-setting, self-instruction) to foster learning among high school students with disabilities. In their lessons, teachers worked with students to build mastery and self-directed learning. For example, in one lesson, students set up their own mini-rewards so that they could self-reinforce for work completion. Other examples included helping students to set up personal goals, which included both process (strategies to use to carry out a task) and product goals (the outcomes of what students were trying to achieve) to help students remain focused, sustain motivation, and build self-efficacy. Research supports that when students set their own process and product goals, there is an increase in self-efficacy and self-awareness of strengths and weaknesses, and thus calibration becomes more accurate (Patel & Laud, 2009).

Students with Reading Disabilities

Many students with learning disabilities struggle with reading, which can include difficulties in comprehension, spelling, writing, and fluency (for related discussion, see, in this volume: Dockrell & Lindsay, Chapter 6; Graham & Harris, Chapter 20; Hall et al., Chapter 7; Tricot et al., Chapter 15). Dyslexia constitutes 3–10% of reading disabilities (Snowling, 2013). Students who have dyslexia experience difficulties in accurate or fluent word recognition, decoding, and spelling (Snowling, 2013). These students face other academic challenges including sustaining motivation to learn. Reading disabilities also include students who struggle with phonological awareness (an understanding that sounds and words represent symbols) and with phonemic awareness (an understanding that words consist of sounds; Heward et al., 2017). Reading is essential for academic success, and difficulties can impact learners’ motivation and achievement across multiple academic content areas. Findings on students with learning

disabilities show that most of these students have difficulties in reading comprehension (Gajria, Jitendra, Sood, & Sacks, 2007).

Schunk and Rice (1991, 1992, 1993) conducted numerous studies on children with reading disabilities, demonstrating that, through modeling, goal-setting, self-directed practice, and feedback on the value of applying strategies, students' self-efficacy for reading comprehension and their performances can be increased. Recent studies have focused on specific self-regulated learning strategies such as self-monitoring to improve self-efficacy for students with reading disabilities such as dyslexia (Kanani, Adibsereshki, & Haghighi, 2017; for related discussion, see Perry et al., Chapter 13, this volume). Self-monitoring involves keeping track of whether one's targeted behavior has occurred. It is one of the most important and heavily researched strategies for self-regulated learners with disabilities (Mason & Reid, 2018).

Kanani et al. (2017) conducted a study on students with dyslexia who were randomly assigned to an experimental condition that involved self-monitoring training or a control condition where they received small-group instruction. Students in both conditions were pre- and post-tested on self-efficacy and achievement, and an additional assessment was obtained 2 months after the intervention occurred. Results indicated that students who participated in the self-monitoring training had increased self-efficacy scores and higher achievement scores compared with students in the control group. It seems, then, that keeping track of one's performance can have a positive impact on reading achievement and self-efficacy among students with dyslexia.

In addition, there is research that has focused on struggling readers who also have writing disabilities (for related discussion, see Graham & Harris, Chapter 20, this volume). One line of work has used the Self-Regulated Strategy Development (SRSD) program (for related discussion, see Perry et al., Chapter 13, this volume). Mason (2013), for example, conducted writing intervention for these students' comprehension of expository texts. She examined an integrated approach that included teaching SRSD strategies for writing along with specific reading strategies to improve reading comprehension. The SRSD involved six steps including processes such as self-monitoring, self-instruction, goal-setting, and self-reinforcement. The TWA strategy (think before reading, while reading, after reading) provided students with the framework for better reading comprehension. Teaching struggling readers strategies for writing and reading expository texts can lead to better understanding of what often can be difficult to comprehend. Students who are able to read informative texts and monitor their understanding are more likely to feel self-efficacious to do so. Providing specific strategies to students with reading disabilities enhances their cognitive judgments of personal capability to comprehend when reading and reduces the likelihood of feelings of diminished self-worth as a result of repeated frustrated and failed reading attempts (Mason, 2013; Zimmerman, Schunk, & DiBenedetto, 2017).

Students with Attention-Deficit/Hyperactivity Disorder

ADHD is a neurobehavioral disorder that appears early on in life (for related discussion, see, in this volume: Follmer & Sperling, Chapter 5; Martin, Chapter 16). In a recent study by the Centers for Disease Control and Prevention, 9% of the children were found to be diagnosed with ADHD (Walkup, Stossel, & Rendleman, 2014). Children with ADHD have difficulty focusing and staying attentive, sustaining

mental energy, and concentrating. They tend to be disorganized, perform poorly on assessments, and can have difficulty remaining still and staying on task (Capelatto, Ciasca, Lima, & Salgado-Azoni, 2014). According to the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association, 2013), children with ADHD are categorized in terms of presenting predominantly inattentive or predominantly hyperactive/impulsive behaviors, or a combination of the two. Students with ADHD may appear to be daydreaming, fidgety, and restless, and as a result may have been repeatedly exposed to reprimands from teachers and parents to focus, sit still, and pay attention. Their difficulties in executive functioning have been linked to problems in self-regulation (Barkley, 2012), and in many children ADHD is comorbid with another functional impairment such as a reading disability (Mayes & Calhoun, 2006). There is a strong likelihood that students with ADHD have lower levels of self-efficacy.

A study conducted on adolescents with and without ADHD compared their self-efficacy beliefs for self-regulated learning (Major et al., 2013). This study also examined internalizing problems, attention problems, and gender differences. Findings suggested that female students with ADHD had lower self-efficacy beliefs about being able to regulate their learning than did female students without ADHD and male students with and without ADHD. Students with greater self-reported difficulties with attention and greater internalizing difficulties reported lower self-efficacy beliefs. These results suggest that the impact of ADHD on self-efficacy may be particularly troubling for female students' beliefs about their capability to regulate learning.

Tabassam and Grainger (2016) examined self-efficacy belief differences among elementary students with ADHD, with comorbidity (ADHD and a learning disability), and without any disabilities. Students were administered measures of self-efficacy and attributions (beliefs about perceived causes of outcomes). Students with learning disabilities had been previously shown to attribute failures to internal causes such as ability and effort and successes to external causes such as luck and chance. These students experience repeated failures and high levels of frustration. Comparing themselves with other classmates who do not seem to struggle in the same way as they do can lead to their making negative internal attributions for poorer performances (e.g., low ability). This internalization of feelings contributes to their attributing their performance inward, towards themselves. Findings from this study revealed that both groups of students with disabilities experienced lower self-efficacy and attributional beliefs directed towards themselves than their peers without disabilities.

Harris, Friedlander, Saddler, Frizzelle, and Graham (2005) studied self-monitoring of attention and self-monitoring of performance among third-, fourth-, and fifth-grade students with ADHD enrolled in regular classrooms. Dependent variables of being on task and academic performance in spelling were examined. Students received training on self-monitoring for both staying on task and performance. Upon completion of the study, they were interviewed about what they learned from training. Students' spelling grades improved after both forms of training, but self-monitoring for attention resulted in substantially higher gains in spelling for most students. These findings emphasize the importance of self-regulated learning strategies such as self-monitoring for student success. Enactive mastery is a powerful source of self-efficacy that suggests that, when students with ADHD are being taught, their being helped to monitor

their attention and performance is likely to lead to task success and higher self-efficacy beliefs. Self-monitoring, in particular, seems beneficial for students with ADHD.

Sources of Self-Efficacy for Students with Learning and Related Disabilities

Students with learning, reading, and executive function disabilities often struggle academically and, owing to low self-efficacy beliefs, are less likely to set high goals, persist when faced with difficulties, or attribute failure to effort and strategy (Schunk & Bursuck, 2013; for related discussion, see, in this volume: Follmer & Sperling, Chapter 5; Graham & Harris, Chapter 20; Hall et al., Chapter 7; Martin, Chapter 16). The sources of self-efficacy can provide them with information to feel more self-efficacious and calibrate more accurately with performance. Teachers who give these students opportunities for success (enactive mastery) can build self-efficacy by assigning moderately challenging tasks that the students can succeed at with moderate effort (Klassen & Lynch, 2007; Margolis & McCabe, 2006). Students with learning and related disabilities tend to experience anxiety and nervousness, which can contribute to lower levels of confidence.

These students are also often acutely aware of the learning challenges they face. Importantly, teachers can provide models (vicarious learning) such as peers or others who can demonstrate skills and strategies to complete the targeted task. Teachers can also take advantage of access to the Internet by using YouTube videos or other video models (for related discussion, see Okolo & Ferretti, Chapter 26, this volume). Videos give learners opportunities to repeatedly watch the model because they can stop and restart the video as often as needed. This can provide specific information about how to approximate the desired behavior and may be especially important for students with ADHD who have difficulty concentrating for extended periods.

Social or verbal persuasion can help sustain learners' motivation (Bandura, 1997). Teachers can use verbal persuasion by reminding students of what needs to be done as they encourage them to perform the activity (Margolis & McCabe, 2006). Indeed, it seems helpful to give reminders to students with executive function disorders (e.g., ADHD), because they are inclined to forget instructions and schedules (Barkley, 2012). Verbal persuasion must be genuine and credible and followed by constructive feedback upon task completion for students to capitalize on this important resource. Research shows the opposite can happen as well. Students with reading, writing, and cognitive processing deficits who report feeling that their teacher did not acknowledge how hard they worked or who made comments that suggested their work was not up to par were likely to feel lower levels of self-efficacy (Klassen & Lynch, 2007).

Students with learning and related disabilities may also experience physiological and affective reactions to tasks. A history of repeated failures and frustrations can result in high levels of anxiety, frustration, distress, and learned hopelessness (Bandura, 1997; for related discussion, see, in this volume: Cassady & Thomas, Chapter 3; Pekrun & Loderer, Chapter 18; Wigfield & Ponnock, Chapter 17). When learners experience these negative feelings and thoughts, it can trigger additional stress and agitation (Zimmerman et al., 2017). Teachers can provide these students with relaxation training and refer them to counseling to help them work through feelings of anxiety. Teachers and counselors can also teach them strategies for coping with irrational or

fear-of-failure thoughts. These can help reduce the negative physiological and affective reactions that can lower self-efficacy beliefs (Margolis & McCabe, 2006). In addition, providing students with learning disabilities opportunities to practice and emulate tasks to be done with constructive feedback from the teacher may help reduce anxiety when the tasks are ready to be carried out for a grade (Schunk & DiBenedetto, 2016). Practice also gives students the chance to observe their performances and thus may lead to better calibration. If anxiety is unchecked at lower levels, it runs the risk of escalating to a potentially clinical level that can negatively impact academic development (Bandura, 1997; Major et al., 2013). Students who continually and/or excessively feel anxious may develop feelings of helplessness and low self-efficacy beliefs for learning.

Self-Efficacy Calibration Studies on Students with Learning and Related Disabilities

Students who can accurately estimate their skill for performance on a task are considered accurate calibrators (Cleary, 2009). Students with disabilities often overestimate their capability to perform well (Klassen, 2002). The problem with overestimating is that it can result in less effort being exerted in preparing for a task and potentially more disappointment in the event of poor performance. On the other hand, struggling students may mis-calibrate their self-efficacy for learning and performance because they underestimate the task demands and struggle with self-knowledge (Klassen, 2002). DiBenedetto and Zimmerman (2010) found that students who were at risk for learning in science overestimated their capability to perform well on a designated test.

Crane, Zusho, Ding, and Cancelli (2017) examined calibration accuracy among students with disabilities using academic (vocabulary words) and nonacademic (arranging six tiles to tell a story) tasks. Results indicated that, even though students performed comparably on the academic and nonacademic tasks, their self-efficacy was much higher for the nonacademic tasks. In addition, when tested on a completely new task, their calibration for completing the task worsened. In other words, they continued to report high self-efficacy beliefs even when they did not get any answers correct. These findings suggest that teaching metacognitive strategies—helping students determine when they know something and when they do not—might improve self-efficacy calibration because, if a student is self-aware, they are more likely to have accurate beliefs about their capabilities (Zimmerman et al., 2017).

In a study mentioned earlier (Klassen & Lynch, 2007), adolescents with learning disabilities rated their self-efficacy beliefs higher than would be expected given their low performance. Each of the teachers who was interviewed indicated that the students with learning disabilities lacked an awareness of their strengths and weaknesses, and that this lack of self-knowledge influenced students' self-efficacy judgments. The teachers suggested that many students overestimated their self-efficacy as a means of self-protection. Students with learning disabilities may have poor metacognitive awareness and feel they have personal limitations. These beliefs may lead them to overestimate self-efficacy to protect their self-images and self-worth (Klassen, 2006; Zimmerman et al., 2017).

Klassen (2002) reviewed 22 studies conducted on students with disabilities and self-efficacy. Of the 22 studies, 8 showed that students mis-calibrated their self-efficacy. In 7 out of the 8 studies, students overestimated their capability to perform well on typical academic tasks such as writing, spelling, mathematics, and reading. In 1 of the 7 studies, students underestimated their self-efficacy for spelling, although they overestimated their capability of performing well in a mathematics task. Although the remaining 14 studies did not comment on the calibration, Klassen suggests that students with learning disabilities tend to be overly optimistic about their capability to perform well. The important implication from these findings is that students who tend to overestimate their self-efficacy may not have an accurate understanding of the task demands as well as the self-regulation skills (i.e., strategic planning, self-monitoring) needed to perform well.

IMPLICATIONS OF THEORY AND RESEARCH FOR EDUCATIONAL PRACTICE

Review of SCT theory and research suggests some implications for educational practice for students with disabilities, as well as for their teachers and parents (for related discussion, see, in this volume: Bergin & Prewitt, Chapter 14; Graham & Harris, Chapter 20; Hall et al., Chapter 7; Perry et al., Chapter 13; Strnadová, Chapter 4; Swanson, Chapter 2; Tricot et al., Chapter 15). It is evident that students with learning disabilities, reading disabilities, and ADHD may hold inaccurate self-efficacy beliefs. They may judge their learning capabilities lower than they actually are, or, conversely, they may feel overly optimistic about what they can learn. Either situation can be problematic for motivation and learning.

A clear implication is that ways to convey information to students about their capabilities should be integrated into instructional approaches. Giving students practice accompanied by feedback conveys information that can boost capacity and enactive mastery that, in turn, can boost self-efficacy. It is also possible for vicarious information to be conveyed through live or video models. Teachers can also encourage students with verbal persuasion, and negative emotions (which may lower self-efficacy) can be addressed by showing students what they have accomplished. In all these examples, teachers help struggling students to feel and perceive a sense of efficacy.

Research also suggests several mechanisms whereby self-efficacy can be developed. As noted in this review, various instructional methods that are beneficial for self-efficacy development include having learners set realistic and short-term goals, teaching them strategies to use and having them practice applying these, and having them monitor their learning progress (for related discussion, see Bergin & Prewitt, Chapter 14, this volume). Although students with learning, reading, and executive function disabilities often need skill remediation, they also need information that conveys to them that they are capable of learning and performing well. For example, in self-contained classrooms, self-monitoring strategies have been taught to elementary school students who have ADHD and emotional disorders to help them stay on task (Mathes & Bender, 1997). The results indicated that students' on-task behavior greatly

improved, and the strategies taught were maintained over time. Providing students with strategies they can use to regulate their behavior will likely lead to improving academic performance and, ultimately, self-efficacy (Schunk & Bursuck, 2013; for related discussion, see Perry et al., Chapter 13, this volume).

A sense of collective self-efficacy can be developed when students work in groups. It is important that students with learning, reading, and executive function disabilities contribute productively to the group. Teachers should structure group tasks such that all members have responsibilities and can demonstrate learning and performance accomplishments. However, it is possible that some students in inclusive environments may see students with disabilities in their class/group as holding them back or as disrupting classroom processes. Realistically, then, teachers will also need to guard against narrow, stereotyped, and/or prejudiced views among some students.

FUTURE RESEARCH DIRECTIONS

Existing research documents the importance of self-efficacy for academic performance and achievement among learners with learning and related disabilities. In the remainder of this chapter, we address recommendations for future self-efficacy research: sociocultural influences on self-efficacy; technology uses to build self-efficacy; and self-efficacy in out-of-school contexts.

Sociocultural Influences on Self-Efficacy

An important area for future research is to determine how sociocultural variables may influence the way that disabilities are perceived and the extent to which this impacts the self-efficacy of students with these disabilities. *Culture* refers to beliefs and value systems that can influence motivation and learning (McInerney, 2008; for related discussion, see, in this volume: Hall et al., Chapter 7; Macfarlane, Macfarlane, & Mataiti, Chapter 25). Although self-efficacy beliefs are hypothesized to be generic and apply across cultures, research has shown that cultural variables can affect individuals' beliefs, and these can have implications for students' self-efficacy (McInerney & King, 2018). Individuals from different cultures may have different beliefs about the causes and treatments for learning, reading, and executive function disabilities (Heward et al., 2017). People may erroneously attribute disabilities to persons based on the pace and rate of their learning of the mainstream language and curriculum. In both of these instances, there will be implications for self-efficacy.

These issues are becoming more pronounced as schools become increasingly diverse. Today, it is, thus, more important to study self-efficacy development among students from different cultures. McInerney and King (2018) discuss the challenge with finding studies that examine cultural influences on core theoretical constructs that have been primarily established in the United States. This challenge is amplified when students with disabilities are also considered.

Cultural dimensions that have been explored widely in self-efficacy research are individualism and collectivism. Individualistic cultures tend to stress independence and individual initiative, whereas collectivist cultures emphasize group identity and

“we” consciousness (Klassen, 2004). The United States and Western European countries are high in individualism, whereas Asian cultures tend to be more collectivist (Klassen, 2004). Researchers comparing these cultures typically find that individuals from collectivist cultures judge self-efficacy lower than do those from more individualistic cultures, including when performances are equivalent or higher. Further, the lower self-efficacy beliefs are typically better calibrated or correlated with actual performance outcomes (Klassen, 2004). These results suggest that collectivist cultures may promote modesty in self-efficacy judgments. They also raise the issue of whether collective self-efficacy may be a better predictor of performance in these cultures than individual self-efficacy (Klassen, 2004). How individualism and collectivism interact with the self-efficacy of students with disabilities has not received much empirical attention.

Classrooms have students from myriad cultural backgrounds. Although self-efficacy beliefs may be universal, the challenge for educators is to understand that students’ values, beliefs, and sociocultural experiences can affect self-efficacy. Researchers have not examined in depth the roles of cultural variables in self-efficacy among students with learning and related disabilities. More cross-cultural studies are needed examining the potential culturally specific influences on learning, performance, and self-regulation.

Using Technology to Build Self-Efficacy

Technology, including computers and mobile devices, is a major presence in the classroom. Forms of technology have great potential to assist the learning and motivation of students with disabilities (Hasselbring & Glaser, 2000; for related discussion, see Okolo & Ferretti, Chapter 26, this volume). Much research related to technology and self-efficacy has focused on measuring students’ self-efficacy for using computers (Joo, Bong, & Choi, 2000). A literature review of computer-based learning environments (CBLEs) examined relationships between computer self-efficacy, self-regulated learning processes, and performance outcomes and found three significant outcomes (Moos & Azevedo, 2009). The first is that there are both behavioral factors (e.g., familiarity with being in a CBLE) and psychological factors (e.g., positive attitude and curiosity about being in a CBLE) that are positively related to computer self-efficacy. Second, computer self-efficacy is positively related to self-regulated processes such as navigational strategies and metacognition. Third, computer self-efficacy is related to learning outcomes.

A new area of inquiry is game-based learning. Video gaming can be used to increase and sustain motivation and interest and help students make connections to real-life situations (Foster, 2008). Video games capture learners’ attention, are fun and exciting to play, often involve cognitive flexibility and the ability to strategize, are familiar to many learners, and can be developed to target learning goals. Good instructional games can take advantage of learners’ attention by allowing them to identify with avatars that represent the players or other characters (e.g., a marine biologist), which helps boost intrinsic interest in the learning (Nietfeld, 2018).

The role that technology may play in the development of self-efficacy in various settings (e.g., CBLEs, gaming, online social media) should be investigated among students with disabilities. The motivational inducements afforded by technology may

have the desirable effect of gaining and holding learners' attention on the learning situation, which has potential to enhance their self-efficacy as they experience success. In addition, cell phones and other electronic devices may help students with disabilities self-monitor by setting alarms for due dates for assignments or reminders to be working on school assignments. But, conversely, the extra features (audio, video) of technology may prove distracting and raise cognitive load on students' working memories, which would have the opposite effect (Kalyuga, 2007). Added research is needed that explores variables associated with technology to determine how instructional conditions can be ideally structured for students with disabilities and the effects of these interventions on these students' self-efficacy.

Self-Efficacy in Out-of-School Settings

Most self-efficacy research has been conducted with learners in formal academic settings (e.g., classrooms). But much learning occurs outside of these settings, such as in homes, during volunteer activities, and in the context of mentoring interactions. Students with learning and related disabilities often engage in out-of-school support activities (e.g., tutoring, therapy, etc.), which may be another site/context for self-efficacy intervention.

To test the generality of self-efficacy as a predictor of motivation and learning among students with learning, reading, and executive function disabilities, more research is needed in nonacademic settings where students learn, and how that relates to self-efficacy development in nonformal settings. For example, mentoring relationships can enhance mentees' self-efficacy (Schunk & Mullen, 2013). Mentors are models who show how tasks are completed and what proficiency levels are required for successful completion of tasks. They demonstrate self-regulation and how to cope in challenging situations. Through the development of self-regulated competency, mentors can foster mentees' self-efficacy and help them become independent, adaptable, and self-directed (DiBenedetto & White, 2013), but further research is needed on mentoring variables that may impact self-efficacy among students with disabilities, such as the types of individual who may make good mentors and good instructional strategies to be used by these mentors.

As a counterpoint, it is also important to recognize that self-efficacy sources outside of school may conflict with those experienced in school. For example, students may develop self-efficacy beliefs in school through performance accomplishments, exposure to competent models, and teacher encouragement, but those same positive sources may not be present outside of school. Thus, an important research question is how students reconcile discrepant self-efficacy information. It may be valuable to provide instruction to parents and others outside of school who work with students with learning, reading, and executive function disabilities on how to inculcate positive self-efficacy beliefs to foster motivation and learning.

CONCLUSION

The theoretical framework of SCT is highly relevant to students with disabilities. Situated within this framework, self-efficacy has been shown to affect the academic development and outcomes of students with ADHD and students with learning and

reading disabilities. The research findings suggest that educational practices should be evaluated on both how well they help students learn and how well they raise learners' self-efficacy for learning and achieving. Future research on self-efficacy among students with ADHD and students with learning and reading disabilities will further elucidate the operation of self-efficacy and the opportunities for its development in educational contexts.

REFERENCES

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.
- Bandura, A. (1986). *Social foundations of thought and action*. Upper Saddle River, NJ: Prentice Hall.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.
- Barkley, R. A. (2012). *Executive functioning and self-regulation: Extended phenotype, synthesis and clinical implications*. New York: Guilford.
- Bernadowski, C. (2017). From novice to expert: The perceived self-efficacy of teachers implementing Orton-Gillingham with children with dyslexia—A case study. *Journal on English Language Teaching*, 7, 51–58.
- Butler, D. L. (1998). The strategic content learning approach to promoting self-regulated learning: A report of three studies. *Journal of Educational Psychology*, 90, 682–697. doi:<http://dx.doi.org.libproxy.uncg.edu/10.1037/0022-0663.90.4.682>
- Cantrell, S. C., & Hughes, H. K. (2008). Teacher efficacy and content literacy implementation: An exploration of the effects of extended professional development with coaching. *Journal of Literacy Research*, 40, 95–127. doi:10.1080/10862960802070442
- Capelatto, I. V., Ciasca, S. M., Lima, R. F., & Salgado-Azoni, C. A. (2014). Cognitive functions, self-esteem and self-concept of children with attention deficit and hyperactivity disorder. *Psicologia: Reflexão e Crítica*, 27, 331–340. doi:10.1590/1678-7153.201427214
- Cleary, T. (2009). Monitoring trends and accuracy of self-efficacy beliefs during interventions: Advantages and potential applications to school-based settings. *Psychology in the Schools*, 46, 154–171. <https://doi-org.libproxy.uncg.edu/10.1002/pits.20360>
- Crane, N., Zusho, A., Ding, Y., & Cancelli, A. (2017). Domain-specific metacognitive calibration in children with learning disabilities. *Contemporary Educational Psychology*, 50, 72–79. doi:10.1016/j.cedpsych.2016.09.006
- DiBenedetto, M. K. (2018). Self-regulation in secondary classrooms: Theoretical and research applications to learning and performance. In *Connecting Self-regulated Learning and Performance with Instruction Across High School Content Areas* (pp. 3–23). Cham, Switzerland: Springer.
- DiBenedetto, M. K., & White, M. C. (2013). Applying the model of development of self-regulatory competence to mentoring. In H. Bembenutty, T. Cleary, & A. Kitsantas (Eds.), *Applications of self-regulated learning across diverse disciplines* (pp. 445–472). Charlotte, NC: Information Age Publishing.
- DiBenedetto, M. K., & Zimmerman, B. J. (2010). Differences in self-regulatory processes among students studying science: A microanalytic investigation. *The International Journal of Educational and Psychological Assessment*, 5, 2–24.
- Fast, L. A., Lewis, J. L., Bryant, M. J., Bocian, K. A., Cardullo, R. A., Rettig, M., & Hammond, K. A. (2010). Does math self-efficacy mediate the effect of the perceived classroom environment on standardized math test performance? *Journal of Educational Psychology*, 102, 729–740. doi:<http://dx.doi.org.libproxy.uncg.edu/10.1037/a0018863>
- Foster, A. (2008). Games and motivation to learn science: Personal identity, applicability, relevance and meaningfulness. *Journal of Interactive Learning Research*, 19, 597–614.
- Gajria, M., Jitendra, A. K., Sood, S., & Sacks, G. (2007). Improving comprehension in expository text in students with LD: A research synthesis. *Journal of Learning Disabilities*, 40, 210–225.
- Harris, K., Friedlander, B., Saddler, B., Frizzelle, R., & Graham, S. (2005). Self-monitoring of attention versus self-monitoring of academic performance. *The Journal of Special Education*, 39, 145–157.
- Hasselbring, T., & Glaser, C. H. W. (2000). Use of computer technology to help students with special needs. *The Future of Children*, 10, 102–122. doi:10.2307/1602691

- Heward, W. L., Alber-Morgan, S. R., & Konrad, M. (2017). *Exceptional children: An introduction to special education*. Boston: Pearson Education.
- Joo, Y. J., Bong, M., & Choi, H. J. (2000). Self-efficacy for self-regulated learning, academic self-efficacy, and internet self-efficacy in web-based instruction. *Educational Research Technology and Development*, 48, 5–17. doi:10.1007/BF02313398
- Kalyuga, S. (2007). Enhancing instructional efficiency of interactive elearning environments: A cognitive load perspective. *Educational Psychology Review*, 19, 387–399. doi:https://doi-org.libproxy.uncg.edu/10.1007/s10648-007-9051-6
- Kanani, Z., Adibsereshki, N., & Haghgoo, H. A. (2017). The effect of self-monitoring training on the achievement motivation of students with dyslexia. *Journal of Research in Childhood Education*, 31, 430–439. doi:10.1080/02568543.2017.1310154
- Klassen, R. M. (2002). A question of calibration: A review of the self-efficacy beliefs of students with learning disabilities. *Learning Disability Quarterly*, 25, 88–102. doi:10.2307/1511276
- Klassen, R. M. (2004). Optimism and realism: A review of self-efficacy from a cross-cultural perspective. *International Journal of Psychology*, 39, 205–230. doi:10.1080/00207590344000330
- Klassen, R. M. (2006). Too much confidence? The self-efficacy of adolescents with learning disabilities. In F. Pajares & T. Urdan (Eds.), *Self-efficacy beliefs of adolescents* (pp. 181–200). Greenwich, CT: Information Age Publishing.
- Klassen, R. M., & Lynch, S. L. (2007). Self-efficacy from the perspective of adolescents with LD and their specialist teachers. *Journal of Learning Disabilities*, 40, 494–507.
- Klassen, R. M., Tze, V. M. C., Betts, S. M., & Gordon, K. A. (2011). Teacher efficacy 1998–2009: Signs of progress or unfulfilled promise? *Educational Psychology Review*, 23, 21–43. doi:10.1007/s10648-010-9141-8
- Lackaye, T., Margalit, M., Ziv, O., & Ziman, T. (2006). Comparisons of self-efficacy, mood, effort, and hope between students with learning disabilities and their non-LD-matched peers. *Learning Disabilities Research and Practice*, 21, 111–121. doi:https://doi-org.libproxy.uncg.edu/10.1111/j.1540-5826.2006.00211.x
- Latouche, A. P., & Gascoigne, M. (2017). In-service training for increasing teachers' ADHD knowledge and self-efficacy. *Journal of Attention Disorders*, 23, 270–281. doi:10.1177/1087054717707045
- Laud, L., Patel, P., Cavanaugh, C. A., & Lerman, T. (2018). Self-regulated learning in action. In M. K. DiBenedetto (Ed.), *Connecting self-regulated learning and performance with instruction across high school content areas* (pp. 377–414). Dordrecht, The Netherlands: Springer.
- Licht, B. G., & Kistner, J. A. (1986). Motivational problems of learning-disabled children: Individual differences and their implications for treatment. In J. K. Torgesen & B. W. L. Wong (Eds.), *Psychological and educational perspectives on learning disabilities* (pp. 225–255). Orlando: Academic Press.
- Major, A., Martinussen, R., & Wiener, J. (2013). Self-efficacy for self-regulated learning in adolescents with and without attention deficit hyperactivity disorder (ADHD). *Learning and Individual Differences*, 27, 149–156. doi:https://doi.org/10.1016/j.lindif.2013.06.009
- Margolis, H., & McCabe, P. P. (2006). Improving self-efficacy and motivation: What to do, what to say. *Intervention in School and Clinic*, 41, 218–227.
- Mason, L. H. (2013). Teaching students who struggle with learning to think before, while, and after reading: Effects of self-regulated strategy development instruction. *Reading & Writing Quarterly*, 29, 124–144.
- Mason, L. H., & Reid, R. (2018). Self-regulation: Implications for individuals with special needs. In D. H. Schunk & J. A. Greene (Eds.), *Handbook of self-regulation of learning and performance* (2nd ed., pp. 473–484). New York: Routledge.
- Mathes, M. Y., & Bender, W. N. (1997). Improving homework in adolescents with attention deficit-hyperactivity disorder who are receiving pharmacological interventions. *Remedial and Special Education*, 18, 121–128.
- Mayes, S. D., & Calhoun, S. L. (2006). Frequency of reading, math, and writing disabilities in children with clinical disorders. *Learning and Individual Differences*, 16, 145–157. doi:10.1016/j.lindif.2005.07.004
- McInerney, D. M. (2008). The motivational roles of cultural differences and cultural identity in self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, research, and applications* (pp. 369–400). New York: Lawrence Erlbaum.
- McInerney, D. M., & King, R. (2018). Culture and self-regulation in educational contexts. In D. H. Schunk & J. A. Greene (Eds.), *Handbook of self-regulation of learning and performance* (2nd ed., pp. 485–502). New York: Routledge.
- Moos, D. C., & Azevedo, R. (2009). Learning with computer-based learning environments: A literature review of computer self-efficacy. *Review of Educational Research*, 79, 576–600. doi:0.3 102/0034654308326083

- Nietfeld, J. L. (2018). The role of self-regulated learning in digital games. In D. H. Schunk & J. A. Greene (Eds.), *Handbook of self-regulation of learning and performance* (2nd ed., pp. 271–284). New York: Routledge.
- Patel, P., & Laud, L. (2009). Using goal-setting in “P(paw)LANS” to improve writing. *Teaching Exceptional Children Plus*, 5(4). Article 3. Retrieved from www.researchgate.net/publication/28800008_Using_Goal-Setting_in_PpawLANS_to_Improve_Writing
- Phillips, D. A. (1987). Socialization of perceived academic competence among highly competent children. *Society for Research in Child Development*, 58, 1308–1320.
- Schunk, D. H. (2012). Social cognitive theory. In K. R. Harris, S. Graham, & T. Urdan (Eds.), *APA educational psychology handbook. Vol. 1: Theories, constructs, and critical issues* (pp. 101–123). Washington, DC: American Psychological Association.
- Schunk, D. H., & Bursuck, W. D. (2013). Self-regulation and disability. In M. L. Wehmeyer (Ed.), *The Oxford handbook of positive psychology and difficulty* (pp. 265–278). New York: Oxford University Press.
- Schunk, D. H., & DiBenedetto, M. K. (2016). Self-efficacy theory in education. In K. R. Wentzel & D. Miele (Eds.), *Handbook of motivation at school* (2nd ed., pp. 34–54). New York: Routledge.
- Schunk, D. H., & Mullen, C. A. (2013). Toward a conceptual model of mentoring research: Integration with self-regulated learning. *Educational Psychology Review*, 25, 361–389. doi:10.1007/s10648-013-9233-3
- Schunk, D. H., & Rice, J. M. (1991). Learning goals and progress feedback during reading comprehension instruction. *Journal of Reading Behavior*, 23, 351–364.
- Schunk, D. H., & Rice, J. M. (1992). Influence of reading comprehension strategy instruction on children’s achievement outcomes. *Learning Disability Quarterly*, 15, 51–64. doi:10.2307/1510565
- Schunk, D. H., & Rice, J. M. (1993). Strategy fading and progress feedback: Effects on self-efficacy and comprehension among students receiving remedial reading services. *Journal of Special Education*, 27, 257–276. doi:10.1177/002246699302700301
- Snowling, M. J. (2013). Early identification and interventions for dyslexia: A contemporary view. *Journal of Research in Special Educational Needs*, 13, 7–14. doi:10.1111/j.1471-3802.2012.01262.x
- Tabassam, W., & Grainger, J. (2016). Self-concept, attributional style and self-efficacy beliefs of students with learning disabilities with and without attention deficit hyperactivity disorder. *Learning Disability Quarterly*, 2, 141–151. doi:10.2307/1511280
- Usher, E. L., & Schunk, D. H. (2018). Social cognitive theoretical perspective of self-regulation. In D. H. Schunk & J. A. Greene (Eds.), *Handbook of self-regulation of learning and performance* (2nd ed., pp. 19–35). New York: Routledge.
- Walkup, J. T., Stossel, L., & Rendleman, R. (2014). Beyond rising rates: Personalized medicine and public health approaches to the diagnosis and treatment of attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, 53, 14–16.
- Zimmerman, B. J., & DiBenedetto, M. K. (2008). Mastery learning and assessment: Students and teachers in an era of high stakes testing. *Psychology in the Schools*, 45, 206–216. doi:<https://doi-org.libproxy.uncg.edu/10.1002/pits.20291>
- Zimmerman, B. J., Schunk, B. J., & DiBenedetto, M. K. (2017). Role of self-efficacy and related beliefs in self-regulation of learning and performance. In A. Elliot, C. Dweck, & D. Yeager (Eds.), *Handbook of competence and motivation* (2nd ed., pp. 83–114). New York: Guilford Press.

12

SELF-DETERMINATION AND AUTONOMOUS MOTIVATION

Implications for Students with Intellectual, Developmental, and Specific Learning Disabilities

Michael L. Wehmeyer and Karrie A. Shogren

Dating back to the late 17th century, the construct “self-determination” has been used to explain and predict human behavior in discussions of philosophy pertaining to free will and the philosophical doctrine of determinism (Wehmeyer, Shogren, Little, & Lopez, 2017). For the purposes of this chapter, it is not necessary to go as far back as the 17th century, other than to note at the outset that the doctrine of determinism posits that all actions (including human behavior) are in some way, shape, or form *caused* by preceding events or actions. Self-determinism per se refers to self- (versus other-) caused action. The earliest application of the self-determination construct that was relevant to psychology emerged in the 1930s in the field of personality psychology, as issues pertaining to causation of human behavior became central to the emerging discipline. Most prominently, Andreas Angyal proposed that humans “are subjected to the laws of the physical world, as is any other object of nature, with the exception that it can oppose self-determination to external determination” (1941, p. 33).

Angyal’s organismic approach to self-determination influenced the two primary theoretical frameworks discussed in this chapter—self-determination theory (SDT) and causal agency theory (CAT)—both of which view self-determination in the context of theories of human agentic behavior and from an organismic perspective that views human behavior as self-regulated and goal-directed (for related discussion, see, in this volume: Bergin & Prewett, Chapter 14; Perry, Mazabel, and Yee, Chapter 13; Strnadová, Chapter 4). The following section examines these two theories of self-determination and, in particular with CAT, discusses the application of the self-determination construct to the education of youth with special needs, particularly the education of learners with intellectual disability, autism, emotional and behavioral disorders, and specific learning disabilities, with whom most of the research in this area has been conducted.

BRIEF OVERVIEW OF INTELLECTUAL, DEVELOPMENTAL, AND SPECIFIC LEARNING DISABILITIES

As noted, although research pertaining to self-determination and students with special needs has been conducted across disability categories, it is the case that the majority of this research has been conducted among students with intellectual disability, developmental disabilities, and specific learning disabilities. Each disability category is briefly discussed in this section before we discuss theories in self-determination.

Intellectual Disability

According to the 11th edition of the American Association on Intellectual and Developmental Disabilities definition manual, intellectual disability is “characterized by significant limitations both in intellectual functioning and in adaptive behavior as expressed in conceptual, social, and practical adaptive skills” and “originates before age 18” (Schalock et al., 2010, p. 5; for related discussion, see Strnadová, Chapter 4, this volume). “Significant limitations” refers to two or more standard deviations on standardized, norm-referenced assessments of intelligence and adaptive behavior. “Intelligence” refers to a person’s general mental capability for solving problems, paying attention to relevant information, thinking abstractly, remembering important information and skills, learning from everyday experiences, and generalizing knowledge from one setting to another. “Adaptive behavior” refers to the conceptual, social, and practical skills that people learn and perform to function in everyday life. Students with intellectual disability, as such, have impairments to intellectual and practical functioning across most domains. Although it is difficult to accurately gauge the prevalence rate of people with intellectual disability, recent large population reviews place the percentage of the population with intellectual disability at between 0.05 and 1.55 percent (McKenzie, Milton, Smith, & Ouellette-Kuntz, 2016). The same study placed the incidence of intellectual disability at about 1 percent of the general population. According to the U.S. Department of Education’s National Center for Education Statistics (2018), about 6 percent of students receiving special education services are identified as having intellectual disability, constituting, again, roughly 1 percent of the total population of all students.

Developmental Disability

Developmental disability is defined in the U.S. Developmental Disabilities Assistance and Bill of Rights Act of 2000 as:

a severe, chronic disability of an individual that:

- (1) Is attributable to a mental or physical impairment or combination of mental and physical impairments;
- (2) Is manifested before the individual attains age 22;
- (3) Is likely to continue indefinitely;

- (4) Results in substantial functional limitations in three or more of the following areas of major life activity:
 - (i) Self-care;
 - (ii) Receptive and expressive language;
 - (iii) Learning;
 - (iv) Mobility;
 - (v) Self-direction;
 - (vi) Capacity for independent living; and
 - (vii) Economic self-sufficiency.
 - (5) Reflects the individual's need for a combination and sequence of special, interdisciplinary or generic services, individualized supports, or other forms of assistance that are of lifelong or extended duration and are individually planned and coordinated;
 - (6) An individual from birth to age nine, inclusive, who has a substantial developmental delay or specific congenital or acquired condition, may be considered to have a developmental disability without meeting three or more of the criteria described in paragraphs (1) through (5) of this definition, if the individual, without services and supports, has a high probability of meeting those criteria later in life.
- (45 CFR (B)(XII)(C), 1325.3)

In general, the term refers to any of several conditions that emerge during child development, typically described as from birth to 18 years of age, that results in substantial limitations in three or more of the major life areas identified in (4) above (for related discussion, see Sigafoos, Green, O'Reilly, and Lancioni, Chapter 8, this volume). There are no prevalence estimates overall for developmental disabilities, but only for conditions that qualify under the term, including (in addition to intellectual disability), autism, cerebral palsy, spina bifida, Fragile X syndrome, and fetal alcohol syndrome. In the main, each of these is a relatively low prevalence condition. For example, the prevalence of cerebral palsy ranges from 1.5 to 4.0 per 1,000 live births, worldwide (Arneson et al., 2009), and the prevalence of spina bifida ranges between 6.9 and 21.9 per 10,000 live births, depending upon what part of the world data are from (Zaganjor et al., 2016). Although students with intellectual disability usually qualify under the developmental disability category, other types of disability may not impact cognition but still result in substantial limitations in life areas, including cerebral palsy or spina bifida, both of which are motor-related impairments that impact life functioning.

The *Diagnostic and Statistical Manual of Mental Disorders*, 5th edition (DSM-5; American Psychiatric Association, 2013; 299.00, F84.0) identified diagnostic criteria for autism spectrum disorder as:

- A. Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history:
 1. Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.
 2. Deficits in nonverbal communicative behaviors used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal

- communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.
3. Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.
- B. Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history:
1. Stereotyped or repetitive motor movements, use of objects, or speech (e.g., simple motor stereotypies, lining up toys or flipping objects, echolalia, idiosyncratic phrases).
 2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat food every day).
 3. Highly restricted, fixated interests that are abnormal in intensity or focus (e.g., strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interest).
 4. Hyper- or hypo-reactivity to sensory input or unusual interests in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement).
- C. Symptoms must be present in the early developmental period (but may not become fully manifest until social demands exceed limited capacities or may be masked by learned strategies in later life).
- D. Symptoms cause clinically significant impairment in social, occupational, or other important areas of current functioning.
- E. These disturbances are not better explained by intellectual disability (intellectual developmental disorder) or global developmental delay. Intellectual disability and autism spectrum disorder frequently co-occur; to make comorbid diagnoses of autism spectrum disorder and intellectual disability, social communication should be below that expected for general developmental level.

According to the Centers for Disease Control and Prevention Autism and Developmental Disabilities Monitoring (CDC ADDM), the prevalence of autism has been rising steadily and is about 2.47 percent of school age children (Xu, Strathearn, Liu, & Bao, 2018).

Specific Learning Disabilities

In this chapter, we use the term specific learning disabilities to refer to “a disorder in one or more basic psychological processes involved in understanding or using language, spoken or written” (Individuals with Disabilities Education Act, 2004, Sec. 300.8 (c) (10)) that may impact a student’s ability to listen, think, speak, read, write, spell,

or do mathematical calculations (for related discussion, see, in this volume: Bergin & Prewett, Chapter 14; Graham & Harris, Chapter 20; Hall, Capin, Vaughn, & Cannon, Chapter 7; Jordan, Barbieri, Dyson, & Devlin, Chapter 19; Morsanyi, Chapter 21; Perry et al., Chapter 13; Schunk & DiBenedetto, Chapter 11; Strnadová, Chapter 4; Swanson, Chapter 2; Tricot, Vandenbroucke, & Sweller, Chapter 15). Common specific learning disabilities include dyslexia (impacts reading and language-based processing), dysgraphia (impacts handwriting and fine motor skills), dyscalculia (impacts comprehension of math symbols, understanding of numerical values), and auditory processing disorder (affects how sound is processed and speech/language understood). In the US, 35 percent of all students with disabilities receiving special education have specific learning disabilities (National Center for Educational Statistics, 2017).

THEORIES IN SELF-DETERMINATION

As noted, two theoretical frameworks utilizing the self-determination construct have influenced research and practice in motivation and in understanding the development of causal agency and self-determination: SDT and CAT. The former has been applied across a wide range of individuals and contexts. The latter has been more focused on educational settings, including those involving students with special needs.

Self-Determination Theory

SDT is the most frequently referenced theory utilizing the self-determination construct (Deci, 1980; Deci & Ryan, 1985; 2002; Ryan & Deci, 2002, 2017; for related discussion, see Strnadová, Chapter 4, this volume). SDT is a metatheory examining intrinsic and social factors that influence autonomous motivation. What became, by the early 2000s, a more fully formed version of SDT (Deci & Ryan, 2002) began with experimental studies of “the effects of environmental events on intrinsic motivation” (Deci & Ryan, 1985, p. 9) and, more specifically, the negative impacts of extrinsic rewards on intrinsic motivation. That research was synthesized in a meta-analysis of 128 experimental studies examining the effects of extrinsic rewards on intrinsic motivation (Deci, Koestner, & Ryan, 1999). Deci and colleagues concluded that the analysis “exploring the effects of extrinsic rewards on intrinsic motivation is clear and consistent,” and that “tangible rewards had a significant negative impact on intrinsic motivation for interesting tasks” (p. 653). We emphasize the roots of SDT (Deci, 1980) because of the wide use of mechanistic and extrinsic rewards-based strategies with some students with special needs, particularly students with intellectual disability, autism, or emotional or behavioral disorders (Wehmeyer, 2004), and then will consider the potential negative consequences of such strategies for issues pertaining to self-determination and autonomous motivation in the “Implications for Practitioners” section.

As formulated today, SDT provides a comprehensive explanation of human agentic action and autonomous motivation (Adams, Little, & Ryan, 2017). At the heart of SDT is that “optimal human development is the interaction between growth-striving humans and their social environment in which basic psychological needs are either supported or thwarted” (Adams et al., 2017, pp. 48–49). SDT posits three basic psychological needs: the needs for competence, autonomy, and relatedness (Deci & Ryan,

2000; Ryan, 1995). When social environments support the satisfaction of these needs, optimal growth and positive development occur.

Autonomy

Of the three basic psychological needs, the need for autonomy appears to be the most extensively discussed in the SDT literature and is often seen as the most immediately relevant to students with special needs, as discussed subsequently. Within SDT, the autonomy construct is used for different purposes: to refer to an optimal motivational state (e.g., autonomous motivation; Ryan & Deci, 2006), to a generalized motivational state, and as a basic psychological need. Deci and Ryan (2012) articulated the importance of autonomy to SDT thus:

To be autonomous means to behave with a sense of volition, willingness, and congruence; it means to fully endorse and concur with the behavior one is engaged in. Autonomy—this capacity for and desire to experience self-regulation and integrity—is a central force within both the life span development of individuals and in the movement of history toward greater freedom and voice for citizens within cultures and governments. In healthy individual development, people move in the direction of greater autonomy.

(p. 85)

According to SDT, the basic psychological need for autonomy is satisfied when a person experiences choice and volition and believes themselves to be the origin of their actions (Koestner, Powers, Carbonneau, Milyavskaya, & Chua, 2012; for related discussion, see Pekrun & Loderer, Chapter 18, this volume). Autonomous actions are those that are self-endorsed and congruent with one's values and interests (Vansteenkiste, Niemiec, & Soenens, 2010). Expanding on this, autonomous actions express integrity and are based on one's core or "higher order values" (Ryan & Deci, 2004, p. 450). Often, the social context forces values to conflict, and a choice must be made that reflects one's true or autonomous self. The rationale and outcome of negotiating and integrating the demands of intrinsic and extrinsic sources of motivation determine the relative autonomy of an action (Ryan & Deci, 2004). So, an autonomous action is one in which the "rationale behind an action-response (behavior) to an extrinsic pressure reflects one's core values" (Wehmeyer, Little, & Sergeant, 2009, p. 359).

Competence

The basic psychological need for competence refers to a person's need to be effective within environments and draws from White's (1959) theory of effectance motivation, positing an intrinsic drive for mastery of one's environment. Within SDT, the psychological need for competence motivates people to engage in actions that are challenging and to persist at such actions until successful (Sheldon, Ryan, & Reis, 1996). The psychological need for competence does not refer to skills or skill levels per se, but to perceptions of competence and mastery and, more specifically, to the experience of perceiving increased mastery and effectiveness (Deci, Ryan, & Guay, 2013; for

related discussion, see, in this volume: Schunk & DiBenedetto, Chapter 11; Wigfield & Ponnock, Chapter 17).

Relatedness

The basic psychological need for relatedness refers to the need for people to feel connectedness with other people and to feel a sense of social belonging (Deci et al., 2013; for related discussion, see Gillies, Chapter 22, this volume). Relatedness refers to the need to care for and be cared for by others (Hofer & Busch, 2011). Again, it refers not to physical relationships per se, but to the feeling that one belongs, is cared for, and is connected.

As a macro-theory, SDT is comprised of six mini-theories, each of which addresses a different problem of motivation. These mini-theories are:

- *Cognitive evaluative theory*, which posits that autonomy-supportive social contexts enhance intrinsic motivation, whereas controlling social environments (which are often characterized by external rewards) thwart or reduce intrinsic motivation.
- *Organismic integration theory*, which proposes a continuum of six types of motivation: amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic motivation. The latter three have some level of autonomy associated with them (Geldhof, Fenn, & Finders, 2017).
- *Causality orientations theory*, which describes three types of personality orientation—autonomous, controlled, and impersonal—that influence behavior (Deci & Ryan, 1985). People have each of these three orientations to some degree, but, as a general personality orientation, one can be identified that dominates (Koestner, Bernieri, & Zuckerman, 1992).
- *Basic psychological needs theory*, which provides the theoretical frame for the operation of basic psychological needs fulfillment, as described previously.
- *Goal content theory*, which operationalizes what goals are more likely to promote well-being and fulfill basic psychological needs, forwarding two types of goal—intrinsic goals and extrinsic goals (Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004). Intrinsic goals are those goals that are concordant with personal preferences and are self-endorsed, whereas extrinsic goals are those that involve being in pursuit of an external reward or contingent reinforcement (Martos & Kopp, 2012; Niemiec, Ryan, & Deci, 2009).
- *Relationships motivation theory*, which posits that relationship autonomy, or full endorsement of one's involvement in a relationship rather than feeling coerced or uncertain, is associated with healthier relationships (Ryan & Deci, 2017).

SDT has only been minimally examined in the context of special needs learners. That said, the basic understanding of self-determination forwarded by SDT formed the basis for CAT (discussed next), which focuses extensively on the disability context, and there is an emerging literature suggesting that the motivations and relationships established by research in SDT are applicable to people with special needs. As early as 1986, Deci and Chandler wrote about the need in the field of specific learning disabilities to consider the importance of basic psychological needs for autonomy,

competence, and relatedness for all students. Students with specific learning disabilities, they pointed out, may have been held to low expectations, not been seen as competent, not been provided optimal challenges, and had diminished opportunities for autonomy owing to the inherent structure within special education settings.

More recently, Frielink, Schuengel, and Embregts (2018; for related discussion, see Strnadová, Chapter 4, this volume) tested the applicability of SDT for people with intellectual disability, finding that the tenets proposed in SDT held for this population: autonomy support (in the form of multiple actions to increase autonomy) was associated with higher autonomous motivation and psychological need satisfaction; higher levels of autonomous motivation and psychological need satisfaction were associated with more positive psychological well-being; and relatedness need satisfaction was associated with autonomous motivation. In essence, promoting autonomy enhanced feelings of being cared for and of caring for (relatedness), autonomy, and psychological well-being. Finally, Shogren et al. (2019) examined the relationship among basic psychological needs satisfaction, student autonomous engagement, and self-determination of high school students with autism, using tools from both SDT and CAT, and found that higher levels of need satisfaction were related to higher levels of self-determination. Again, these findings fit with what would be predicted by SDT. So, although only preliminary, it seems clear that the education of learners with special needs can be informed by research in SDT. Next, we turn to theory and research in CAT, which has an extensive focus on students with special needs.

Causal Agency Theory

CAT (Shogren, Wehmeyer, Palmer, Forber-Pratt, et al., 2015; Wehmeyer, 2004) emerged from research into and theory of the application of the self-determination construct in the disability context. In the early 1990s, efforts in the field of secondary special education began to emphasize the importance of the involvement of students with disabilities in their educational planning and goal-setting and attainment if they were to achieve more positive employment, independent living, and other adult outcomes (Wehmeyer, 1992). As a result, efforts to promote student self-determination emerged that focused not on motivation, but on actions that would enable students with disabilities to become more self-determined. Thus, intervention and research development occurred, as noted previously, mainly among students with intellectual and developmental disabilities (Wehmeyer, Kelchner, & Richards, 1996; Wehmeyer, Palmer, Agran, Mithaug, & Martin, 2000) and students with specific learning disabilities (Wehmeyer & Field, 2007). In 2015, Shogren, Wehmeyer, Palmer, Forber-Pratt, et al. synthesized research and theory development in self-determination relevant to students with disabilities and aligned this work with research in motivation to propose CAT.

Like SDT, CAT views self-determination through the lens of theories of human agency and views agentic people (as driven by organismic attributions) who seek to be the origin of their actions (Little, Hawley, Henrich, & Marsland, 2002). Unlike SDT, CAT is not focused on motivation, but provides a framework for understanding the causal actions that enable people to become self-determined (Shogren, Wehmeyer, & Palmer, 2017, p. 55). CAT forwards a theoretical model of the development of dispositional self-determination, defining self-determination as acting as:

the causal agent in one's life. Self-determined people (i.e., causal agents) act in service to freely chosen goals. Self-determined actions function to enable a person to be the causal agent in his or her life.

(Shogren, Wehmeyer, Palmer, Forber-Pratt, et al., 2015, p. 258)

Although the assumption is that self-determined people have a tendency to act or think in a particular way, there is also a presumption of contextual variance (i.e., environmental opportunities and threats). More importantly, as a dispositional characteristic, self-determination can be measured, and variance will be observed across individuals and within individuals over time, particularly as the context changes (Shogren, Little, & Wehmeyer, 2017).

Another central term within CAT is the notion of causal agency, which reflects the emphasis on the organismic nature of self-determination. One of the issues noted in the research on disability, as discussed more fully subsequently, is that young people with disabilities do not act as causal agents in their lives. SDT was built on the theory of personal causation offered by Richard de Charms (1968). De Charms noted that:

Man's [sic] primary motivational propensity is to be effective in producing changes in his environment. Man strives to be a causal agent, to be the primary locus of causation for, or the origin of, his behavior; he strives for personal causation.

(p. 269)

Within CAT, acting as the causal agent in one's life implies that it is oneself, rather than someone or something else, who makes or causes things to happen in one's life. More than merely causing action, however, causal agency implies that one acts intentionally to accomplish a specific end or to cause or create change. This, in turn, is consistent with self-determined action as volitional. Volitional action refers to acting based on conscious choice; conscious choice implies intentionality and not just random action. Self-determined actions enable a person to act as a causal agent (for related discussion, see Pekrun & Loderer, Chapter 18, this volume).

Human agentic theories differentiate between self-determination as self-caused action and self-determination as controlling one's behavior. Self-determined action does not imply control over events or outcomes, but refers to the degree to which action is self-caused, volitional and agentic, and driven by beliefs about the relationships between actions (or means) and ends. These elements of self-determined action form the essential characteristics of self-determination within CAT: volitional action, agentic action, and action-control beliefs.

Volitional Action

As has been noted, people who act as causal agents in their lives act volitionally. Volitional actions involve those actions that enable the organism to initiate and activate causal actions. We refer to the skills to initiate and activate causal action as causal capabilities. Causal capabilities refer to the cognitive or physical skills that enable a person to initiate causal action. These include choice-making, goal-setting, problem-solving, decision-making, and planning skills (Shogren, Little, et al., 2017; for related discussion, see, in this volume: Bergin & Prewett, Chapter 14; Perry et al., Chapter 13).

Agentic Action

Agentic action refers to action that enables an individual to sustain causal action toward a desired goal or outcome and to modify their goal or plan as necessary to achieve the goal or attain the desired outcome (for related discussion, see Schunk & DiBenedetto, Chapter 11, this volume). When acting agentially, self-determined people “identify pathways that lead to a specific ends or cause or create change” (Shogren, Little, et al., 2017, p. 62). When acting agentially, the person’s action is self-regulated and self-directed and enables the person to progress toward freely chosen goals (Shogren, Little, et al., 2017).

The skills to sustain causal action toward a goal or outcome are referred to as agentic capabilities; they involve the cognitive or physical capacities involved in directing behavior toward an end. Agentic capacity involves self-regulatory and self-management knowledge and skills that enable persons to compare their current state with a goal state and to self-monitor and self-evaluate progress (for related discussion, see, in this volume: Bergin & Prewett, Chapter 14; Perry et al., Chapter 13). Agentic perceptions are those identified under causal perceptions and pertain not so much to whether one acts on the environment initially, but whether one sustains action over time (Shogren, Little, et al., 2017).

Action-Control Beliefs

Action-control theory “focuses on the role of specific self-regulatory beliefs as mediators of motivated action” (Little et al., 2002, p. 396). It is, in essence, a theoretical framework within which to consider those self-perceptions and beliefs that mediate causal action. CAT incorporates action-control beliefs from action-control theory (for related discussion, see Pekrun & Loderer, Chapter 18, this volume). There are three types of action-control belief:

beliefs about the link between the self and the goal (control expectancy; “When I want to do ____, I can”); beliefs about the link between the self and the means for achieving the goal (capacity beliefs; “I have the capabilities to do ____”); and beliefs about the utility or usefulness of a given means for attaining a goal (causality beliefs; “I believe my effort will lead to goal achievement” vs. “I believe other factors—luck, access to teachers or social capital—will lead to goal achievement”).

(Shogren, Little, et al., 2017, p. 62; for related discussion, see Schunk & DiBenedetto, Chapter 11, this volume)

Positive action-control beliefs function to enable a person to act with self-awareness and self-knowledge in an empowered, goal-directed manner (Shogren, Wehmeyer, Palmer, Rifenbark, & Little, 2015).

Again, research through the 1990s among students with intellectual, developmental, and specific learning disabilities confirmed that students had limited capacity with regard to skills related to volitional and agentic action and did not hold beliefs that would enable them to act as causal agents (Wehmeyer, 1993; Wehmeyer & Kelchner, 1994). As discussed below, interventions developed through research in that period showed that students with intellectual, developmental, and specific learning disabilities

could become more self-determined, provided they received adequate opportunities to learn skills that resulted in enhanced volitional and agentic action.

The Development of Self-Determination

CAT has been used to frame research and practice pertaining to the education of adolescents with disabilities and to examine mediators and moderators of causal action and self-determination. As mentioned previously, it has also been used in tandem with SDT to present a model of the development of self-determination. That model of the development of self-determination and its implications for students with special needs begins with assumptions inherent in CAT. These assumptions are that the ongoing process of navigating challenges and engaging in self-regulated, goal-directed actions gives rise to a sense of personal empowerment and action-control beliefs, or the sense that one knows and has what it takes to achieve goals. This, in turn, contributes to the development of a sense of causal agency; that is, that the person acts with an eye toward causing an effect to accomplish a specific end or to cause or create change in his or her life. Further, repeated experiences of causal agency lead to enhanced self-determination (Shogren, Little, et al., 2017).

As noted previously, however, CAT was not developed to address motivational aspects of self-determination and causal action. Any model of development would be incomplete without components addressing motivation. Figure 12.1 illustrates this model of the development of self-determination. The developmental process begins with the person's basic psychological needs for autonomy, competence, and relatedness proposed by SDT. Satisfaction of these needs leads to autonomous motivation, defined as intrinsic motivation and well-internalized extrinsic motivation (Deci & Ryan, 2012). The causal action sequence is initiated as individuals seek to fulfill each of the basic psychological needs, triggering a causal action sequence. Action-control beliefs about the link between the self and the goal (control expectancy beliefs), about the links between the self and the means that are available for use to address a challenge

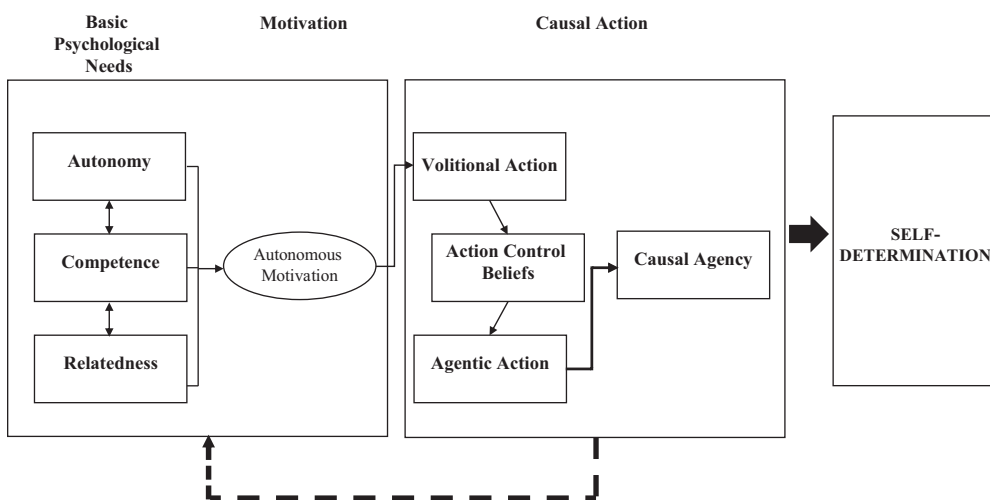


Figure 12.1 Model of the Development of Self-Determination

(agency beliefs), and about which specific means are most effective for reaching one's goals (causality beliefs) (Little et al., 2002) interact with and mediate volitional and agentic actions (employing causal and agentic capabilities), resulting in causal agency. Repeated experiences with the causal action sequence leads to multiple experiences with causal agency and, as a result, enhanced self-determination.

So, for example, a student with specific learning disabilities may feel isolated from her peers. In an effort to build relationships (e.g., fulfill basic psychological need for relatedness), she talks with her teacher about wanting to make friends. She believes she has a good personality and could make friends if given the opportunity (action-control beliefs). Together, they plan for the student to participate in an after-school club focused on theater and drama (causal action). The student actively participates (agentic action) and becomes an active part of the club, takes a small role in a school play, and makes several friends. She has had an experience of acting as a causal agent in her life, and she will repeat the types of action that enabled her to have that experience. Doing so repeatedly will enhance her self-determination.

RESEARCH

As has been noted, CAT was developed in the disability context (and particularly in the context of special education) as a means to improve life outcomes for children and young people with disabilities, so there is research pertaining to self-determination and disability within that theoretical context. In contrast, there has been a relative dearth of research into SDT in the disability context, and very little in the educational context. Accordingly, we divide this section not by theoretical framework, but by two important components of education as relevant to students with special needs: creating autonomy-supportive classrooms and implementing autonomy-supportive interventions. We begin, though, with a brief overview of what the research has to say about the self-determination of students with disabilities.

Self-Determination and Students with Intellectual, Developmental, and Specific Learning Disabilities

The first thing to note with regard to research knowledge about students with special needs is that empirical work over the past two decades has clearly established that students across multiple disability categories are too often not very self-determined. Data exist that document limited self-determination among students with intellectual disability (Wehmeyer & Metzler, 1995), specific learning disabilities (Field, 1996; Field, Sarver, & Shaw, 2003; Pierson, Carter, Lane, & Glaeser, 2008), emotional and behavioral disorders (Carter, Lane, Pierson, & Glaeser, 2006; Pierson et al., 2008), and autism (Chou, Wehmeyer, Palmer, & Lee, 2017).

Why is it that students with special needs have limited self-determination? First, as noted, it is important to recognize that this is not a function of whether or not students with disabilities can become self-determined, because the evidence is clear that, if provided adequate opportunities, students with disabilities can acquire skills that lead to enhanced self-determination. In one of the first meta-analytic studies to examine this, Algozzine, Browder, Karvonen, Test, and Wood (2001) conducted group- and single-subject design meta-analyses of studies in which students across multiple dis-

ability categories (though, primarily with students with intellectual, developmental, and specific learning disabilities) had received some intervention to promote component skills of self-determined behavior, including decision-making, goal-setting and attainment, self-advocacy, problem-solving, and self-awareness skills. The results of these meta-analyses showed that there were medium-to-strong effects of interventions to promote these component skills, indicating that students with disabilities were able to learn skills leading to self-determination if provided instruction. A few years later, Cobb, Lehmann, Newman-Gonchar, and Alwell (2009) conducted a narrative synthesis of seven meta-analyses of the impacts of interventions to promote the self-determination of students across disability categories and concluded that there is sufficient evidence that interventions to teach or promote choice-making, problem-solving, decision-making, goal-setting and attainment, and self-advocacy skills result in enhanced skills in these areas.

So, it is clear that, when provided instruction to promote component skills leading to self-determination, students with intellectual, developmental, and specific learning disabilities (as well as students with other types of disability) can benefit and acquire such skills. Research has also examined directly whether students with special needs become more self-determined when provided such instruction. In a cluster-randomized control group study on the effect of interventions to promote self-determination in high school students with intellectual disability or specific learning disabilities, Wehmeyer, Palmer, Shogren, Williams-Diehm, and Soukup (2012) found that students in the treatment group showed significant growth in their self-determination, at higher levels than students with intellectual, developmental, and specific learning disabilities who did not receive interventions to promote self-determination. Using a group-randomized, modified equivalent control group design, Wehmeyer, Shogren, et al. (2012) studied the impact of instruction using the self-determined learning model of instruction (described in a subsequent section) on the self-determination of students with intellectual disability or specific learning disabilities, finding that students who received the intervention showed significantly more positive gains in self-determination status.

If the findings that students with intellectual, developmental, and specific learning disabilities are not self-determined cannot be attributed to their own capacity to acquire the skills that lead to greater self-determination, then we need to turn to other possible explanations for why they have limited self-determination. There is less research in education that examines this, but research among adults with intellectual disability points squarely to the lack of opportunities for people to learn and practice these skills, to make choices and express preferences, to be involved in decisions impacting the quality of their lives, and, in general, to live self-determined lives (Stancliffe, 2001; Wehmeyer & Bolding, 1999, 2001). This is particularly clear in areas pertaining to the lack of choice-making opportunities (Stancliffe, 2001; Stancliffe & Wehmeyer, 1995) and decision-making opportunities (Shogren, Wehmeyer, Lassman, & Forber-Pratt, 2017).

Finally, does it matter that young people with disabilities have relatively few opportunities to learn and practice skills leading to self-determination and are less self-determined than their peers without disabilities? The research examining the impact of interventions to promote self-determination on school and adult outcomes suggest that it does matter. Such interventions are focused on teaching

students knowledge and skills that enable them to act in a self-determined manner, such as goal-setting, problem-solving, self-advocacy, and self-regulation or self-management skills. So, first, research shows that teaching such skills matters in school. Multiple randomized control trial studies and meta-analytic studies involving students across disability categories (though predominantly students with intellectual and developmental disabilities or students with specific learning disabilities, as these constitute the largest groups of students receiving special education) have established that interventions to promote knowledge and skills leading to enhanced self-determination result in improved educational goal attainment, capacity to interact with the curriculum, and transition knowledge and empowerment (Lee, Wehmeyer, & Shogren, 2015; Lee, Wehmeyer, Soukup, & Palmer, 2010; Shogren, Palmer, Wehmeyer, Williams-Diehm, & Little, 2012). It also matters once students leave school. In a study examining employment and community inclusion outcomes for students with intellectual, developmental, and specific learning disabilities from Wehmeyer, Palmer, et al. (2012), Shogren, Wehmeyer, Palmer, Rifenbark, et al. (2015) found that participants who received interventions to promote skills and knowledge leading to enhanced self-determination and, as a result, left school as more self-determined young people, achieved significantly better employment and community access outcomes 1–2 years post-high school. A randomized-trial study by Powers et al. (2012) also provided causal evidence of the effect of promoting knowledge and skills leading to enhanced self-determination on community inclusion, particularly for youth with behavioral disabilities in foster care and special education. In addition, research has linked enhanced self-determination to more positive quality of life and life satisfaction outcomes for people with intellectual disability (Lachapelle et al., 2005; Nota, Ferrari, Soresi, & Wehmeyer, 2007; Shogren, Lopez, Wehmeyer, Little, & Pressgrove, 2006; Wehmeyer & Schwartz, 1998).

Finally, a focus in the research pertaining to self-determination has been examining the impact of increased student involvement in educational planning. Across multiple studies, research has found that students across disability categories (including primarily students with intellectual, developmental, and specific learning disabilities) who are involved in their own educational and future planning achieve more positive school outcomes (Wehmeyer, Palmer, Lee, Williams-Diehm, & Shogren, 2011) and enhanced self-determination (Seong, Wehmeyer, Palmer, & Little, 2015). In fact, research showed a reciprocal relationship between student involvement and self-determination, in which students with intellectual and specific learning disabilities who were more involved in their educational planning process became more self-determined, and those students who were more self-determined were more likely to be involved in their planning (Williams-Diehm, Wehmeyer, Palmer, Soukup, & Garner, 2008).

In summary, then, the research is clear that, although students with disabilities—and primarily students with intellectual, developmental, and specific learning disabilities—tend to be less self-determined than their peers without disabilities, if provided adequate opportunities to learn and practice knowledge and skills leading to greater self-determination, they can become more self-determined and, as a result, can achieve more positive school and adult-life outcomes. We now turn to what the research says about the role of teachers and instruction in promoting the self-determination of these students.

Autonomy-Supportive Classrooms

As is consistent with the intent of SDT, research using SDT has focused on the contexts and social interactions to promote autonomous motivation. This research has examined the impact of creating classroom environments and teacher–student interactions that promote the intrinsic motivation of students. Although research with regard to autonomy-supportive classrooms has not focused on students with disabilities, we draw connections between findings from this research to the education of students with disabilities in inclusive settings. As discussed earlier in the chapter, the limited research on SDT and disability has linked autonomy supports for students with intellectual disability with more positive psychological well-being and more positive life satisfaction (Frielink et al., 2018). Further, we know from research reported in the previous section that students with intellectual, developmental, and specific learning disabilities achieve more positive school and adult outcomes when provided with instruction that enables them to act more autonomously. As such, it seems intuitive that autonomy-supportive teachers and classrooms should benefit students with special needs in the same ways they benefit other students (for related discussion, see Strnadová, Chapter 4, this volume).

Reeve (2002) summarized several studies of autonomy-supportive teachers and found that they avoided directives, praised mastery, avoided criticism, gave answers less often, responded to student-generated questions, and communicated with empathy and perspective-taking. Reeve concluded that autonomy-supportive teachers are responsive, flexible, and motivate through interest, whereas controlling teachers take charge, shape students toward a right answer, evaluate, and motivate through pressure. Autonomy-supportive classrooms are learning communities in which students have meaningful roles in setting classroom rules, feel safe to explore and take risks, are supported to solve problems and set personal goals, and are responsible for monitoring and evaluating their progress.

These findings are clearly linked, philosophically, with research demonstrating that instruction to support greater autonomy and self-determination for students with special needs results not only in more positive school and learning outcomes, but also in higher expectations for students with intellectual, developmental, and specific learning disabilities. We have already discussed studies that show that interventions to promote the self-determination of students with intellectual, developmental, and specific learning disabilities result in more positive school and adult outcomes for these students. Shogren, Plotner, Palmer, Wehmeyer, and Paek (2014) examined changes in expectations of teachers for student performance before and after students with intellectual disability or specific learning disabilities were provided instruction to promote self-determination. Teacher expectations for student performance rose significantly after they had supported students to acquire self-determination-related skills, independent of disability category.

Chang, Fukuda, Durham, and Little (2017) identified important characteristics of autonomy-supportive classrooms and teaching:

- *Communicate frequently to clarify expectations and acknowledge students' feelings.* Students who know what is expected of them can plan and act to meet expectations. Students who are unsure of learning goals or classroom expectations become “dependent on immediate teachers' behaviors” (Chang et al., 2017, p. 104).

- *Offer more choices and remove controlling events in learning.* Controlling events and external parameters (from competition to tests) reduce intrinsic motivation. Providing students with opportunities to make choices and self-direct learning promotes internal reliance and intrinsic motivation.
- *Allow students to participate actively.* In many classrooms, students are passive observers/absorbers and do not take primary responsibility for engaging with content. Autonomy-supportive classrooms emphasize student self-direction and active involvement in generating, delivering, and consuming information and content.
- *Provide positive and informational feedback.* Feedback needs to be constructive but positive, not negative.
- *Provide structured guidance.* Structure refers to “the extent and clarity of expectations that teachers provide to students as well as the methods to achieve desired educational outcomes” (Chang et al., 2017, p. 105). Structured guidance emphasizes elements of all of the previous points: explicit and understandable directions, constructive feedback, and support for students to plan for learning and action.

Taken together, autonomy-supportive classrooms create a learning environment in which students are motivated to act and to self-direct learning (Chang et al., 2017; Reeve, 2002). Autonomy-supportive interventions provide tools to teachers to facilitate students’ self-regulated and self-directed learning. So, as we see in this literature and in the research with students with special needs, autonomy-supportive classrooms enable students with special needs to have opportunities to learn and practice skills leading to self-determination. For example, as we discussed previously, there is an emphasis in special education law and practice in the US that adolescents with special needs should be involved in planning for their transition to adulthood. We know from research cited previously that simply being involved in the transition planning meeting enhanced the self-determination of students with intellectual disability and specific learning disabilities (Williams-Diehm et al., 2008). Classrooms that are autonomy-supportive would provide multiple opportunities for students like these to learn how to self-regulate learning and goal-setting so as to prepare students for their transition planning meeting.

Autonomy-Supportive Interventions

There are a number of evidence-based practices that have been shown to improve the self-determination of students with special needs. Because instruction begins with planning, we address the research pertaining to evidence-based practices to promote student involvement in educational and future planning first, followed by research pertaining to evidence-based practices to enable students to self-regulate their learning.

Promoting Student Involvement in Educational and Future Planning

In the prior section, we discussed the research establishing that student involvement in educational planning can promote self-determination, and, reciprocally, enhanced self-determination can predict higher involvement in educational planning. There is considerable evidence that students with disabilities can acquire the skills needed

to play a meaningful role in their educational planning process (Martin et al., 2006; Mason, Field, & Sawilowsky, 2004; Test et al., 2004; for related discussion, see Perry et al., Chapter 13, this volume). For example, Martin and colleagues (2006) found that students with specific learning disabilities and emotional and behavioral disorders who received instruction to promote active involvement in educational planning were significantly more likely than peers not receiving such instruction to: participate in educational meetings; take a more visible leadership role in such meetings; state their interests, abilities, and areas of instructional and support needs more clearly; and remember their goals after the meeting. Indeed, there were other benefits from active student involvement that went beyond the student. For example, Martin, Marshall, and Sale (2004) found that the presence of students with specific learning disabilities at educational planning meetings (along with their parents) also increased parental involvement and enhanced the probability that a student's strengths, needs, and interests would be discussed.

Two interventions to promote student involvement in educational planning have evidence of their causal impact on promoting the self-determination of youth with disabilities. Both are available online at no cost (www.ou.edu/education/centers-and-partnerships/zarrow.html) and, thus, will only be briefly described here. The self-directed IEP (Martin, Marshall, Maxson, & Jerman, 1996) is a process to teach adolescents across disability categories (including students with intellectual, developmental, and specific learning disabilities who are the focus of this chapter) to direct their own planning meeting focused on their transition to adulthood. Students learn and implement 11 steps for leading their meeting, including stating the purpose of the meeting, introducing attendees, reviewing past goals and progress, stating new transition goals, summarizing goals, and closing the meeting by thanking attendees. *Whose Future Is It Anyway?* (Wehmeyer et al., 2004) is a student self-regulated process to promote more meaningful involvement in transition planning for students with intellectual and developmental disabilities consisting of 36 sessions enabling students to self-direct instruction related to (1) self- and disability-awareness; (2) making decisions about transition-related outcomes; (3) identifying and securing community resources to support transition services; (4) writing and evaluating transition goals and objectives; (5) communicating effectively in small groups; and (6) developing skills to become an effective team member, leader, or self-advocate. The materials are student-directed, and guidelines for teachers to support students to self-direct the process are included.

Promoting Student Self-regulated Goal Setting

The self-determined learning model of instruction (SDLMI; Wehmeyer et al., 2000) is an evidence-based autonomy-supportive intervention to enable teachers to teach students to self-regulate problem-solving to set and attain educationally relevant goals (for related discussion, see, in this volume, Bergin & Prewett, Chapter 14; Perry et al., Chapter 13). The model has been validated with students across virtually all disability categories (including students with intellectual, developmental, and specific learning disabilities) as effective for promoting educational goal attainment, enhancing self-determination, and promoting enhanced involvement in general education settings. The model consists of a three-phase instructional process in which each phase presents

a problem to be solved by the student. The student solves the problem by answering a series of four questions (per phase). Each question is linked to a set of teacher objectives, and each instructional phase includes a list of educational supports teachers can use to teach or support students to self-direct their learning. The questions differ in each phase, but represent identical steps in the problem-solving sequence: (1) identify the problem, (2) identify potential solutions to the problem, (3) identify barriers to solving the problem, and (4) identify consequences of each solution. These steps form a means–end problem-solving sequence that enables the student to solve the problem posed in each instructional phase (What is my goal? What is my plan? What have I learned?). A teacher’s guide to implementing the SDLMI with detailed information is available (www.self-determination.org).

IMPLICATIONS FOR PRACTITIONERS

Efforts to promote self-determination within an organismic perspective assume a dynamic interplay between the student and the context. Students are not passive recipients of information, but are active self-regulators of learning. Contexts provide supports and opportunities, as well as hindrances and impediments for volitional and agentic action, but it is the student and their drive to act as a *causal agent* that form the primary impetus of behavior. Thus, the goal for practitioners should be to actively involve students with intellectual, developmental, and specific learning disabilities in all aspects of the educational process. Practitioners should keep in mind that being self-determined means acting as the causal agent in one’s life; that is, it involves making or causing things to happen in one’s life. This is different from doing something independently, without help. Thus, when thinking about implementing educational practices to promote self-determination, there is a need to provide whatever support a student might need to be successful. So, a student with intellectual disability may not be able to make a completely independent decision about what type of job she would like to receive instruction to learn, but she could likely express preferences that a teacher or a vocational counselor could take into account in identifying possible instructional options. Or, a student with autism who has difficulty speaking verbally may need technology supports in order to be successful in increasing social interactions with peers. The important factor is not that a student necessarily does something independently, but that the student is provided supports they need to be successful.

Measurement

The instructional process to promote self-determination begins with measurement in most cases. Several older measures of self-determination exist, including the AIR Self-Determination Scale (Wolman, Campeau, Dubois, Mithaug, & Stolarski, 1994), which was normed among students with specific learning disabilities, and The Arc’s Self-Determination Scale (Wehmeyer & Kelchner, 1995), which was normed among students with intellectual disability. Most recently, to align measurement in self-determination with CAT, researchers have developed a new suite of measures that were developed with students across disability categories (including students with intellectual, developmental, and specific learning disabilities), as well as with students without disabilities. The Self-Determination Inventory: Student Report (SDI-SR;

Shogren, Wehmeyer, Little, et al., 2017; Shogren, Wehmeyer, Palmer, Forber-Pratt, et al., 2017) and Self-Determination Inventory: Parent/Teacher Report (SDI-PTR; Shogren, Wehmeyer, et al., 2014) are both norm-referenced, standardized measures of self-determination for use with youth and young adults aged 13–22 years. The SDI-SR is a student self-report measure and can provide a process to enable students to be actively engaged in identifying areas of strengths and instructional needs in relation to self-determination. The SDI-PTR is a parent or teacher report version of the same measure, and can be used to provide information for students with more extensive support needs. Both were developed to be aligned with CAT (Shogren, Wehmeyer, Palmer, Forber-Pratt, et al., 2015) and to provide valid and reliable information on self-determination that could be used to guide classroom instruction as well as to evaluate change over time as a result of intervention.

The SDI-SR is administered online (www.self-determination.org; for related discussion, see Okolo & Ferretti, Chapter 26, this volume) and includes features to promote use by students with cognitive and other disabilities. These features include in-text definitions of challenging words (hovering over the word results in a pop-up dialogue box that provides a simple definition of the word); an audio version of every item (pressing a play button next to each item results in the item being read aloud); a progress bar showing how much of the assessment a student has completed; a continuous bar, rather than a Likert-type scale or other answer formats, on which students use a slider to indicate where on the continuum they believe their answer to be located; and a checkmark indicating when an item has been answered.

Measurement can provide information for planning, and, as previously discussed, there is clear evidence that engaging students with intellectual, developmental, and specific learning disabilities in educational planning has multiple benefits, including as a means to enhance self-determination. This may be an important role for educational psychologists, given their central part in educational measurement and the planning process. Educational psychologists can not only support teachers to interpret test and assessment scores in understandable ways, but also work with teachers to actually provide an evaluation process that identifies and emphasizes student strengths rather than just areas of limitations. A recent U.S. Supreme Court ruling (*Endrew F. v. Douglas County School District*, 2017) on what is considered an appropriate education for students with disabilities emphasizes the need for assessment that highlights a student's potential for growth, and so a strengths-based approach will facilitate that process. By working with teachers and students with special needs to provide information for the student to better understand his or her areas of strengths and areas of instructional needs, educational psychologists can empower students to use those strengths to act as a causal agent in their lives.

Context

With regard to the context in which students with intellectual, developmental, and specific learning disabilities learn, we have discussed the importance of creating autonomy-supportive classrooms. De Naeghel, Van Keer, and Vanderlinde (2014) identified strategies linked to each of the basic psychological needs identified by SDT: autonomy, competence, and relatedness. Strategies, linked to the basic need for autonomy, include (for related discussion, see Pekrun & Loderer, Chapter 18, this volume):

- Giving young people options from which to choose. Research clearly shows that students with intellectual disability have fewer opportunities to make choices (Wehmeyer & Metzler, 1995), so creating environments that emphasize choice-making can foster autonomy and self-determination by giving these students chances to learn how to make choices.
- Identifying and basing instruction on young people's preferences and interests. Often, the focus of instruction and conversation is on the disability and what students cannot do. Students with developmental disabilities, for example, may not have as many opportunities as typically developing students to learn what they like and do not like, what they are good at, and so forth, so basing instruction on preferences and interests teaches students with disabilities that they can have a voice in their instruction (Chou et al., 2017).
- Promoting self-initiation of actions. Again, students with special needs too often have things done to or for them and have too few opportunities to self-initiate actions. Research shows that students with intellectual disability, for example, often wait for someone to prompt them before acting (Wehmeyer et al., 2017). So, teaching and supporting students to self-initiate action teaches them how to act volitionally.

Strategies linked to the young person's need for competence involve practices that (for related discussion, see, in this volume, Perry et al., Chapter 13; Schunk & DiBenedetto, Chapter 11; Tracey, Merom, Morin, & Maïano, Chapter 24; Wigfield & Ponnock, Chapter 17):

- Provide optimal challenges for young people. Expectations for students with disabilities are often low, but research shows that a focus on promoting self-determination for students across disability categories (including intellectual, developmental, and specific learning disabilities) raises expectations for students (Shogren, Plotner, et al., 2014). Ensuring that students with special needs are provided optimal challenges will raise the bar for what students might accomplish.
- Clearly communicate expectations. The presumed lack of competence of students with disabilities can limit expectations, as mentioned (Shogren, Plotner, et al., 2014). Communicating clear and high expectations can communicate to students the belief that they can be successful. So, for students with emotional and behavioral disorders, who often have difficulty with teachers, a teacher communicating high expectations and a belief in the student's capacities may encourage the student to try things they may not have otherwise attempted.
- Provide consistent and positive feedback. Students with autism or intellectual disability may be frequently told what to do and how to do it. By shaping feedback so that, instead of answering the question for the student, the teacher provides guiding information and ways for students to self-correct, teachers can provide students with opportunities to self-regulate learning.

Strategies that are linked to young people's need for relatedness include strategies that (for related discussion, see Gillies, Chapter 22, this volume):

- Emphasize relationship-building. The literature shows that students with special needs, across most disability categories, are isolated and report that they are lonely (Hughes et al., 2012). For example, a student with autism, which is a common developmental disability, may not be able to participate in all of the activities that their peers do because of impairments to communication and social interactions. By creating classrooms that emphasize student interactions and relationships, teachers can improve social outcomes and promote participation.
- Promote positive social interactions. Many students with intellectual disability are educated in classrooms away from their nondisabled peers (Wehmeyer & Shogren, 2017). It is important to ensure that students with intellectual disability have opportunities to interact with same-age peers. This, in turn, can lead to opportunities for students to participate with peers and increase their autonomy.

Skill Development

We have discussed the SDLMI (Wehmeyer et al., 2000) as a teaching model to teach students to self-regulate educational goal-setting and attainment. In addition to using the SDLMI, research has established that providing opportunities for students with special needs to learn and practice skills such as problem-solving, decision-making, goal-setting and attainment, and self-advocacy can promote self-determination (Algozzine et al., 2001; Cobb et al., 2009). In fact, these skills form the educational supports that are embedded within the SDLMI (Wehmeyer et al., 2000). Such instruction can be infused into lessons and teaching in virtually any content area across virtually any grade and should include a focus on the following:

- *Goal-setting and attainment skills* (for related discussion, see Bergin & Prewett, Chapter 14, this volume). Goal-oriented action is at the heart of self-determination, as specified by CAT, which defines causal agency as acting in service to freely chosen goals. Self-determination refers to volitional action, and volition implies both actions based upon preferences and actions that are intentional; intentional actions are goal-focused. So, promoting goal-setting and attainment skills enable youth with special needs to learn how to become causal agents in their lives. Promoting goal-setting and attainment involves teaching students with intellectual, developmental, and specific learning disabilities to: (1) identify and define a goal clearly and concretely, (2) develop a series of objectives or tasks to achieve the goal, and (3) specify the actions necessary to achieve the desired outcome. Research among students with intellectual, developmental, and specific learning disabilities (Shogren et al., 2012; Wehmeyer & Shogren, 2017) provides general strategies to follow to make goals both meaningful and attainable for these students. First, goals should be optimally challenging: they should not be so challenging that the student cannot attain them, but they must be challenging enough to motivate students. Next, although it is preferable for students to participate in setting their own goals, at whatever level is appropriate given the nature of their disability, if this is not possible, and goals are, for example, predetermined by the curriculum, then the student's preferences and interests should be incorporated into the goal to increase the student's motiva-

tion to pursue the goal. Teachers can support students to set goals even within the parameters in which they (teachers) must operate. For example, in an algebra lesson, a student might not set a goal as to what is learned, but may set a goal with regard to studying hours that will enable them to achieve the goal. Goals that have personal meaning are more likely to be attained (Latham & Locke, 1991; Locke & Latham, 1990).

- *Choice-making skills and opportunities* (for related discussion, see, in this volume, Pekrun & Loderer, Chapter 18; Strnadová, Chapter 4). In both SDT and CAT, self-determined action is volitional—that is, based on one’s preferences and interests. Choice-making is the expression of preferences and forms the means by which students with special needs learn to act volitionally. Promoting choice-making (e.g., the expression of a preference between two or more options) has multiple benefits. By making choices, students, particularly younger children, learn that they can exert control over their environment. Choice opportunities can and should be infused through the school day. Students can be provided opportunities to choose within or between instructional activities. They can also choose with whom they engage in a task, where they engage in an activity, and if they complete an activity (Brown, Appel, Corsi, & Wenig, 1993). For example, research has found that, when students with emotional and developmental disabilities are provided opportunities to make choices, reductions in problem behavior and increases in adaptive behaviors are observed (Shogren, Faggella-Luby, Bae, & Wehmeyer, 2004).
- *Problem-solving skills*. CAT identifies problem-solving skills as critical to people being able to act as agents in their lives—that is, to initiate and sustain action toward a goal. Indeed, this is true within SDT as well, which, as mentioned previously, is a “comprehensive macro-theory that details the origins and outcomes of human agentic action” (Adams et al., 2017, p. 47). A problem is an activity or task for which a solution is not known or readily apparent. The process of solving a problem involves: (1) identifying and defining the problem, (2) listing possible solutions, (3) identifying the impact of each solution, (4) making a judgment about a preferred solution, and (5) evaluating the efficacy of the judgment (D’Zurilla & Goldfried, 1971). Research (Wehmeyer & Kelchner, 1994) has shown that, for example, students with intellectual disability generate fewer possible solutions to problems than do students without disability. Also, many problems are social in nature, and students with autism and other developmental disabilities may have particular difficulty navigating problems in a social context, and so developing effective social problem-solving skills is, obviously, central to the process of becoming self-determined, given the dynamic nature of organismic theories of human development and behavior.
- *Decision-making skills*. CAT positions decision-making skills as component skills of self-determination that contribute to agentic action, as described earlier in the chapter. Making a decision involves coming to a judgment about which solution from among several is best at a given time and typically involves: (1) identifying alternative courses of action, (2) identifying the possible consequences of each action, (3) assessing the probability of each consequence occurring, (4) choosing the best alternative, and (5) implementing the decision (Beyth-Marom, Fischhoff, Quadrel, & Furby, 1991; Furby & Beyth Marom, 1992). Studies in the area of

promoting student involvement in planning, reviewed previously, have shown that adolescents with intellectual, developmental, and specific learning disabilities can effectively participate in the decision-making process. Additionally, Khemka and Hickson (2017) have shown that youth with intellectual disability can be taught decision-making and problem-solving skills that enable them to avoid situations of potential harm.

- *Self-regulated and student-directed learning skills* (for related discussion, see Perry et al., Chapter 13, this volume). In both CAT and SDT, people who act volitionally and are causal agents in their lives do so by self-regulating actions toward goals. Self-regulation is the process of setting goals, developing action plans to achieve those goals, implementing and following the action plans, evaluating the outcomes of the action plans, and changing action plans if the goal was not achieved. Student-directed learning strategies involve teaching students strategies that enable them to modify and regulate their own behavior (Agran, King-Sears, Wehmeyer, & Copeland, 2003). The emphasis in such strategies is shifted from teacher-mediated and teacher-directed instruction to student-directed instruction. Research in education and rehabilitation has shown that student-directed learning strategies are as successful as, and often more successful than, teacher-directed learning strategies, and that these strategies are effective means to increase independence and productivity. A variety of strategies have been used to teach students with intellectual and learning disabilities how to manage their own behavior or direct learning (Agran et al., 2003). Among the most commonly used strategies are picture cues and antecedent cue regulation strategies, self-instruction, self-monitoring, self-evaluation, and self-reinforcement, and research shows that such strategies can benefit students across disability categories (Agran et al., 2003). For example, strategies exist that enable students with learning disabilities to learn self-regulation strategies that enable them to write essays effectively, and other strategies have been shown to be useful in enabling students with intellectual disability to perform tasks that involve multiple steps (Wehmeyer & Field, 2007).
- *Self-advocacy skills* (for related discussion, see, in this volume, Pekrun & Loderer, Chapter 18; Strnadová, Chapter 4). Acting as a causal agent requires individuals to advocate on their own behalf and on behalf of people and causes that are important to them. CAT identifies these skills as critical to self-regulation and agentic action. Students with intellectual disability, for example, can reduce being dependent upon others by learning how to advocate on their own behalf, including how to effectively communicate their perspective, how to negotiate, how to compromise, how to be assertive (but not aggressive), and how to deal with systems (Wehmeyer et al., 2004). The educational planning process is an excellent opportunity for students to learn and practice self-advocacy skills (Wehmeyer & Field, 2007).

FUTURE DIRECTIONS

There are multiple trends that we believe will increase the visibility and importance of issues pertaining to self-determination and students with intellectual, developmental, and specific learning disabilities in the future. For one, the field of education is embrac-

ing the tenets of personalized learning in which there is an emphasis on the infusion of technology and repeated assessment to drive instruction, as well as a focus on student choices, interests, and preferences and student-directed learning. The National Center on Learning Disabilities (NCLD) defines personalized learning as “an educational learning approach where students’ learning experiences—what they learn, and how, when, and where they learn it—are tailored to their individual needs, skills, and interests, and enable them to take ownership of their learning” (Parsi, Whittaker, & Jones, 2018, p. 19). Often, the emphasis in personalized learning is on the technology that supports such individualization, but at the heart of personalized learning is student-directed learning and student choice and voice. The NCLD reviewed the literature, conducted meetings with stakeholders in education and in personalized learning, and conducted pilot projects. They observed that:

personalized learning requires students to make good choices about their learning, assert their needs and pursue their goals in order to be successful. These skill sets are vital for all learners, but they are especially important for students with disabilities. Yet these skills are not frequently taught to students, an omission that harms those who need these skills the most.

(Parsi et al., 2018, p. 2)

If schools are going to personalize learning, it will be important for educators and others to focus on enabling young people to become more self-determined, to self-direct learning, and to become causal agents in their own lives. This will be as true—perhaps more so—for students with intellectual, developmental, and specific learning disabilities, who need more personalized, individualized instruction and stand to potentially benefit from the technologies that accompany these efforts (Wehmeyer & Zhao, *in press*).

Relatedly, it was noted previously that neither SDT nor CAT were disability-specific, although the latter was developed and evaluated within a disability context. Thus, for example, interventions such as the SDLMI or efforts to teach component skills such as goal-setting or problem-solving are not disability-specific interventions; however, it is the case that all young people can benefit from efforts to involve them in assessment and planning for their educational program, self-regulating their learning, and becoming more self-determined. It is important, however, to ensure that students with intellectual, developmental, and specific learning disabilities do not get left behind in efforts to promote self-determination. It is clear that they can benefit from such efforts (Shogren, Wehmeyer, Palmer, Rifenbark, et al., 2015) and thus deserve the opportunity to be included in such educational initiatives. Too often, as has been indicated throughout the chapter, people hold low expectations for students with intellectual, developmental, and specific learning disabilities, do not provide challenging opportunities, and do things to and for them (Shogren, Plotner, et al., 2014). It is true that promoting self-determination is important for all students, but perhaps especially so for students with special needs. The practice-based steps mentioned previously will assist educators to make sure that students with special needs are not left out of high-quality instruction to promote self-determination.

In addition, education is not the only field in which rapid change is occurring. The lack of stability in a changing global economy is a frequently noted phenomenon. Rather than secure employment in a stable organization, the 21st-century work world

will increasingly become characterized by temporary assignments, time-limited projects, and a transformation of the labor force from “core workers with permanent jobs to peripheral workers with temporary assignments” (Savickas, 2012, p. 13). Savickas noted that young people entering the work world today should expect to occupy many jobs (as opposed to one secure job) over their lifetime. The diversity of the workforce and rapid pace of changes in technology and knowledge that young people will be confronted with in the postmodern world, as well as the recognition of the complexity of human life, require that young people become self-determined, to be autonomously motivated and to become causal agents in their own lives. Historically, people with special needs have been underrepresented in the workforce and at the margins of these global-wide shifts (Butterworth & Migliore, 2015). If young people are not enabled to become more self-determined and to become causal agents in their lives, they are at risk of being left even further behind across their life span.

CONCLUSION

There is now more than 25 years of research on issues pertaining to self-determination and students with intellectual, developmental, and specific learning disabilities. It has become clear that, if these young people are given the opportunity to learn skills that enable them to make things happen in their lives, they can acquire such skills. Moreover, when they do so, they become more self-determined and experience more positive school and post-school outcomes. Indeed, looking at research from both SDT and CAT, it is evident that living self-determined lives is important for optimal life outcomes, and, accordingly, educational programs for students with intellectual, developmental, and specific learning disabilities should seek to include efforts to learn and practice the skills necessary to enable them to be causal agents in their own lives.

REFERENCES

- Adams, N., Little, T. D., & Ryan, R. M. (2017). Self-determination theory. In M. L. Wehmeyer, K. A. Shogren, T. D. Little, & S. J. Lopez (Eds.), *Development of self-determination through the life-course* (pp. 47–54). New York: Springer. doi:10.1007/978-94-024-1042-6_4
- Agran, M., King-Sears, M., Wehmeyer, M. L., & Copeland, S. R. (2003). *Teachers' guides to inclusive practices: Student-directed learning strategies*. Baltimore: Paul H. Brookes.
- Algozzine, B., Browder, D., Karvonen, M., Test, D. W., & Wood, W. M. (2001). Effects of interventions to promote self-determination for individuals with disabilities. *Review of Educational Research*, 71, 219–277. doi:10.3102/00346543071002219
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.
- Arneson, C.L., Durkin, M.S., Benedict, R.E., Kirby, R.S., Yeargin-Allsopp, M., Van Naarden Braun, K. ... Doernberg, N.S. (2009). Prevalence of cerebral palsy: Autism and Developmental Disabilities Monitoring Network. *Disability and Health Journal*, 2, 45–48.
- Angyal, A. (1941). *Foundations for a science of personality*. Cambridge, MA: Harvard University Press.
- Beyth-Marom, R., Fischhoff, B., Quadrel, M. J., & Furby, L. (1991). Teaching decision making to adolescents: A critical review. In J. Baron & R. V. Brown (Eds.), *Teaching decision making to adolescents* (pp. 19–59). Hillsdale, NJ: Lawrence Erlbaum.
- Brown, F., Appel, C., Corsi, L., & Wenig, B. (1993). Choice diversity for people with severe disabilities. *Education and Training in Mental Retardation*, 28, 318–326.
- Butterworth, J., & Migliore, A. (2015). *Trends in employment outcomes of young adults with intellectual and developmental disabilities, 2006–2013*. Boston: University of Massachusetts. https://scholarworks.umb.edu/ici_pubs/70/

- Carter, E. W., Lane, K. L., Pierson, M. R., & Glaeser, B. (2006). Self-determination skills and opportunities of transition-age youth with emotional disturbance and learning disabilities. *Exceptional Children*, 72, 333–346. doi:10.1177/001440290607200305
- Chang, R., Fukuda, E., Durham, J., & Little, T. D. (2017). Enhancing students' motivation with autonomy-supportive classrooms. In M. L. Wehmeyer, K. A. Shogren, T. D. Little, & S. J. Lopez (Eds.), *Development of self-determination throughout the life-course* (pp. 99–110). New York: Springer. doi:10.1007/978-94-024-1042-6_8
- Chou, Y., Wehmeyer, M. L., Palmer, S., & Lee, J. H. (2017). Comparisons of self-determination among students with autism, intellectual disability, and learning disabilities: A multivariate analysis. *Focus on Autism and Other Developmental Disabilities*, 32, 124–132. doi:10.1177/1088357615625059
- Cobb, B., Lehmann, J., Newman-Gonchar, R., & Alwell, M. (2009). Self-determination for students with disabilities: A narrative metasynthesis. *Career Development for Exceptional Individuals*, 32, 108–114. doi:10.1177/0885728809336654
- D'Zurilla, T. J., & Goldfried, M. R. (1971). Problem solving and behavior modification. *Journal of Abnormal Psychology*, 78, 107–126. *Developmental Disabilities Assistance and Bill of Rights Act of 2000* (P. L. 106-402) (2000) 10.1037/h0031360.
- De Naeghel, J., Van Keer, H., & Vanderlinde, R. (2014). Strategies for promoting autonomous reading motivation: A multiple case study research in primary education. *Frontline Learning Research*, 3, 83–101.
- de Charms, R. (1968). *Personal causation: The internal affective determinants of behavior*. New York: Academic Press.
- Deci, E. L. (1980). *The psychology of self-determination*. Lexington, MA: Lexington Books.
- Deci, E. L., & Chandler, C. L. (1986). The importance of motivation for the future of the LD field. *Journal of Learning Disabilities*, 19, 587–594. doi:10.1177/002221948601901003
- Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, 125, 627–668. doi:10.1037/0033-2909.125.6.627
- Deci, E. L., & Ryan, R. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press. <https://doi.org/10.1007/978-1-4899-2271-7>
- Deci, E. L., & Ryan, R. M. (2000). The 'what' and 'why' of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11, 227–268. doi:10.1207/S15327965PLI1104_01
- Deci, E. L., & Ryan, R. M. (2002). *Handbook of self-determination research*. Rochester, NY: University of Rochester Press.
- Deci, E. L., & Ryan, R. M. (2012). Motivation, personality, and development within embedded social contexts: An overview of Self-Determination Theory. In R. M. Ryan (Ed.), *The Oxford handbook of human motivation* (pp. 85–107). Oxford: Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780195399820.013.0006>.
- Deci, E. L., Ryan, R. M., & Guay, F. (2013). Self-determination theory and actualization of human potentials. In D. M. McInerney, H. W. Marsh, R. G. Craven, F. Guay, & D. M. McInerney (Eds.), *Theory driving research: New wave perspectives on self-processes and human development* (pp. 109–133). Charlotte, NC: Information Age.
- Endrew F. v. Douglas County School District RE-1*, 580 U.S. (2017).
- Field, S. (1996). Self-determination instructional strategies for youth with learning disabilities. *Journal of Learning Disabilities*, 29, 40–52. doi:10.1177/002221949602900107
- Field, S., Sarver, M. D., & Shaw, S. F. (2003). Self-determination: A key to success in postsecondary education for students with learning disabilities. *Remedial and Special Education*, 24, 339–349. doi:10.1177/07419325030240060501
- Frielink, N., Schuengel, C., & Embregts, P. J. C. M. (2018). Autonomy support, need satisfaction, and motivation for support among adults with intellectual disability: Testing a self-determination theory model. *American Journal on Intellectual and Developmental Disabilities*, 123, 33–49. doi:10.1352/1944-7558-123.1.33
- Furby, L., & Beyth Marom, R. (1992). Risk taking in adolescence: A decision-making perspective. *Developmental Review*, 12, 1–44. doi:10.1016/0273-2297(92)90002-J
- Geldhof, G. J., Fenn, M. L., & Finders, J. K. (2017). A self-determination perspective on self-regulation across the life span. In M. L. Wehmeyer, K. A. Shogren, T. D. Little, & S. J. Lopez (Eds.), *Development of self-determination through the life-course* (pp. 221–235). New York: Springer. doi:10.1007/978-94-024-1042-6_17
- Hofer, J., & Busch, H. (2011). Satisfying one's needs for competence and relatedness: Consequent domain-specific well-being depends on strength of implicit motives. *Personality and Social Psychology Bulletin*, 37, 1147–1158. doi:10.1177/0146167211408329

- Hughes, C., Kaplan, L., Berstein, R., Boykin, M., Reilly, C., Brigham, N., ... Harvey, M. (2012). Increasing social interaction skills of secondary school students with autism and/or intellectual disability: A review of the literature. *Research and Practice for Persons with Severe Disabilities*, 37, 288–307. doi:10.2511/027494813805327214
- Individuals with Disabilities Education Act. (2004). 20 U.S.C. § 1400.
- Khemka, I., & Hickson, L. (2017). The role of positive psychology in interpersonal decision making. In K. A. Shogren, M. L. Wehmeyer, & N. Singh (Eds.), *Handbook of positive psychology in intellectual and developmental disabilities* (pp. 145–171). New York: Springer. doi:10.1007/978-3-319-59066-0_11
- Koestner, R., Bernieri, F., & Zuckerman, M. (1992). Self-regulation and consistency between attitudes, traits and behaviors. *Personality and Social Psychology Bulletin*, 18, 52–59. doi:10.1177/0146167292181008
- Koestner, R., Powers, T. A., Carbonneau, N., Milyavskaya, M., & Chua, S. N. (2012). Distinguishing autonomous and directive forms of goal support: Their effects on goal progress, relationship quality, and subjective well-being. *Personality and Social Psychology Bulletin*, 38, 1609–1620. doi:10.1177/0146167212457075
- Lachapelle, Y., Wehmeyer, M. L., Haelewyck, M. C., Courbois, Y., Keith, K. D., Schalock, R., ... Walsh, P. N. (2005). The relationship between quality of life and self-determination: An international study. *Journal of Intellectual Disability Research*, 49, 740–744. doi:10.1111/j.1365-2788.2005.00743.x
- Latham, G. P., & Locke, E. A. (1991). Self-regulation through goal setting. *Organizational Behavior and Human Decision Processes*, 50, 212–247. doi:10.1016/0749-5978(91)90021-K
- Lee, S. H., Wehmeyer, M. L., & Shogren, K. A. (2015). The effect of instruction with the self-determined learning model of instruction on students with disabilities: A meta-analysis. *Education and Training in Autism and Developmental Disabilities*, 50, 237–247.
- Lee, S. H., Wehmeyer, M. L., Soukup, J. H., & Palmer, S. B. (2010). Impact of curriculum modifications on access to the general education curriculum for students with disabilities. *Exceptional Children*, 76, 213–233. doi:10.1177/001440291007600205
- Little, T. D., Hawley, P. H., Henrich, C. C., & Marsland, K. (2002). Three views of the agentic self: A developmental synthesis. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 389–404). Rochester, NY: University of Rochester Press.
- Locke, E. A., & Latham, G. P. (1990). *A theory of goal setting and task performance*. Upper Saddle River, NJ: Prentice-Hall.
- Martin, J. E., Marshall, L. H., Maxson, L. M., & Jerman, P. L. (1996). *The self-directed IEP*. Retrieved from www.zarrowcenter.ou.edu/
- Martin, J. E., Marshall, L. H., & Sale, P. (2004). A 3-year study of middle, junior high, and high school IEP meetings. *Exceptional Children*, 70, 285–297. doi:10.1177/001440290407000302
- Martin, J. E., Van Dycke, J., Christense, W. R., Greene, B. A., Gardner, J. E., & Lovett, D. L. (2006). Increasing student participation in IEP Meetings: Establishing the self-directed IEP as an evidenced-based practice. *Exceptional Children*, 72, 299–316. doi:10.1177/001440290607200303
- Martos, T., & Kopp, M. (2012). Life goals and well-being: Does financial status matter? Evidence from a representative Hungarian sample. *Social Indicators Research*, 105, 561–568. doi:10.1007/s11205-011-9788-7
- Mason, C., Field, S., & Sawilowsky, S. (2004). Implementation of self-determination activities and student participation in IEPs. *Exceptional Children*, 70, 441–451. doi:10.1177/001440290407000404
- McKenzie, K., Milton, M., Smith, G., & Ouellette-Kuntz, H. (2016). Systematic review of the prevalence and incidence of intellectual disabilities: Current trends and issues. *Current Developmental Disorders Reports*, 3, 104–115. doi:10.1007/s40474-016-0085-7
- National Center for Education Statistics. (2018). Children and youth with disabilities. Washington, DC: U.S. Department of Education. Accessed online at https://nces.ed.gov/programs/coe/indicator_cgg.asp
- National Center for Educational Statistics (2017). *The condition of education 2017*. Accessed online at <https://nces.ed.gov/pubs2017/2017144.pdf>
- Niemiec, C. P., Ryan, R. M., & Deci, E. L. (2009). The path taken: Consequences of attaining intrinsic and extrinsic aspirations in post-college life. *Journal of Research in Personality*, 43, 291–306. doi:10.1016/j.jrp.2008.09.001
- Nota, L., Ferrari, L., Soresi, S., & Wehmeyer, M. L. (2007). Self-determination, social abilities, and the quality of life of people with intellectual disabilities. *Journal of Intellectual Disability Research*, 51, 850–865. doi:10.1111/j.1365-2788.2006.00939.x
- Parsi, A., Whittaker, M. C., & Jones, L. E. (2018). *Agents of their own success: Self-advocacy skills and self-determination for students with disabilities in the era of personalized learning*. Washington, DC: National Center for Learning Disabilities.

- Pierson, M. R., Carter, E. W., Lane, K. L., & Glaeser, B. C. (2008). Factors influencing the self-determination of transition-age youth with high-incidence disabilities. *Career Development for Exceptional Individuals*, 31, 115–125. doi:10.1177/0885728808317659
- Powers, L. E., Geenen, S., Powers, J., Pommier-Satya, S., Turner, A., Dalton, L., & Swand, P. (2012). My life: Effects of a longitudinal, randomized study of self-determination enhancement on the transition outcomes of youth in foster care and special education. *Children and Youth Services Review*, 34, 2179–2187. doi:10.1016/j.childyouth.2012.07.018
- Reeve, J. (2002). Self-determination theory applied to educational settings. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 183–203). Rochester, NY: Rochester University Press.
- Ryan, R. M. (1995). Psychological needs and the facilitation of integrative processes. *Journal of Personality*, 63, 397–427. doi:10.1111/j.1467-6494.1995.tb00501.x
- Ryan, R. M., & Deci, E. L. (2002). Overview of self-determination theory: An organismic dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3–33). Rochester, NY: University of Rochester Press.
- Ryan, R. M., & Deci, E. L. (2004). Autonomy is no illusion: Self-determination theory and the empirical study of authenticity, awareness, and will. In J. Greenberg, S. L. Koole, & T. Pyszczynski (Eds.), *Handbook of experimental existential psychology* (pp. 449–479). New York: Guilford Press.
- Ryan, R. M., & Deci, E. L. (2006). Self-regulation and the problem of human autonomy: Does psychology need choice, self-determination, and will? *Journal of Personality*, 74, 1557–1585. doi:10.1111/j.1467-6494.2006.00420.x
- Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. New York: Guilford Press.
- Savickas, M. L. (2012). Life design: A paradigm for career intervention in the 21st century. *Journal of Counseling & Development*, 90, 13–19. doi:10.1111/j.1556-6676.2012.00002.x
- Schalock, R. L., Borthwick-Duffy, S. A., Bradley, V. J., Buntinx, W. H. E., Coulter, D. L., Craig, E. M., & Yeager, M. H. (2010). *Intellectual disability: Definition, classification, and systems of supports*. Washington, DC: American Association on Intellectual and Developmental Disabilities.
- Seong, Y., Wehmeyer, M. L., Palmer, S. B., & Little, T. D. (2015). Effects of the self-directed individualized education program on self-determination and transition of adolescents with disabilities. *Career Development and Transition for Exceptional Individuals*, 38, 132–141. doi:10.1177/2165143414544359
- Sheldon, K. M., Ryan, R. M., & Reis, H. T. (1996). What makes for a good day? Competence and autonomy in the day and in the person. *Personality and Social Psychology Bulletin*, 22, 1270–1279. doi:10.1177/01461672962212007
- Shogren, K. A., Faggella-Luby, M. N., Bae, S. J., & Wehmeyer, M. L. (2004). The effect of choice-making as an intervention for problem behavior: A meta-analysis. *Journal of Positive Behavior Interventions*, 6, 228–237.
- Shogren, K. A., Little, T. D., & Wehmeyer, M. L. (2017). Human agentic theories and the development of self-determination. In M. L. Wehmeyer, K. A. Shogren, T. D. Little, & S. J. Lopez (Eds.), *Development of self-determination through the life-course* (pp. 17–26). New York: Springer. doi:10.1007/978-94-024-1042-6_2
- Shogren, K. A., Lopez, S. J., Wehmeyer, M. L., Little, T. D., & Pressgrove, C. L. (2006). The role of positive psychology constructs in predicting life satisfaction in adolescents with and without cognitive disabilities: An exploratory study. *Journal of Positive Psychology*, 1, 37–52. doi:10.1080/17439760500373174
- Shogren, K., Palmer, S., Wehmeyer, M. L., Williams-Diehm, K., & Little, T. (2012). Effect of intervention with the self-determined learning model of instruction on access and goal attainment. *Remedial and Special Education*, 33, 320–330. doi:10.1177/0741932511410072
- Shogren, K. A., Plotner, A. J., Palmer, S. B., Wehmeyer, M. L., & Paek, Y. (2014). Impact of the self-determined learning model of instruction on teacher perceptions of student capacity and opportunity for self-determination. *Education and Training in Autism and Developmental Disabilities*, 49, 440–448.
- Shogren, K. A., Raley, S., Wehmeyer, M. L., Grandfield, E. M., Jones, J., & Shaw, L. (2019). Exploring the relationship among basic psychological needs satisfaction and frustration, agentic engagement, motivation, and self-determination in adolescents with disabilities. *Advances in Neurodevelopmental Disorders*, 3, 119–128.
- Shogren, K. A., Wehmeyer, M. L., Lassmann, H., & Forber-Pratt, A. J. (2017). Supported decision making: A synthesis of the literature across intellectual disability, mental health, and aging. *Education and Training in Autism and Developmental Disabilities*, 52, 144–157.
- Shogren, K. A., Wehmeyer, M. L., Little, T. D., Forber-Pratt, A. J., Palmer, S. B., & Seo, H. (2017). Preliminary validity and reliability of scores on the Self-Determination Inventory: Student Report version. *Career Development and Transition for Exceptional Individuals*, 40, 92–103. doi:10.1177/2165143415594335

- Shogren, K. A., Wehmeyer, M. L., & Palmer, S. B. (2017). Causal agency theory. In M. L. Wehmeyer, K. A. Shogren, T. D. Little, & S. J. Lopez (Eds.), *Development of self-determination through the life-course* (pp. 55–67). New York: Springer. doi:10.1007/978-94-024-1042-6_5
- Shogren, K. A., Wehmeyer, M. L., Palmer, S. B., Forber-Pratt, A., Little, T., & Lopez, S. (2015). Causal agency theory: Reconceptualizing a functional model of self-determination. *Education and Training in Autism and Developmental Disabilities, 50*, 251–263.
- Shogren, K. A., Wehmeyer, M. L., Palmer, S. B., Forber-Pratt, A., Little, T. J., & Lopez, S. J. (2014). *Self-Determination Inventory: Parent/Teacher Report*. Lawrence, KS: Kansas University Center on Developmental Disabilities.
- Shogren, K. A., Wehmeyer, M. L., Palmer, S. B., Forber-Pratt, A., Little, T. J., & Lopez, S. J. (2017). *Self-Determination Inventory: Student-Report*. Lawrence, KS: Kansas University Center on Developmental Disabilities.
- Shogren, K. A., Wehmeyer, M. L., Palmer, S. B., Rifenbark, G. G., & Little, T. D. (2015). Relationships between self-determination and postschool outcomes for youth with disabilities. *Journal of Special Education, 53*, 30–41. doi:10.1177/0022466913489733
- Stancliffe, R. (2001). Living with supports in the community: Predictors of choice and self-determination. *Mental Retardation and Developmental Disabilities Research Reviews, 7*, 91–98. doi:10.1002/mrdd.1013
- Stancliffe, R. J., & Wehmeyer, M. L. (1995). Variability in the availability of choice to adults with mental retardation. *Journal of Vocational Rehabilitation, 5*, 319–328. doi:10.1016/1052-2263(95)00142-3
- Test, D. W., Mason, C., Hughes, C., Konrad, M., Neale, M., & Wood, W. (2004). Student involvement in individualized education program meetings. *Exceptional Children, 70*, 391–412. doi:10.1177/001440290407000401
- U.S. Department of Education. (2018). *39th Annual Report to Congress on the implementation of the Individuals with Disabilities Education Act, Parts B and C. 2017*. Washington, DC: Author.
- Vansteenkiste, M., Niemiec, C., & Soenens, B. (2010). The development of the five mini-theories of self-determination theory: An historical overview, emerging trends, and future directions. In T. Urdan & S. Karabenick (Eds.), *Advances in motivation and achievement, vol. 16: The decade ahead* (pp. 105–165). Bingley, UK: Emerald.
- Vansteenkiste, M., Simons, J., Lens, W., Sheldon, K. M., & Deci, E. L. (2004). Motivating learning, performance, and persistence: The synergistic effects of intrinsic goal contents and autonomy-supportive contexts. *Journal of Personality and Social Psychology, 87*, 246–260. doi:10.1037/0022-3514.87.2.246
- Wehmeyer, M. L. (1992). Self-determination and the education of students with mental retardation. *Education and Training in Mental Retardation, 27*, 302–314.
- Wehmeyer, M. L. (1993). Gender differences in locus of control scores for students with learning disabilities. *Perceptual and Motor Skills, 77*, 359–366. doi:10.2466/pms.1993.77.2.359
- Wehmeyer, M. L. (2004). Beyond self-determination: Causal agency theory. *Journal of Developmental and Physical Disabilities, 16*, 337–359. doi:10.1007/s10882-004-0691-x
- Wehmeyer, M. L., & Bolding, N. (1999). Self-determination across living and working environments: A matched-samples study of adults with mental retardation. *Mental Retardation, 37*, 353–363. [https://doi.org/10.1352/0047-6765\(1999\)037%3C0353:SALAWE%3E2.0.CO;2](https://doi.org/10.1352/0047-6765(1999)037%3C0353:SALAWE%3E2.0.CO;2)
- Wehmeyer, M. L., & Bolding, N. (2001). Enhanced self-determination of adults with mental retardation as an outcome of moving to community-based work or living environments. *Journal of Intellectual Disability Research, 45*, 371–383. doi:10.1046/j.1365-2788.2001.00342.x
- Wehmeyer, M. L., & Field, S. (2007). *Self-determination: Instructional and assessment strategies*. Thousand Oaks, CA: Corwin.
- Wehmeyer, M. L., & Kelchner, K. (1994). Interpersonal cognitive problem-solving skills of individuals with mental retardation. *Education and Training in Mental Retardation and Developmental Disabilities, 29*, 265–278.
- Wehmeyer, M. L., & Kelchner, K. (1995). *The Arc's Self-Determination Scale*. Arlington, TX: Arc National Headquarters.
- Wehmeyer, M. L., Kelchner, K., & Richards, S. (1996). Essential characteristics of self-determined behavior of individuals with mental retardation. *American Journal on Mental Retardation, 100*, 632–642.
- Wehmeyer, M. L., Lawrence, M., Kelchner, K., Palmer, S., Garner, N., & Soukup, J. (2004). *Whose future is it anyway? A student-directed transition planning process* (2nd ed.). Lawrence, KS: Beach Center on Disability.
- Wehmeyer, M. L., Little, T. D., & Sergeant, J. (2009). Self-determination. In S. J. Lopez & C. R. Snyder (Eds.), *The Oxford handbook of positive psychology* (2nd ed., pp. 367–374). Oxford: Oxford University Press. doi:10.1093/oxfordhpb/9780195187243.013.0033

- Wehmeyer, M. L., & Metzler, C. (1995). How self-determined are people with mental retardation? The National Consumer Survey. *Mental Retardation*, 33, 111–119.
- Wehmeyer, M. L., Palmer, S., Shogren, K., Williams-Diehm, K., & Soukup, J. (2012). Establishing a causal relationship between interventions to promote self-determination and enhanced student self-determination. *Journal of Special Education*, 46, 195–210. doi:10.1177/0022466910392377
- Wehmeyer, M. L., Palmer, S. B., Agran, M., Mithaug, D. E., & Martin, J. E. (2000). Promoting causal agency: The self-determined learning model of instruction. *Exceptional Children*, 66, 439–453. doi:10.1177/001440290006600401
- Wehmeyer, M. L., Palmer, S. B., Lee, Y., Williams-Diehm, K., & Shogren, K. A. (2011). A randomized-trial evaluation of the effect of whose future is it anyway? on self-determination. *Career Development for Exceptional Individuals*, 34, 45–56. doi:10.1177/0885728810383559
- Wehmeyer, M. L., & Schwartz, M. (1998). The relationship between self-determination, quality of life, and life satisfaction for adults with mental retardation. *Education and Training in Mental Retardation and Developmental Disabilities*, 33, 3–12.
- Wehmeyer, M. L., Shogren, K., Palmer, S., Williams-Diehm, K., Little, T., & Boulton, A. (2012). The impact of the self-determined learning model of instruction on student self-determination. *Exceptional Children*, 78, 135–153. doi:10.1177/001440291207800201
- Wehmeyer, M. L., & Shogren, K. A. (Eds.). (2017). *Handbook of research-based practices for educating students with intellectual disability*. New York: Routledge.
- Wehmeyer, M. L., Shogren, K. A., Little, T. D., & Lopez, S. (2017). *Development of self-determination through the life-course*. New York: Springer. <https://doi.org/10.1007/978-94-024-1042-6>
- Wehmeyer, M. L., & Zhao, Y. (in press). *Educating students to become self-determined learners: Why and how*. Alexandria, VA: ASCD.
- White, R. W. (1959). Motivation reconsidered: The concept of competence. *Psychological Review*, 66, 297–333. doi:10.1037/h0040934
- Williams-Diehm, K., Wehmeyer, M. L., Palmer, S., Soukup, J. H., & Garner, N. (2008). Self-determination and student involvement in transition planning: A multivariate analysis. *Journal on Developmental Disabilities*, 14, 25–36.
- Wolman, J., Campeau, P., Dubois, P., Mithaug, D., & Stolarski, V. (1994). *AIR Self-Determination Scale and user guide*. Palo Alto, CA: American Institute for Research.
- Xu, G., Strathearn, L., Liu, B., & Bao, W. (2018). Prevalence of autism spectrum disorder among US children and adolescents, 2014–2016. *Journal of the American Medical Association*, 19, 81–82. doi:10.1001/jama.2017.17812
- Zaganjor, I., Sekkarie, A., Tsang, B.L., Williams, J., Razzaghi, H., Mulinare, J. . . . Rosenthal, J. (2016). Describing the prevalence of neural tube defects worldwide: A systematic literature review. *PLOS One*, 11, doi: 10.1371/journal.pone.0151586.

13

USING SELF-REGULATED LEARNING TO SUPPORT STUDENTS WITH LEARNING DISABILITIES IN CLASSROOMS

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INTRODUCTION

When teachers talk about students' strengths or challenges in school, their focus is typically broader than the academic and curriculum domains (e.g., children's skill at reading, writing, and mathematics). It often also extends to capacities for paying attention, following instructions, working well with others, coping with challenges, and adapting to complex environments. Both general and special educators rate these capacities, which are captured in descriptions of self-regulation, as essential to children's success in school (Cleary & Zimmerman, 2006; McClelland, Morrison, & Holmes, 2000; Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009). Similarly, longitudinal studies (of which there are very few) of individuals with learning disabilities (LDs), characterize those with the most successful outcomes as having a strong sense of self, internal locus of control, and ability to achieve goals through the effective application of strategies, persistence, and use of social supports (Butler, 2004; Butler & Schnellert, 2015; Goldberg, Higgins, Raskind, & Herman, 2003). Descriptions of these learners are consistent with descriptions of self-regulating learners.

In these ways, self-regulation is both a risk and protective factor for students who struggle in school. It is well established that some students struggle more than others to self-regulate their learning (e.g., students with LDs, developmental disabilities, attention deficits, and social and emotional disorders; for related discussion, see, in this volume, Bergin & Prewett, Chapter 14; Follmer & Sperling, Chapter 5; Hall, Capin, Vaughn, & Cannon, Chapter 7; Martin, Chapter 16; Schunk & DiBenedetto, Chapter 11; Swanson, Chapter 2). For example, students with LDs may be challenged to self-regulate for learning owing to specific difficulties with core executive functions involved in self-regulation, limited knowledge about or ineffective use of learning strategies, and negative motivational beliefs constructed in their experience at

school (Butler & Schnellert, 2015; Graham, Harris, & McKeown, 2013; Wong, Harris, Graham, & Butler, 2003). However, self-regulation is a developmental process, and there is ample research indicating any students who struggle with self-regulation can improve in this area over time and with support.

Therefore, our chapter emphasizes the protective potential of targeting self-regulatory processes as supports for exceptional learners in classrooms, with a particular focus on students with LDs (Butler & Schnellert, 2015; Englert & Mariage, 2013; Graham et al., 2013; Swanson, Kehler, & Jerman, 2010; Wong et al., 2003). Content will be presented in four main sections. First, we describe what is involved in successful self-regulated learning (SRL). Second, we offer a working definition of LDs. Our third and main section examines how a focus on SRL can help students with LDs to learn effectively in classrooms. In addition to focusing on *self*-regulation, we highlight the powerful application of co-regulation and socially shared regulation of learning with students who struggle in school. Finally, we conclude with a discussion of implications for practice and directions for future research.

WHAT IS SELF-REGULATED LEARNING?

“Self-regulated” describes individuals who control thoughts and actions to achieve goals (their own and others) and respond to environmental stimuli (Zimmerman, 2008). Executive functions are complex cognitive abilities that make goal-driven behavior possible (Blair & Ursache, 2010; Diamond, 2016). Self-regulation involves both core executive functions, such as working memory, focused attention, and inhibitory control, and higher-level executive processes, including goal-setting, planning, and problem-solving (Diamond, 2016; for related discussion, see, in this volume, Bergin & Prewett, Chapter 14; Follmer & Sperling, Chapter 5). Learners rely on working memory and/or focused attention to keep goals in mind as they complete a task (for related discussion, see Tricot, Vandenbroucke, & Sweller, Chapter 15, this volume). Similarly, inhibitory control helps them ignore internal and environmental distractions that can interfere with working memory and successful task completion. According to Diamond (2016), these core processes make cognitive flexibility possible, which is critical for higher-level processes that are required to self-regulate learning.

SRL refers to self-regulation in the context of learning. It involves metacognition (e.g., self-awareness), motivation (willingness to persist under challenging circumstances), and strategic action (knowing strategies and using them adaptively and flexibly; Butler, Schnellert, & Perry, 2017; Winne & Perry, 2000; Zimmerman, 1990). When assigned tasks in school, successfully self-regulating learners use metacognition to consider their strengths and challenges relative to the demands of the task. Then they choose and apply strategies they know will support successful task completion. Motivated by “growth mindset” (Dweck, 2006), these learners tend to focus on personal progress and deep understanding and, realizing errors are inevitable in any learning opportunity, are willing to engage with new and challenging tasks to achieve their learning targets (Hadwin, Järvelä, & Miller, 2011, 2018).

Models of SRL describe cyclical processes that guide learners’ thoughts and actions before, during, and after their engagement in learning tasks (Butler, 1995; Winne & Hadwin, 1998; Zimmerman & Campillo, 2003). Self-regulating learners actively interpret tasks, set goals, make plans, enact strategies, monitor progress, and make adjustments to cope with demands and challenges they experience while completing a

learning task (Butler et al., 2017). These models emphasize the power of self-reflection/monitoring for producing feedback loops that help learners recognize when they need to make adjustments to achieve their goals (Winne & Perry, 2000). Also important are learners' motivations (e.g., their ability beliefs, expectations for success, and the value they place on success in particular situations) for predicting their willingness to expend the effort required for engaging in cycles of strategic action to facilitate learning (Zimmerman, 2008; for related discussion, see, in this volume, Pekrun & Loderer, Chapter 18; Wigfield & Ponnock, Chapter 17).

Contemporary models of self-regulation focus on understanding its social and situated nature and introduce constructs such as co-regulation and socially shared regulation (see Hadwin et al., 2018), which may be particularly relevant for supporting students with LDs in classrooms (for related discussion, see Gillies, Chapter 22, this volume). Co-regulation builds from Vygotskian and neo-Vygotskian perspectives on learning and reflects elements of sociocultural theory, especially zones of proximal development, mediation, and internalization (McCaslin, 2009; Vygotsky, 1978; Wertch, 1985). It reflects a gradual transition from other regulation to self-regulation through, for example, modeling, instrumental feedback, or metacognitive prompts (McCaslin & Good, 1996; Schunk & Zimmerman, 1997). Adults typically co-regulate children, but children can co-regulate each other, as they work together to complete tasks and solve problems (e.g., Whitebread, 2013; Whitebread, Bingham, Grau, Pino Pasternak, & Sangster, 2007). Also, children can co-regulate adults, as they offer feedback about the extent to which tasks are too difficult or not interesting (Perry, 2013).

Socially shared regulation describes how learners regulate activity during interpersonal interactions or in collaborative tasks (Hadwin et al., 2018), but differs from co-regulation in its emphasis on mutualistic interdependence—learners co-construct task understandings and set goals together; pool metacognitive, motivational, and strategic resources to accomplish a task; and jointly monitor progress toward a shared outcome (Winne, Hadwin, & Perry, 2013). When students design projects together and take advantage of one another's expertise, they engage in socially shared regulation of learning. In socially shared regulation of learning, expertise is distributed across learners. Students with LDs may thrive in this social context where they are able to both access support and shore up their self-efficacy by contributing their gifts in a collaborative/cooperative learning situation.

Productive co-regulation and socially shared regulation of learning are enhanced by socially responsible self-regulation (Hutchinson, 2013), which involves children regulating themselves in pro-social, socially competent ways to advance their own and others' learning. Children who engage in socially responsible self-regulation regulate their own cognition, motivation, emotion, and action with particular sensitivity to "what's going on" for other learners. They want to see others succeed and have the ability to give as well as receive targeted instrumental support to complete tasks successfully. Classrooms that focus on socially responsible self-regulated learning are ideal environments for students with LDs. The culture of support within these contexts means that help-seeking is normalized for all students, and that those who struggle have multiple sources of support. Importantly, students with LDs are also expected to give support where needed, contributing to their sense of purpose and worth.

In summary, developing self-regulatory skills for learning is important for all learners, but particularly for students with LDs or learning difficulties in the context of

school. Understanding how self-regulation, co-regulation, and socially shared regulation support learning can help teachers attend to the strengths and specific challenges these learners bring to their classrooms.

WHAT IS A LEARNING DISABILITY?

Definitions of LD vary in emphasis, but there are some agreed upon elements that are reflected in the definition offered by the American Psychiatric Association (American Psychiatric Association [APA], 2013) in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; DSM-5). In the DSM-5, LDs, or specific learning disorders as they are labeled in it, are defined as unexpected neurodevelopmental disorders that begin by school age and affect the ability to learn specific and key academic skills such as reading, writing, or arithmetic (APA, 2013; for related discussion, see, in this volume, Graham & Harris, Chapter 20; Jordan, Barbieri, Dyson, & Devlin, Chapter 19; Morsanyi, Chapter 21; Tricot et al., Chapter 15). In general, it is considered that LDs may be due to heredity or problems during pregnancy or birth (e.g., exposure to toxins, brain injury), and do not result from poor instruction or lack of instruction, economic or environmental disadvantages, or sensory/motor disorders. LDs are lifelong and may affect learning at school, work, or daily living activities. Finally, they may coexist with attention, behavior, and social-emotional disorders, sensory impairments, and other medical conditions (APA, 2013; Learning Disabilities Association of Canada [LDAC], 2015; Miciak, Fletcher, & Stuebing, 2016; National Center for Learning Disabilities [NCLD], 2017; for related discussion, see Martin, Chapter 16, this volume).

Definitions of LDs emphasize how underlying cognitive processes, including, but not limited to, executive functions, critically influence individuals' success in academic domains (Mason & Reid, 2018; Meltzer, Dunstan-Brewer, & Krishnan, 2018). For example, students with LDs are often challenged to navigate academic environments and activities that place a high demand on self-regulatory skills (e.g., higher-order executive functions required in goal-oriented learning; metacognition required for self-assessment and task analysis; Butler & Schnellert, 2015; Meltzer et al., 2018; Swanson & Zheng, 2013). Therefore, supporting executive functions and developing capacities for SRL are particularly relevant to address the needs of students with LDs in school (for related discussion, see, in this volume, Follmer & Sperling, Chapter 5; Martin, Chapter 16; Tricot et al., Chapter 15).

Unfortunately, the identification and classification of LDs remain elusive (Hosp, Huddle, Ford, & Hensley, 2016; Miciak et al., 2016). Much of what is described above is difficult to operationalize in assessments, and the difficulties students with LDs experience are not unique to this group (e.g., attention and memory problems and challenges to learning in key academic areas fall under the definition of other disabilities as well). For instance, the inclusion of intelligence testing in the identification of LDs is still used in some jurisdictions despite research showing its lack of validity (Siegel, 2013). As a result, prevalence estimates vary by jurisdiction and definition (Fletcher, Stuebing, Morris, & Lyon, 2013; Miciak et al., 2016). The APA (2013) estimates that between 5 and 15% of children and youth worldwide have an LD (across academic domains) but, for example, in the United States, 5% of children enrolled in public schools have a formal diagnosis of LDs, and, in Canada, the number of children formally identified with LDs is 3.2% (Cortiella & Horowitz, 2014; LDAC, 2015).

In addition to these “identified” learners, teachers recognize that other students in their classrooms have “significant learning challenges,” but do not meet the criteria for receiving a clinical diagnosis of LD and, therefore, do not qualify for special education services. Also at issue in identifying and appropriately serving students with LDs is that learning challenges may be wrongly inferred when school contexts do not support linguistic and cultural diversity. When Western cultural and linguistic values and standards are rigidly imposed on diverse students, some groups (e.g., Indigenous learners, language minority learners) may be over- or underrepresented in special education, particularly in the LDs category (Bailey & Betts, 2009; Gersten & Woodward, 1994; Lesaux & Harris, 2013; for related discussion, see Macfarlane, Macfarlane, & Mataiti, Chapter 25, this volume). Because classroom contexts and individual learning differences may present challenges for a wide range of reasons, formal diagnosis should not be a prerequisite for transforming classroom practices that can support and empower all learners.

HOW CAN WE USE SRL TO SUPPORT STUDENTS WITH LEARNING DISABILITIES?

An efficient way to meet the learning needs of students with LDs is through tiers of effective research-based instruction offered in both general and special education settings (Vaughn, Zumeta, Wanzek, Cook, & Klingner, 2014). Tier 1 involves high-quality instruction in the general classroom that all students receive. Tier 2 refers to more intensive, targeted support for individuals and small groups of learners, which can be provided in classrooms, but is typically offered in remedial/special education settings. This structure allows for flexible design of learning opportunities that appropriately address the wide-ranging learning needs of all students in classrooms, with allowance for more intensive support for students who require it.

We agree with Butler and Schnellert (2015) that many of the challenges students with LDs experience in school can be addressed with support for SRL. Tier 2 supports for SRL have been well established in research and practice since the mid-1980s when strategy interventions became recognized as a powerful way of supporting learning in students with LDs (Wong et al., 2003). We elaborate on three well-known examples below, but we advocate for building supports for SRL directly into classroom tasks and activities, as, in most jurisdictions, students with LDs are included in general education classrooms. Moreover, classroom supports for SRL can benefit young learners who may not be identified with LDs and students who miss one or more of the “markers” for LDs in any jurisdiction. Establishing in-class structures and supports (corresponding to Tier 1 supports) is a main focus of our research, so, after discussing Tier 2 supports, we expand on our Tier 1 approach further below.

Tier 2 Supports for SRL

We elaborate on *reciprocal teaching* (Palincsar & Brown, 1984), *self-regulated strategy development* (Harris & Graham, 1996), and *strategic content learning* (Butler, 1995) as examples of Tier 2 supports for SRL. Importantly for students with LD, these approaches support the underlying executive functions that enable learners to be metacognitive, motivated for deep and meaningful learning, and strategic

(e.g., focusing students' attention on key aspects of tasks; explicitly teaching strategies for effective reading and writing). Moreover, these approaches attend to the need for learners to acquire the metacognitive "conditional knowledge" concerning the strategies they may use (i.e., knowledge of where, when, and why particular strategies can benefit their learning in particular situations), which is believed to be at least partly responsible for their strategy-related production deficiencies (Paris, Lipson, & Wixson, 1983). Each of these approaches acknowledges the importance of social supports, emphasizing how teachers and peers can scaffold/co-regulate learning. Finally, these approaches have been implemented and demonstrated to be effective for students with LDs at a wide range of age/grade levels and in a variety of contexts, including general education classrooms.

Reciprocal Teaching

Reciprocal teaching (Palincsar & Brown, 1984) was originally designed to support students with LDs who struggled with reading comprehension and was implemented as a Tier 2 support (i.e., in small groups led by remedial teachers). It encourages learners to use four strategies: predicting, questioning, summarizing, and clarifying. Palincsar and Brown chose these strategies because they reflect what "good" readers routinely do and address many of the problems students who struggle with reading comprehension experience. Specifically, they help learners to build understandings about the requirements and characteristics of reading tasks as well as to use strategies flexibly to guide comprehension. Reciprocal teaching is an iterative process that begins with readers making predictions about a new text (e.g., what they think the story will be about, based on the title and using their prior knowledge or experience with the topic). Following this discussion of predictions, the group begins to read the text, a portion at a time. One member (teacher first, then students) leads the discussion for each portion read, asking questions and then summarizing responses to create a shared synthesis of the text. Finally, the group discusses points that need clarification before repeating this cycle for the next portion of text.

How does reciprocal teaching support students with LDs to develop SRL? The four strategies provide a "metascript," or a repertoire of tactics, students can use to monitor and, when necessary, remediate comprehension. In the discussions, social forms of regulation play a key role—strategic reading progresses from other/co-regulation to self-regulation as teachers gradually guide students to independently implement the strategies (Brown & Palincsar, 1989; Pearson & Gallagher, 1983). Initially, teachers co-regulate students' participation in discussions, adjusting their feedback according to students' abilities and the challenges texts present. Over time, learners internalize the strategies and use them independently and flexibly to guide their conversations (shared regulation) about text. Then, teachers engage in less explicit instruction and modeling of the strategies and more monitoring and coaching behaviors to support self-regulation.

Palincsar and Brown (1984) observed that students who experienced reciprocal teaching improved in their ability to make predictions, generate questions, and summarize and clarify text. Moreover, through discussion and collaborative practice, learners came to see the relationship between their use of strategies and learning

outcomes, which motivated their continued engagement in this self-regulating approach to reading. Since its inception, reciprocal teaching has been used to support students with and without LDs in elementary through post-secondary settings. It continues to be used as a Tier 2 support, but also has been successfully used as a Tier 1 support for reading in general education classrooms (e.g., as part of multiple-strategy interventions, such as collaborative strategic reading and peer-assisted learning; Berkeley & Larsen, 2018; Gajria & Jitendra, 2016). Research on the use of peer-assisted learning strategies and collaborative strategic reading in elementary classrooms consistently shows improvement in strategic reading comprehension for students with a range of reading skills, and different levels of English proficiency and socioeconomic status (Fuchs & Fuchs, 2007; Klingner, Vaughn, Arguelles, Hughes, & Ahwe, 2004).

Self-Regulated Strategy Development

Self-regulated strategy development (SRSD; Harris & Graham, 1996) was designed to support students with LDs, specifically with writing disabilities, to become more strategic and agentic in their writing. Skilled writers use self-regulation strategies to take control of the process of composing, the environment in which they write, and their motivational dispositions for writing (Graham, Harris, MacArthur, & Santangelo, 2018). On the other hand, students with writing difficulties and disabilities are often challenged with initiating and sustaining their motivation to write and using productive and flexible planning, drafting, and revising strategies, and have inaccurate knowledge about writing tasks (Butler & Schnellert, 2015; Gillespie Rouse & Graham, 2016; Graham et al., 2013; for related discussion, see Graham & Harris, Chapter 20, this volume). SRSD responds to these motivational and cognitive challenges by: (a) integrating explicit instruction about writing skills and strategies and how to self-regulate the writing process (i.e., planning, drafting and revising); and (b) fostering positive attitudes and adaptive attributions to develop a sense of self as a skilled writer (Graham et al., 2018, 2013; Harris, Graham, Mason, & Friedlander, 2008).

In SRSD, students and teachers collaborate throughout six recursive stages of instruction to develop and engage in self-regulated writing (Graham et al., 2018, 2013). In the first stage, students are helped to activate and develop knowledge and skills needed to understand, acquire, and implement writing and self-regulation strategies (e.g., goal-setting, self-monitoring). The second stage focuses on introducing and discussing a given strategy (declarative and conditional knowledge about it), setting personalized goals to learn to use the strategy, and identifying effective ways to monitor progress (for related discussion, see Bergin & Prewett, Chapter 14, this volume). In a third stage, teachers model and demonstrate how and when to use writing and self-regulation strategies and invite students to generate a list of statements that could guide their writing process. Fourthly, students are encouraged to memorize strategies (i.e., steps and their meaning) through mnemonics and personalized statements. Throughout, students receive support from teachers and/or peers (fifth stage) to practice and take ownership of strategies by having them use, evaluate, and modify learned strategies to suit new tasks and settings. In a sixth stage, scaffolds fade out as students implement strategies independently and flexibly. Across stages, students are

helped to identify self-statements that may undermine their motivation and writing performance and ways to develop positive attributions and a positive view of themselves as writers.

Teachers using SRSD support students with LDs to engage in productive cycles of strategic action for writing. For example, students learn to ask themselves: “What is it I have to do here?” This supports them to understand the task, set appropriate goals, and recruit productive strategies to then engage in effective self-evaluation practices (e.g., “Have I addressed all my pre-writing points?”). Moreover, students are invited to reflect on what strategies are helping and not helping them to be productive writers, as well as when and why to use and personalize strategies in the context of specific writing tasks, building conditional knowledge (Paris et al., 1983). SRSD’s emphasis on linking strategy use to effort and positive outcomes fosters adaptive causal attributions and motivation for writing in students, which increases the likelihood of students with LDs engaging in productive forms of SRL (Graham et al., 2018).

SRSD has been extensively studied in students who struggle with writing (students with and without LDs), as well as with typically developing writers (for related discussion, see Graham & Harris, Chapter 20, this volume). Across all groups, SRSD is associated with sustained growth in writing quality and performance, knowledge of writing skills and strategies, and self-efficacy (Gillespie Rouse & Graham, 2016; Graham et al., 2018, 2013; Greene, 2018). More recently, SRSD has been implemented as a classroom-wide instructional approach to deliver the curriculum in the K–12 system, which has consistently resulted in positive gains for students with a range of writing abilities (Benedek-Wood, Mason, Wood, Hoffman, & McGuire, 2014; Harris, Graham, Friedlander, & Laud, 2013; Mason et al., 2017). Its goals of empowering students to take control over their learning, building their motivation and confidence towards writing, and fostering proficient writing skills aid in the achievement of 21st-century learning targets and open doors for higher education and employment opportunities for *all* learners.

Strategic Content Learning

Strategic content learning (SCL; Butler, 1995, 1998) is a context-specific approach to SRL that was developed to address production difficulties in students with LDs who, despite knowing learning strategies, were not strategic in using them (Butler & Schnellert, 2015; Butler et al., 2017). It combines strategy learning with practice opportunities in a wide range of authentic activities (e.g., reading, writing, studying, math problem-solving). SCL supports students’ engagement in iterative cycles of strategic action and in systematic discussions about learning and strategic processing using a problem-solving approach (Butler, Beckingham, & Lauscher, 2005). It responds to learners’ strengths, needs, and experiences to personalize strategy instruction and accomplish student-selected authentic academic tasks. Teachers (as coaches) co-regulate students through a set of statements and questions that help them to: (a) understand and interpret task demands and requirements (e.g., What are you being asked to do here?); (b) set personal goals, choose, and use co-constructed strategies to achieve their goals (e.g., What do you think you could do to achieve your goal?); (c) monitor progress and evaluate the effectiveness of the strategies used (e.g., How well is that going?); and (d) make adaptations (e.g., What could you do differently?) to achieve their own and others’ goals (for related discussion, see Bergin & Prewett, Chapter 14,

this volume). Also, teachers provide informative and effort-oriented feedback to keep students engaged in productive learning (e.g., Do you think drawing a picture to better understand the problem would help?).

As students engage in situated and iterative cycles of strategic action, they are empowered to navigate different learning tasks and environments because they: develop a deeper understanding of themselves as learners in relation to tasks; take control of their learning (e.g., they choose, generate, modify strategies); and learn to associate their effort and deliberate actions with achieving personal goals. Research involving more than 100 individual case studies (in secondary and tertiary school contexts) indicates SCL enhances students' metacognitive knowledge, perceived control over learning, self-concept as learners, and task performance over time in students with and without LDs (Butler, 2002; Butler, Elashuk, & Poole, 2000; Freeman, Harrison, Holterman, Jackson, & Cunningham, 2012). SCL has been successfully implemented across grade levels following three service delivery models: one-on-one instruction (as described above), peer tutoring, and in small groups (Butler et al., 2005). Also, SCL has been used to structure class-wide instruction with gains in self-direction and independence for secondary students (Butler, Novak, Beckingham, Jarvis, & Elashuk, 2001).

Tier 1 Supports for SRL

Whereas the strategies we profiled above began as Tier 2 supports and then moved into classrooms, our approach has been based in classrooms, working with teachers to structure tasks/activities, instructional practices, and interpersonal interactions to enable learners to develop and engage in SRL. Currently, we are evolving a set of macro and micro categories (shown in Table 13.1, originally published in Perry, Mazabel, Dantzer, & Winne, 2018) from theory and research in motivation (Jang, Reeve, & Deci, 2010; Reeve, 2006; Stefanou, Perencevich, Di Cintio, & Tuner, 2004) and self-regulation (e.g., Hadwin et al., 2018; Hutchinson, 2013; McCaslin, 2009; Perry, 1998, 2013) to reflect what teachers say and do to support SRL in *all* learners in general education classrooms. Perry's research (1998; Perry, Hutchinson, & Thauberger, 2007; Perry, Nordby, & VandeKamp, 2003; Perry & VandeKamp, 2000) has shown how students develop productive forms of self-, co-, and socially shared regulation of learning in classrooms where SRL-enabling *structures*, such as complex meaningful tasks, clear and flexible expectations/instructions, and familiar routines and norms for participation, exist. In these classrooms, support for autonomy, *giving students influence*, affords students meaningful opportunities to self-regulate learning through making choices that enable them to control challenge and self-assess learning, thus exercising metacognitive awareness and control (for related discussion, see Wehmeyer & Shogren, Chapter 12, this volume). Teachers and students in these classrooms operationalize highly effective forms of *co-* and *shared regulation*, using practices such as metacognitive questioning and formative feedback. Finally, these classrooms function as *communities of learners* in which students experience a sense of belonging and group cohesion through their co-construction of knowledge, positive non-threatening communication, and support for/celebration of diversity and one another's learning. In these classrooms, students feel supported to learn and are, therefore, motivated to engage with learning in productive, self-regulated ways.

Table 13.1 Classroom Practices that Support Self-Regulated Learning

Providing Structure	Activities, routines, and participation structures enable independent and social forms of learning, and accommodate student diversity
Tasks/Activities	Tasks and activities are complex by design (i.e., address multiple instructional goals; are meaningful and authentic; often extend over time; involve cognitive and metacognitive processes; engage students in aspects of the cycle of strategic action; allow for multiple products or ways to represent knowledge)
Expectations/Instructions	Expectations and instructions are explicitly discussed and/or co-constructed with students. Instructions and expectations are clear and flexible, and explanatory rationales are provided
Familiar Routines and Participation Structures	Predictable routines for participation and norms for engagement in activities are established or co-constructed with students. Different ways of participating are valued
Visual Prompts	Visual prompts cue students' engagement in self-regulated learning (e.g., cue metacognition, motivation for learning, and strategic action)
Giving Students Influence	Students' perspectives and experiences are acknowledged and considered. They are given opportunities to take control over their learning
Involvement in Decision Making/Meaningful Choices	Students take part in decision-making about what and how they learn. Choices involve higher levels of thinking (e.g., what resources to use, how to organize information, why to work with a particular partner)
Control over Challenge	Modifications and/or adaptations to the level of difficulty of tasks/activities and expectations regarding product(s) are made by students, or negotiated between teacher and students (e.g., students work at their own pace, choose resources that fit with their interests and abilities)
Self-Assessment	Students have opportunities to self-evaluate the quality of their work in progress, as well as at the end of projects, and can determine next steps/adaptations (e.g., What have I learned? How can I improve?)
Supporting, Scaffolding, Co-regulation	Teacher/peers/tools serve as instrumental supports for learning
Modeling/Demonstrating	Conveying the sequence of actions needed to complete a task (through talk and/or action) and giving students the opportunity to view successful practice and task completion
Questioning	Using metacognitive questions to guide learning and invite students to find solutions to problems or answers to questions on their own, rather than telling them what to do and how to do it
Feedback	Giving students formative, descriptive, and task-specific feedback focused on the learning process so students can identify and reduce distances between current progress/performance and goals
Metacognitive Language	Using and encouraging the use of metacognitive and strategic language to guide learning; engaging students in dialogue about thinking and learning processes
Motivational Messages	Attributing success to effort and using effective strategies; emphasizing progress and growth; challenging students; and communicating confidence in students as learners

(Continued)

Table 13.1 (Continued)

Creating a Community of Learners	Fostering sense of belonging and group cohesion through participation structures and the interpersonal tone of the classroom
Co-constructing Knowledge	Teachers and students are partners in learning and knowledge building
Positive/Non-Threatening Communication	Teachers and students speak to one another respectfully with encouragement. Assessment and feedback emphasize growth and downplay social comparisons
Supporting/Celebrating One Another's Learning	Students are encouraged to share goals and work collaboratively. They engage in adaptive help-seeking and spontaneous help-giving
Accommodations for Individual Differences	Tasks, activities, and assessment practices are open and flexible enough to accommodate diverse interests and abilities across students. All students can participate meaningfully and experience success

We have followed a cohort of elementary students enrolled in our longitudinal study and charted their development of SRL, along with factors that affect it, from kindergarten through Grade 5 (at the time of writing this chapter). We refer to them as the “Kindergarten Cohort.” In each year of the study, the Kindergarten Cohort has been distributed across 18–20 classrooms. Here we expand on our observations in one particular classroom to provide a concrete sense of how our macro and micro categories get operationalized in general education classrooms as SRL supports for all students, including students with learning difficulties (potential LDs). Brigitte¹ was one of 20 Grade 3 teachers in our project. The year she taught the “Kindergarten Cohort,” her class included several students with significant learning challenges.

Ivy was a kind and helpful student, who loved performing and worked hard to persist with challenging tasks. She did not have a formal diagnosis of LD,² but she did have an Individualized Education Plan (IEP) due to her significant learning challenges with reading and math. Ivy needed additional time and support to complete reading tasks, but was always willing to try new strategies.

Nate was a creative and curious student who shared great insights during class discussions. He typically struggled to complete writing tasks, since he often perseverated on details and either went off on a tangent, or became stuck. This struggle with regulation meant that Nate found it difficult to write as much as his peers. He described his lack of focus as “my mind wanders and I get lost in all of my ideas.” Nate also struggled to coordinate the skills needed to work and play cooperatively with others. Despite these challenges, Nate’s family was reluctant to pursue assessment for a formal diagnosis, so Nate was reliant on services provided in the context of his general education classroom activities.

Jackson had struggled in school since kindergarten, due in part to a hearing impairment, and suspected LDs. Jackson enjoyed and was adept at hands-on learning activities, and like Nate, was able to share his ideas verbally. However, in Grade 3, Jackson still struggled with fine motor skills needed for legible printing and generally tried to avoid writing tasks. He worked hard to increase his reading

vocabulary, but still found decoding difficult. In addition, Jackson applied himself to learning new concepts, but was easily distracted. He required extensive repetition, and extra time and support both to learn and express new ideas.

Brigitte was challenged with how best to meet these students' needs and include them in her classroom community. However, subsequent to participating in the professional learning that was part of the longitudinal study, and attending a summer institute on SRL provided by the same researchers, she was inspired by the possibilities of using SRL-promoting practices to create a classroom context that could address the complex learning needs of her students (academic/intellectual, motivational, social-emotional). Over the course of the year, we observed how Brigitte used instrumental structures, student influence, co-regulation, and community to support *all* students' learning and, especially, to meaningfully include *and* support the academic development of Ivy, Nate, and Jackson in all classroom activities.

Structure

When teachers use structures in instrumental, autonomy-supportive, and non-controlling ways, students develop a clear sense of “what to do” and feel in control of their learning (Reeve, 2006; Taylor & Ntoumanis, 2007). Well-structured tasks that present clear instructions and expectations, predictable routines, and familiar norms for participation are associated with perceived competence and actual improvements in motivation, engagement, and learning (Reeve, 2006; Taylor & Ntoumanis, 2007). Brigitte used well-structured tasks to address multiple goals and accommodate wide-ranging student abilities, disabilities, and interests. For example, we observed an instructional unit on biodiversity and ecosystems that lasted for approximately 12 weeks. The overarching goal for the unit was to support students to develop knowledge about biodiversity and, particularly, to recognize biodiversity in local environments—where they live and learn. However, Brigitte also used this unit to support students' writing of expository text and she embedded opportunities for creative and artistic expression, reading and telling stories, discussion, and outdoor education and exploration. In this way, students engaged in a wide range of processes to support their learning and produced a number of artifacts that demonstrated their learning through multiple modalities.

Brigitte started the unit by reading a story and then walking with the class to a local park where students could make connections between key ideas in the story and their local environment. She prompted them to use their senses to observe features of man-made and naturally forested areas. When they returned to the school, the class discussed what they saw and heard on their walk. Brigitte repeated these walks and talks throughout the unit to support progressively deeper understandings of biodiversity. In addition, Brigitte prompted students to work with ideas through painting, drawing, and using plasticine. These hands-on learning activities were purposefully structured to offer multiple points of entry to the content and support all students in accomplishing the task. For example, Ivy likely engaged more readily with listening and speaking than with reading activities, whereas Jackson may have appreciated the opportunity to work with plasticine to develop his ideas, and Nate benefited from discussions in which the class co-constructed content for writing. Brigitte's instrumental structuring of tasks and activities during the

unit helped all students to increase their background knowledge about the topic and develop an appropriate writing plan in advance of writing. In addition, these activities helped to foster these students' motivation and interest for academic writing. It was a particularly effective motivational strategy for Jackson, who told researchers he disliked writing, but worked hard on this project because he thought learning about ecosystems was both interesting and important.

To set students up for writing, Brigitte invited them to represent their learning by creating their own version of an ecosystem using "loose parts" (objects such as feathers, pinecones, and wood pieces she brought into the classroom). She encouraged them to think about the beach, the farmland, the bog, and the neighborhoods they had talked about and visited over the course of the unit. As students enthusiastically gathered materials and created their pictures, Brigitte made clear her rationale for having them work this way: "This is going to be your writing prompt." She also coached them to be thoughtful and effortful, "so take your time, use all of your creative energies" (observation, May 8, 2017), to ensure the artifacts created would offer rich visual prompts for writing. In response, Jackson created a scene from a natural conservation area across the street from the school. He included a walkway, some trees, and water. Nate took his time creating an intricate beach scene, including a rocky shoreline and an aquatic dinosaur (taking some license with historic accuracy). Ivy made a picture of a river or creek, with animals and trees nearby.

When most students were finished and satisfied with what they had created, they engaged in a "carousel walk." This was a familiar participation structure in which table groups visited one another to view and hear about the thinking and learning behind their peers' representations. Some students made changes to their representations, if they received helpful feedback or heard an inspiring idea, and Brigitte encouraged this response. Brigitte's structuring of tasks for the biodiversity unit, the support she provided through class-wide discussion, and these peer interactions supported Jackson, Nate, and Ivy to talk about their learning, answer questions, see what peers were creating, and exchange ideas about their work. These activities prepared them to be metacognitive, motivated, and strategic about the aspects of the unit they found difficult.

Student Influence

Teachers create opportunities for students to regulate learning when they involve students in making meaningful decisions for the class and for themselves. They give students influence by providing them with opportunities to make choices (within a supportive task structure), control challenge, and engage in self-assessment (Perry, 1998, 2013). In Brigitte's biodiversity unit, students were invited to use their personalized ecosystems (created in the "loose parts" activity) as a provocation for writing an expository essay. Brigitte provided them with a pre-writing template with space to make a concept map (to brainstorm ideas from their learning that they wanted to include in their text), then a point form list (to organize ideas), and then space to generate key pieces of their paragraphs. She also shared several strategies as possible supports for learning. It was typical for Brigitte to discuss strategies that "could be helpful" with students before and during their work time. Her goal was to offer ideas for students who might get stuck, but she offered the strategies as choices for everyone and prompted students to think deeply about which strategies would work best for them.

Many of the choices Brigitte offered created opportunities for students to control challenge. For example, as students worked on this pre-writing task, Brigitte suggested: “For those of you who want more practice [at writing opening sentences], you can write on the back [of your paper]” (observation, May 8, 2017). Similarly, choices often prompted self-monitoring and self-assessment as, for example, students considered how many “practice” sentences to generate before launching into their official text, where to work to optimize productivity, and whether to remain at the carpet when work time started to receive additional support from peers and the teacher.

Together these opportunities to take control of learning prompted students’ metacognition (What strengths do I bring to this task?), strategic action (What can I do here to optimize my learning?), and motivation for learning (I feel I have the resources to be successful). This is particularly important for students with LDs and other learning challenges, as research consistently finds they experience more positive outcomes (greater sense of competence; lower levels of anxiety; higher levels of engagement; desire for deep learning; willingness to persist when tasks are challenging; and increased achievement) in classrooms where they perceive a high degree of autonomy (Perry, 1998; Reeve, 2006; Reeve & Halusic, 2009; Stefanou et al., 2004). Reflecting on their learning in the biodiversity unit, Nate, Jackson, and Ivy acknowledged that they struggled at times (e.g., Ivy reported that the number of instructions for the writing task was confusing), but overall they emerged feeling satisfied with their learning (e.g., Jackson commented, “It’s part of taking [care] of the ecosystem,” and Nate said the activity was “really exciting”).

Supporting/Scaffolding/Co-regulation

Ideally, co-regulation leads to productive forms of self-regulation, or shared regulation, and so co-regulators need to transfer knowledge in a way that enables recipients to act independently in the future (Perry et al., 2018). Co-regulation happens through the structures and autonomy supports we described above, but classroom discourse is also a powerful vehicle for supporting students’ development of and engagement in SRL. Conversations about learning and strategies for learning were common in Brigitte’s classroom. Brigitte was particularly adept at using metacognitive questioning to help students find solutions to problems.

For example, when Nate was having a hard time writing his ideas about biodiversity, Brigitte asked, “What is causing the obstacle here that is stopping you from working?” After some discussion, they agreed Nate was avoiding the task (an academically maladaptive self-regulatory strategy). Brigitte affirmed Nate’s ability to generate many great ideas and acknowledged that writing them down is difficult. She began asking him questions about his loose parts picture and encouraged him to write his responses one question at a time. This co-regulation both prompted strategic action to help him move ahead with his task and helped Nate develop more metacognitive awareness of his learning challenges. In the future, this kind of learning could help Nate to deal independently with his writing challenges or adaptively seek instrumental support to successfully complete academic and other tasks.

Brigitte’s feedback to students was always specific and encouraging, with a focus on growth mindset messages (Dweck, 2006). For example, she encouraged students to access the help they needed to move ahead with their learning (“you need to ask for

help if you are confused. Is there anything wrong with that?”). Often, she positioned herself as a learner, modeling or demonstrating how she approaches problems similar to those that the students might be experiencing. When students were brainstorming and organizing ideas for writing, she explained,

If you are like me, I might look at some of this [the loose parts representations] and get a really good idea, then quickly write it on the back [of the planning template] if I don't want to commit [to it in my text, yet] .

(observation, May 8, 2017)

These kinds of strategies helped make explicit the kind of thinking students with LDs often struggle to carry out. Ivy, Nate, and Jackson may have engaged with the content owing to hands-on learning activities, but students with LDs often struggle with translating this engagement to written expression. In this example, Brigitte showed students explicitly how to translate the ideas in their creations into a text-based outline they could then use to help plan their writing task.

Participation structures in Brigitte's classroom supported cooperation and collaboration among students. Students were able to work independently or as part of groups located in different areas around the room. This facilitated peer support. Students often were observed asking one another about spellings, or discussing how they might expand their writing or make their writing more interesting. Groups also helped each other to stay on task by monitoring individual and shared processes and noting when they were demonstrating off-task behaviors. These kinds of social support may have helped Nate and Jackson stay on task, and helped all three students to write more fluently. Jackson's enthusiasm for the content might spread to his peers, allowing him to take the lead in a co-regulation event. Importantly, by creating opportunities for students to engage in co- and shared regulation of learning, much of the social and behavioral regulation in Brigitte's classroom was taken care of by students, freeing her to address the needs of students with more serious learning challenges.

Community of Learners

Brown and Campione (1994) characterized classroom communities as spaces where students' work combines individual responsibility with social supports and where students share information and strategies for learning. We have seen how Brigitte created an atmosphere of interdependence and reciprocity through, for example, creating opportunities for students to co-construct knowledge (going on walks to examine local ecosystems; engaging in extended discussions about their learning). Also clear is how Brigitte modeled positive and non-threatening communication, and, in turn, students provided one another with feedback that was respectful, encouraging, and instrumental (as in the carousel walk). Especially for students like Nate, Ivy, and Jackson, being part of a cohesive learning community provides intellectual and motivational support (beyond what general and special education teachers can provide) for regulating learning toward the completion of challenging activities (Englert & Mariage, 2003, 2013; Reeve, 2006). This community is particularly important for students with LDs who may struggle with social isolation (perceived and real) owing to their learning differences, challenges with social learning, or participation in separate/pull-out programming.

In the biodiversity unit, Brigitte expected all students to produce a written report and she understood the demands of the written assignment were high. She paid special attention to cultivating students' motivation and curiosity by assigning a wide range of associated tasks that enabled students to engage with content in different ways and be successful. Students may have seen, for example, that Nate shared important insights during class discussions. By accommodating multiple zones of proximal development within the biodiversity unit (Brown & Campione, 1994), Brigitte ensured all students were meaningfully included, felt valued, and were successful. Importantly, students with LDs or other learning difficulties were recognized as having strengths and making contributions. Rather than being singled out for requiring additional support, Brigitte normalized their learning differences through her use of SRL supports.

By the end of the unit, each student, including Jackson, Ivy, and Nate, had written at least one page about their ecosystem. Jackson wrote about the conservation area, noting the importance of the food chain, specialized plants, and living and nonliving things. In his final reflection on the activity, he reported feeling both happy and frustrated during the unit: "I don't like writing that much really because [it's] not my thing, [but] I felt happy because I'm learning to focus on the work." Ivy talked about the unique features of a farm ecosystem in her report, including how a food chain works differently at a farm, and Nate talked about a local bog that has "bouncy" ground that produces oxygen. He explained some of the differences between living and nonliving things, and some of the animals found in the bog. By attending to structure, student influence, scaffolding, and the community of learners, Brigitte was able to create a highly motivating classroom environment where students, including those who struggled with learning, could self-regulate their learning strategies, persist in an intellectually challenging task, and engage in cycles of strategic action. Brigitte recorded her observations of students' learning throughout the unit (e.g., recording a comment made during a discussion), but, at the end of the unit, she found each student produced significant written outputs, which more than adequately demonstrated their learning about biodiversity. In addition, students such as Ivy, Nate, and Jackson were able to see themselves as accomplished learners. The metacognition, learning strategies, and growth mindset thinking they practiced over the course of the unit likely increased their proficiency for future learning/writing tasks and will help them advocate for the supports they require.

IMPLICATIONS FOR PRACTICE

Self-regulation is associated with positive outcomes across the life span. In the school years, self-regulation is associated with early adjustment to and success in school (Rimm-Kaufman et al., 2009; Vernon-Feagans, Willoughby, & Garrett-Peters, 2016). Self-regulation is also a significant source of achievement differences (Schunk & Zimmerman, 1997). Children who struggle to self-regulate in the context of learning tend to experience both academic and interpersonal problems. Often, poor self-regulation results in failure, which can lead to low self-esteem and low self-efficacy for controlling outcomes in and beyond school (Butler, 2004; for related discussion, see, in this volume, Pekrun & Loderer, Chapter 18; Schunk & DiBenedetto, Chapter 11; Wigfield & Ponnock, Chapter 17). Poor decision-making and "risky"

behavior in adolescence are also associated with poor self-regulation (Magar, Phillips, & Hosie, 2008; for related discussion, see, in this volume, Hue, Chapter 10; O'Donnell & Reschly, Chapter 23; Pekrun & Loderer, Chapter 18). Thus, there is a strong case for attending to children's development of and engagement in self-regulation and supporting SRL in school.

Supporting SRL is important for all learners, but we have focused specifically on students with LDs in this chapter. Researchers and practitioners have been targeting executive functions and SRL within Tier 2 supports for these learners for some time. We have argued (Perry, Yee, Mazabel, Lisaingo, & Määttä, 2017) that opportunities and supports for SRL should also be a focus in general education classrooms (as Tier 1 supports) where, in most jurisdictions and school districts, students with LDs (and other high-incidence categories) spend the majority of their time. Embedding supports for SRL in regularly occurring classroom activities benefits students with LDs, and their peers, by helping them to acquire knowledge and skills in academic domains (e.g., reading, writing, arithmetic), but also to develop metacognitive skills, positive motivational attributions about themselves as learners, and strategic approaches for coping with challenges they will inevitably encounter in learning and living across their life span.

As we detailed in our classroom example earlier, it is particularly important for teachers to attend to task and activity structures, student influence, scaffolding/co-regulation, and fostering a sense of community within the classroom. Brigitte accomplished this by designing complex, open-ended, and meaningful learning tasks and activities that offered students opportunities to take control of their learning and demonstrate their learning in a variety of ways. She created a community of learners through frequent sharing of ideas and insights and through familiar group participation structures that enabled students to engage in socially shared and socially responsible regulation. Her focus on SRL-promoting practices supported students with LDs to develop their metacognition, motivation, and learning strategies to: successfully meet learning targets, become more efficient learners, and maintain motivation and self-esteem when challenged by particular learning tasks.

Supporting SRL requires specialized knowledge and skills on the part of teachers. Therefore, a main component of our research is engaging in collaborative inquiry with teachers (see Perry, Brenner, & MacPherson, 2015, for a detailed description of our "teacher learning teams"). Teachers are guided and supported to hone their teaching toward SRL in an inquiry learning context that is much like the one they are trying to create for their students (i.e., we use frameworks that involve them in self-, co-, and shared regulation of teaching). This approach to professional learning recognizes that meeting the diverse needs of students (with and without LDs) in particular classrooms is complex and contrasts with traditional "expert-led" workshops that seldom lead to lasting changes in teachers' practices (Butler & Schnellert, 2012; Perry et al., 2015). We particularly emphasize developing and implementing SRL-promoting practices that acknowledge and accommodate the diverse needs of students in general classrooms today. We perceive advancing research and practice in SRL depends on productive collaborations between researchers and teachers, and, through these collaborations, teachers can develop sound practices for meeting the diverse academic, social, motivational, and emotional needs of their students.

FUTURE DIRECTIONS FOR RESEARCH

More research is needed to support broader application of SRL frameworks in classrooms. Our research focuses on a set of macro and micro categories (in Table 13.1), arising from naturalistic observations of supports for SRL across the broad range of activities teachers and students engage in on a daily basis. The macro categories identify what Perry (2013) and others (e.g., Reeve, 2006) have consistently observed about classrooms where SRL occurs. In these contexts, teachers balance structural supports with autonomy supports, there is a lot of co-regulation going on, and students experience a strong sense of belonging and commitment to a community of learners. The micro categories identify specific processes/practices for accomplishing the macro categories. A future direction for research is examining how making teachers aware of these categories can help them to support students' SRL, and how students with LDs benefit from these supports. Related to this, developing ecologically valid and trustworthy assessments of children self-regulating learning is important. We are currently working with teachers to develop formative assessments of SRL—assessments *for* SRL—and asking how these tools help them to set goals, shape instruction, and provide feedback to students to enhance their promotion of SRL. These tools may make teachers more aware of the specific challenges students with LDs experience with SRL and support their development of targeted supports for these students. Also, formative assessments of SRL may highlight relative strengths of students, when they use SRL. More research is needed surrounding these potential outcomes.

Finally, more research is needed to determine whether and how SRL frameworks might be used to support learners across diverse sociodemographic groups. Research we have reviewed suggests self-regulation is an asset that cuts across social, economic, linguistic, and cultural differences (Perry et al., 2017). SRL-promoting practices might do a lot to create classrooms that build on and nurture the strengths of students with diverse cultural, linguistic, or learning strengths and challenges, effectively helping to better distinguish learning differences from disabilities so that accurate assessments of learning needs can be made. The preponderance of the research about SRL with general and special education students has involved language majority learners from Western cultures. Research that explicitly addresses the “flexibility” of SRL-promoting practices for including a wide range of cultural perspectives and learning profiles is needed (for related discussion, see Macfarlane et al., Chapter 25, this volume).

CONCLUSION

SRL-promoting practices have demonstrated efficacy for supporting students with LDs in both Tier 1 and Tier 2 contexts. Moreover, SRL is highly relevant in discussions about what learners need to know and be able to do to function well in the global, knowledge-based societies of the 21st century. These discussions emphasize the need to be lifelong learners who apply knowledge adaptively and flexibly to solve new and complex problems, and to cope with rapidly and continuously changing technologies (Dumont, Instance, & Benavides, 2010). Therefore, building from a solid research base on SRL seems an appropriate focus for researchers and practitioners in the fields of educational psychology and special education.

NOTE

- 1 All teacher and student names are pseudonyms.
- 2 This is not unusual for students in early elementary grades in our jurisdiction, where Tier 1 and 2 strategies are tried before referrals are made for psycho-educational testing. Often students receive their formal diagnosis in Grade 3 or 4, but services can be provided without this designation (as indicated by the provision of an IEP).

REFERENCES

- American Psychiatric Association (APA). (2013). *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5). Washington, DC: Author.
- Bailey, B., & Betts, P. (2009). Culture and special education. *International Journal of Special Education*, 24, 78–84.
- Benedek-Wood, E., Mason, L. H., Wood, P. H., Hoffman, K. E., & McGuire, A. (2014). An experimental examination of quick writing in the middle school science classroom. *Learning Disabilities: A Contemporary Journal*, 12, 69–92.
- Berkeley, S., & Larsen, A. (2018). Fostering self-regulation of students with learning disabilities: Insights from 30 years of reading comprehension intervention research. *Learning Disabilities Research and Practice*, 33, 75–86. doi:10.1111/ldrp.121
- Blair, C., & Ursache, A. (2010). A bidirectional model of executive functions and self-regulation. In K. D. Vohs & R. F. Baumeister (Eds.), *Handbook of self-regulation: Research, theory, & applications* (2nd ed., pp. 300–320). New York: Guilford Press.
- Brown, A. L., & Campione, J. C. (1994). Guided discovery in a community of learners. In K. McGilly (Ed.), *Classroom lessons: Integrating cognitive theory with classroom practice* (pp. 229–270). Cambridge, MA: MIT Press.
- Brown, A. L., & Palincsar, A. S. (1989). Guided, cooperative learning and individual knowledge acquisition. In L. B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 393–451). Hillsdale, NJ: Lawrence Erlbaum.
- Butler, D. L. (1995). Promoting strategic learning by postsecondary students with learning disabilities. *Journal of Learning Disabilities*, 28, 170–190. doi:10.1177/00222194502800306
- Butler, D. L. (1998). The strategic content learning approach to promoting self-regulated learning: A report of three studies. *Journal of Educational Psychology*, 90, 682–697. doi:10.1037/0022-0663.90.4.682
- Butler, D. L. (2002). Individualizing instruction in self-regulated learning. *Theory into Practice*, 41, 81–92. doi:10.1207/s15430421tip4102_4
- Butler, D. L. (2004). Adults with learning disabilities. In B. Y. L. Wong (Ed.), *Learning about learning disabilities* (3rd ed., pp. 565–598). Toronto, ON: Academic Press. doi:10.1016/B978-012762533-1/50020-2.
- Butler, D. L., Beckingham, B., & Lauscher, H. J. N. (2005). Promoting strategic learning by eight-grade students struggling in mathematics: A report of three case studies. *Learning Disabilities Research and Practice*, 20, 10.1111/j.1540-5826.2005.00130.x
- Butler, D. L., Elaschuk, C. L., & Poole, S. (2000). Promoting strategic writing by postsecondary students with learning disabilities: A report of three case studies. *Learning Disability Quarterly*, 23, 196–213. doi:10.2307/1511164
- Butler, D. L., Novak, H. J., Beckingham, B., Jarvis, S., & Elaschuk, C. (2001, April). *Professional development and meaningful change: Towards sustaining an instructional innovation*. Paper presented at the annual meeting of the American Educational Research Association, Seattle, WA.
- Butler, D. L., & Schnellert, L. (2012). Collaborative inquiry in teacher professional development. *Teaching and Teacher Education*, 28, 1206–1220. doi:10.1016/j.tate.2012.07.009
- Butler, D. L., & Schnellert, L. (2015). Success for students with learning disabilities: What does self-regulation have to do with it?. In T. Cleary (Ed.), *Self-regulated learning interventions with at-risk youth: Enhancing adaptability, performance, and well-being* (pp. 89–112). Washington, DC: APA Press. doi:10.1037/14641-000
- Butler, D. L., Schnellert, L., & Perry, N. E. (2017). *Developing self-regulating learners*. Upper Saddle River, NJ: Pearson Education.
- Cleary, T. J., & Zimmerman, B. J. (2006). Teachers' perceived usefulness of strategy microanalytic assessment information. *Psychology in the Schools*, 43, 149–155. doi:10.1002/pits.20141

- Cortiella, C., & Horowitz, S. H. (2014). *The state of learning disabilities: Facts, trends and emerging issues* (3rd ed.). New York: National Center for Learning Disabilities.
- Diamond, A. (2016). Why assessing and improving executive functions early in life is critical. In J. A. Griffin, P. McCardle, & L. Freund (Eds.), *Executive function in preschool-age children: Integrating measurement, neurodevelopment, and translational research* (pp. 11–43). Washington, DC: American Psychological Association. doi:10.1037/14797-000
- Dumont, H., Istance, D., & Benavides, F. (Eds.). (2010). *The nature of learning: Using research to inspire practice. Practitioner guide from the Innovative Learning Environments Project*. Paris: OECD, Centre for Educational Research and Innovation. Retrieved from www.oecd.org/edu/ceri/50300814.pdf
- Dweck, C. (2006). *Mindset: The new psychology of success*. New York: Random House.
- Englert, C. S., & Mariage, T. (2003). The sociocultural model in special education interventions: Apprenticing students in higher-order thinking. In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* (pp. 450–467). New York: Guilford Press.
- Englert, C. S., & Mariage, T. (2013). The sociocultural model as a framework in instructional intervention research. In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* (2nd ed., pp. 545–564). New York: Guilford Press.
- Fletcher, J. M., Stuebing, K. K., Morris, R. D., & Lyon, G. R. (2013). Classification and definition of learning disabilities: A hybrid model. In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* (2nd ed., pp. 33–51). New York: Guilford Press.
- Freeman, J. G., Harrison, A., Holtermann, E., Jackson, I., & Cunningham, T. (2012). Navigating the postsecondary landscape. In B. Wong & D. L. Butler (Eds.), *Learning about learning disabilities* (4th ed., pp. 355–375). Amsterdam: Elsevier Academic Press.
- Fuchs, D., & Fuchs, L. S. (2007). Increasing strategic reading comprehension with peer-assisted learning activities. In D. McNamara (Ed.), *Reading comprehension strategies: Theories, interventions, and technologies* (pp. 175–197). Mahwah, NJ: Lawrence Erlbaum. doi:10.4324/9780203810033
- Gajria, M., & Jitendra, A. K. (2016). Effective strategies for developing reading comprehension. In R. Schiff. & R. Joshi (Eds.), *Interventions in learning disabilities: A handbook on systematic training programs for individuals with learning disabilities* (pp. 119–139). Cham, Switzerland: Springer. doi:10.1007/978-3-319-31235-4_11
- Gersten, R., & Woodward, J. (1994). The language minority student and special education: Issues, trends, and paradoxes. *Exceptional Children*, 60, 310–322. doi:10.1177/001440299406000403
- Gillespie Rouse, A., & Graham, S. (2016). Best practices in writing instruction for students with learning disabilities. In R. Schiff. & R. Joshi (Eds.), *Interventions in learning disabilities: A handbook on systematic training programs for individuals with learning disabilities* (pp. 175–190). Cham, Switzerland: Springer. doi:10.1007/978-3-319-31235-4_11
- Goldberg, R. J., Higgins, E. L., Raskind, M. H., & Herman, K. L. (2003). Predictors of success in individuals with learning disabilities: A qualitative analysis of a 20-year longitudinal study. *Learning Disabilities Research & Practice*, 18, 222–236. doi:10.1111/1540-5826.00077
- Graham, S., Harris, K. R., MacArthur, C., & Santangelo, T. (2018). Self-regulation and writing. In D. H. Schunk & J. A. Greene (Eds.), *Handbook of self-regulation of learning and performance* (2nd ed., pp. 138–152). New York: Routledge. doi:10.4324/9781315697048
- Graham, S., Harris, K. R., & McKeown, D. (2013). The writing of students with learning disabilities, meta-analysis of self-regulated strategy development writing intervention studies, and future directions: Redux. In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* (2nd ed., pp. 405–438). New York: Guilford Press.
- Greene, J. A. (2018). *Self-regulation in education*. New York: Routledge.
- Hadwin, A. F., Järvelä, S., & Miller, M. (2011). Self-regulated, co-regulated, and socially shared regulation of learning. In B. J. Zimmerman & D. H. Schunk (Eds.), *Handbook of self-regulation and performance* (pp. 65–84). New York: Routledge. doi:10.4324/9780203839010.ch5
- Hadwin, A., Järvelä, S., & Miller, M. (2018). Self-regulation, co-regulation and shared regulation in collaborative learning environments. In D. H. Schunk & J. A. Greene (Eds.), *Handbook of self-regulation of learning and performance* (2nd ed., pp. 83–106). New York: Routledge. doi:10.4324/9781315697048
- Harris, K. R., & Graham, S. (1996). *Making the writing process work: Strategies for composition and self-regulation*. Cambridge, MA: Brookline Books.
- Harris, K. R., Graham, S., Friedlander, B., & Laud, L. (2013). Bring powerful writing strategies into your classroom! Why and how. *The Reading Teacher*, 66, 538–542. doi:10.1002/TRTR.1156

- Harris, K. R., Graham, S., Mason, L. H., & Friedlander, B. (2008). *Powerful writing strategies for all students*. Baltimore, MD: Brookes.
- Hosp, J. L., Huddle, S., Ford, J. W., & Hensley, K. (2016). Learning disabilities/special education. In S. R. Jimerson, M. K. Burns, & A. M. VanDerHeyden (Eds.), *Handbook of response to intervention: The science and practice of multi-tiered systems of support* (2nd ed., pp. 43–58). New York: Springer. doi:10.1007/978-1-4899-7568-3.
- Hutchinson, L. R. (2013). *Young children's engagement in self-regulation at school*. Doctoral dissertation. Retrieved from <https://open.library.ubc.ca/cIRcle/collections/ubctheses/24/items/1.0073717>
- Jang, H., Reeve, J., & Deci, E. L. (2010). Engaging students in learning activities: It is not autonomy support or structure, but autonomy support and structure. *Journal of Educational Psychology*, 102, 588–600. doi:10.1037/a0019682
- Klingner, J. K., Vaughn, S., Arguelles, M. E., Hughes, M., & Ahwee, S. (2004). Collaborative strategic reading: “Real-world” lessons from classroom teachers. *Remedial and Special Education*, 25, 291–302.
- Learning Disabilities Association of Canada (LDAC). (2015). *Official definition of learning disabilities*. Retrieved from: www.ldac-acta.ca/learn-more/ld-defined/
- Lesaux, N. K., & Harris, J. R. (2013). Linguistically diverse students’ reading difficulties: Implications for models of learning disabilities identification and effective instruction. In L. H. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* (2nd ed., pp. 69–84). New York: Guilford Press.
- Magar, E. C. E., Phillips, L. H., & Hosie, J. A. (2008). Self-regulation and risk-taking. *Personality and Individual Differences*, 45, 153–159. doi:10.1016/j.paid.2008.03.014
- Mason, L. H., Cramer, A. M., Garwood, J. D., Varghese, C., Hamm, J., & Murray, A. (2017). Efficacy of self-regulated strategy development instruction for developing writers with and without disabilities in rural schools: A randomized control trial. *Rural Special Education Quarterly*, 36, 168–179. doi:10.1177/8756870517723617
- Mason, L. H., & Reid, R. (2018). Self-regulation: Implications for individuals with special needs. In D. H. Schunk & J. A. Greene (Eds.), *Handbook of self-regulation of learning and performance* (2nd ed., pp. 472–484). New York: Routledge. doi:10.4324/9781315697048.
- McCaslin, M. (2009). Co-regulation of student motivation and emergent identity. *Educational Psychologist*, 44, 137–146. doi:10.1080/00461520902832384
- McCaslin, M., & Good, T. L. (1996). The informal curriculum. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 622–670). New York: Simon & Schuster Macmillan.
- McClelland, M., Morrison, F., & Holmes, D. (2000). Children at risk for early academic problems: The role of learning-related social skills. *Early Childhood Research Quarterly*, 15, 3017–3329. doi:10.1016/S0885-2006(00)00069-7
- Meltzer, L., Dunstan-Brewer, J., & Krishnan, K. (2018). Learning differences and executive function. In L. Meltzer (Ed.), *Executive function in education: From theory to practice* (2nd ed., pp. 109–141). New York: Guilford Press.
- Miciak, J., Fletcher, J. M., & Stuebing, K. K. (2016). Accuracy and validity of methods for identifying learning disabilities in a response-to-intervention service delivery framework. In S. R. Jimerson, M. K. Burns, & A. M. VanDerHeyden (Eds.), *Handbook of response to intervention: The science and practice of multi-tiered systems of support* (2nd ed., pp. 421–440). New York: Springer. doi:10.1007/978-1-4899-7568-3.
- National Center for Learning Disabilities (NCLD). (2017). *The state of LD: Executive summary*. Retrieved from: www.nclld.org/executive-summary
- Palincsar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction*, 2, 117–175. doi:10.1207/s1532690xci0102_1
- Paris, S., Lipson, M., & Wixson, K. (1983). Becoming a strategic reader. *Contemporary Educational Psychology*, 8, 293–316. doi:10.1016/0361-476X(83)90018-8
- Pearson, P. D., & Gallagher, M. C. (1983). The instruction of reading comprehension. *Contemporary Educational Psychology*, 8, 317–344. doi:10.1016/0361-476X(83)90019-X
- Perry, N. E. (1998). Young children’s self-regulated learning and the contexts that support it. *Journal of Educational Psychology*, 90, 715–729. doi:10.1037/0022-0663.90.4.715
- Perry, N. E. (2013). Classroom processes that support self-regulation in young children [Monograph]. *British Journal of Educational Psychology, Monograph Series II: Psychological Aspects of Education—Current Trends*, 10, 45–68. doi:10.1037/0022-0663.90.4.715
- Perry, N. E., Brenner, C. A., & MacPherson, N. (2015). Teacher learning teams as a framework for bridging theory and practice in self-regulated learning. In T. Cleary (Ed.), *Self-regulated learning interventions with at-risk youth: Enhancing adaptability, performance, and well-being* (pp. 229–250). Washington, DC: American Psychological Association. doi:10.1037/14641-000

- Perry, N. E., Hutchinson, L., & Thauberger, C. (2007). Mentoring teachers to design and implement literacy tasks that support self-regulated reading and writing. *Reading Writing Quarterly*, 23, 27–50. doi:10.1080/10573560600837636
- Perry, N. E., Mazabel, S., Dantzer, B., & Winne, P. (2018). Supporting self-regulation and self-determination in the context of music education. In G. A. D. Liem & D. M. McInerney (Eds.), *Big theories revisited 2: A volume of research on sociocultural influences on motivation and learning* (pp. 295–318). Charlotte, NC: Information Age Press.
- Perry, N. E., Nordby, C. J., & VandeKamp, K. O. (2003). Promoting self-regulated reading and writing at home and school: A tale of two contexts. *Elementary School Journal*, 103, 317–338. doi:10.1086/499729
- Perry, N. E., & VandeKamp, K. O. (2000). Creating classroom contexts that support young children's development of self-regulated learning. *International Journal of Educational Research*, 33, 821–843. doi:10.1016/S0883-0355(00)00052-5
- Perry, N. E., Yee, N., Mazabel, S., Lisaingo, S., & Määttä, E. (2017). Using self-regulated learning as a framework for creating inclusive classrooms for ethnically and linguistically diverse learners in Canada. In N. J. Cabrera & B. Leyendecker (Eds.), *Handbook on positive development of minority children and youth* (pp. 361–384). Cham, Switzerland: Springer Nature.
- Reeve, J. (2006). Teachers as facilitators: What autonomy-supportive teachers do and why their students benefit. *Elementary School Journal*, 106, 225–236. doi:10.1086/501484
- Reeve, J., & Halusic, M. (2009). How K-12 teachers can put self-determination theory principles into practice. *Theory and Research in Education*, 7, 145–154. doi:10.1177/1477878509104319
- Rimm-Kaufman, S. E., Curby, T. W., Grimm, K. J., Nathanson, L., & Brock, L. L. (2009). The contribution of children's self-regulation and classroom quality to children's adaptive behaviors in the kindergarten classroom. *Developmental Psychology*, 45, 958–972. doi:10.1037/a0015861
- Schunk, D. H., & Zimmerman, B. J. (1997). Social origins of self-regulatory competence. *Educational Psychologist*, 32, 195–208. doi:10.1207/s15326985ep3204_1
- Siegel, L. (2013). *Understanding dyslexia and other learning disabilities*. Vancouver, BC: Pacific Educational Press.
- Stefanou, C. R., Perencevich, K. C., Di Cintio, M., & Tuner, J. C. (2004). Supporting autonomy in the classroom: Ways teachers encourage student decision-making and ownership. *Educational Psychologist*, 39, 97–110. doi:10.1207/s15326985ep3902_2
- Swanson, H. L., Kehler, P., & Jerman, O. (2010). Working memory, strategy knowledge, and strategy instruction in children with reading disabilities. *Journal of Learning Disabilities*, 43, 24–47. doi:10.1177/0022219409338743
- Swanson, H. L., & Zheng, X. (2013). Memory difficulties in children and adults with learning disabilities. In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* (2nd ed., pp. 214–238). New York: Guilford Press.
- Taylor, I. M., & Ntoumanis, N. (2007). Teacher motivational strategies and student self-determination in physical education. *Journal of Educational Psychology*, 99, 747–760. doi:10.1037/0022-0663.99.4.747
- Vaughn, S., Zumeta, R., Wanzek, J., Cook, B., & Klingner, J. K. (2014). Intensive interventions for students with learning disabilities in the RTI era: Position statement of the division of learning disabilities council for exceptional children. *Learning Disabilities Research & Practice*, 29, 90–92. doi:10.1111/ldrp.12039
- Vernon-Feagans, L., Willoughby, M., & Garrett-Peters, P. (2016). Predictors of behavioral regulation in kindergarten: Household chaos, parenting, and early executive functions. *Developmental Psychology*, 52, 430–441. doi:10.1037/dev0000087
- Vygotsky, L. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.
- Wertch, J. V. (1985). *Vygotsky and the social formation of mind*. Cambridge, MA: Harvard University Press.
- Whitebread, D. (2013). Self-regulation in young children: Its characteristics and the role of communication and language in its early development. In D. Whitebread, N. Mercer, C. Howe, & A. Tolmie (Eds.), *Self-regulation and dialogue in primary classrooms. British Journal of Educational Psychology Monograph Series II: Psychological Aspects of Education – Current Trends*, No. 10 (pp. 25–44). Leicester: BPS.
- Whitebread, D., Bingham, S., Grau, V., Pino Pasternak, D., & Sangster, C. (2007). Development of metacognition and self-regulated learning in young children: The role of collaborative and peer-assisted learning. *Journal of Cognitive Education and Psychology*, 3, 433–455. doi:10.1891/194589507787382043
- Winne, P. H., & Hadwin, A. (1998). Studying as self-regulated learning. In D. Hacker, J. Dunlosky, & A. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 279–306). Hillsdale, NJ: Erlbaum.

- Winne, P. H., Hadwin, A., & Perry, N. E. (2013). Metacognition and computer-supported collaborative learning. In C. E. Hmelo-Silvier, C. A. Chinn, C. K. K. Chan, & A. O'Donnell (Eds.), *International handbook of collaborative learning* (pp. 462–479). New York: Routledge.
- Winne, P. H., & Perry, N. E. (2000). Measuring self-regulated learning. In M. Boekaerts & P. Pintrich (Eds.), *Handbook of self-regulation* (pp. 531–566). New York: Academic Press.
- Wong, B. Y. L., Harris, K. R., Graham, S., & Butler, D. L. (2003). Cognitive strategies instruction research in learning disabilities. In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* (pp. 383–402). New York: Guilford Press.
- Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist*, 25, 3–17. doi:10.1207/s15326985ep2501_2
- Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments and future prospects. *American Educational Research Journal*, 45, 166–183. doi:10.3102/0002831207312909
- Zimmerman, B. J., & Campillo, M. (2003). Motivating self-regulated problem solvers. In J. E. Davidson & R. J. Sternberg (Eds.), *The psychology of problem solving* (pp. 233–262). Cambridge: Cambridge University Press.

14

GOAL CONCEPTS FOR UNDERSTANDING AND IMPROVING THE PERFORMANCE OF STUDENTS WITH LEARNING DISABILITIES

David A. Bergin and Sara L. Prewett

Human behavior is purposive, intentional, and anticipatory, not just reactive or conditioned. In line with this, goals are increasingly important in psychological theories of human behavior, work performance, personality, sport performance, and a host of other situations, as well as academic achievement. The purpose of this chapter is to discuss the relation between goals and motivation for learning among students with special needs, especially those with learning disabilities (LDs).

LEARNING DISABILITY (LD)

LD diagnoses are common. In the US, for example, about 5% of public school students are identified as having a learning disability under the Individuals with Disabilities Education Act (IDEA), and two-thirds of them are male (Cortiella & Horowitz, 2014). Indeed, LD is the largest category of students who receive special education services in the US. In 2017–2018, that was 2.3 million, or 34% of all students receiving special education services (compared with autism at 10% and emotional disturbance at 5%; National Center for Education Statistics, 2019). The most common characteristic of LD is difficulty with learning to read.

The prevalence of LD is related to its definition, which has varied over the years and often between educational jurisdictions. In the US, for instance, the legal definition of LD varies by state and may be different from psychiatric definitions in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association, 2013). According to the U.S. IDEA, LD refers to:

a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in the imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations.

(Individuals with Disabilities Education Act, 2004)

Elsewhere in North America, definitions of LD vary, often by province or jurisdiction. Ontario, for example, defines LD as “one of a number of neurodevelopmental disorders that persistently and significantly has an impact on the ability to learn and use academic and other skills” (as cited in D’Intino, 2017, p. 229; for related discussion, see Byrnes & Eaton, Chapter 27, this volume). However, some jurisdictions do not even use the term “learning disability” and instead refer to students who are at risk or who experience academic or learning difficulties (for related discussion, see, in this volume, Graham & Harris, Chapter 20; Hall, Capin, Vaughn, & Cannon, Chapter 7; Perry, Mazabel, & Yee, Chapter 13; Schunk & DiBenedetto, Chapter 11; Strnadová, Chapter 4; Swanson, Chapter 2; Tricot, Vandenbroucke, & Sweller, Chapter 15).

In the past, the most common definition of LD focused on an intelligence–achievement discrepancy—that is, when achievement is lower than what would be expected based on a child’s measured intelligence (Geary, 2011). Students with LDs were considered different neurologically from students who experience low achievement *and* low intelligence. However, research suggests that low achievement and LD are difficult to distinguish (Johnson, Humphrey, Mellard, Woods, & Swanson, 2010). Research often compares students who vary in achievement on things such as executive functions (for related discussion, see Follmer & Sperling, Chapter 5, this volume), processing speed, and attention; such research finds both differences and similarities between different groups, variation by subject area (e.g., mathematics versus language arts), and no pattern that is consistently replicated or that has strong implications for intervention (Geary, Hoard, Nugent, & Bailey, 2012; Mazzocco, Myers, Lewis, Hanich, & Murphy, 2013; Root et al., 2017; Sarah, Stephen, & Everarda, 2013; Tolar, Fuchs, Fletcher, Fuchs, & Hamlett, 2016).

Practices for LD identification in the US have recently shifted to focus more on a student’s ability to respond to effective intervention (Prewett et al., 2012). That is, in an ideal classroom, all students receive high-quality instruction and universal screening for learning problems. Students who struggle despite universal intervention are provided with progressively intensive interventions intended to accelerate their learning. This approach is termed *response to intervention* (RTI) or *multi-tier system of supports* (Cortiella & Horowitz, 2014; Fletcher & Vaughn, 2009). Under this model, students are diagnosed with LD if they do not learn from the instruction by which most students learn. Because poor instruction does not explain their low achievement, a disability may be responsible, and specialized intervention may be needed. However, there is still disagreement on diagnosis of LD, and many experts advocate formal assessment of cognitive and neuropsychological processes (Hale et al., 2010).

Research on students with LDs tends to focus on how they differ from other students in their responses to various learning tasks, but the literature seldom considers the motivational aspects of student responses. Students with LDs may respond differently depending on the goals that they hold or that are imposed, and some goals may be more adaptive than others. We first discuss the goal-setting process and then examine achievement goals. The goal-setting process refers to the planning and actions people use to achieve desired outcomes. Achievement goals refer to general outcomes that people desire as a result of their participation in activities. For both, we explore implications for students with LDs.

GOAL-SETTING

Background

Goal-setting refers to a process intended to achieve future valued outcomes (Locke & Latham, 2006). Often goals are divided into smaller subgoals that build toward achieving the distal or final goal. Goal-setting research consistently shows effectiveness in achieving desired outcomes across domains, including academic achievement (Locke, 1996; Locke & Latham, 2006). For educational settings, meta-analyses report a large effect size on performance for overall goal setting ($d = .56$), and an even greater effect size for difficult goals ($d = .67$; Hattie, 2009).

There are more effective and less effective ways to set goals. Effective goals are specific, proximal, and appropriately challenging (Locke & Latham, 2002). Goals should be concrete and directed toward meeting a difficult challenge rather than more ambiguous “do your best” goals. Indeed, “do your best” goals function about the same as not setting goals at all (note that this is different from “personal best” goals that are concrete and specific, as discussed below; Martin, 2012). Teachers need to instruct students on how to set goals by helping them identify a specific outcome (distal goal), scaffold a specific plan with frequent proximal subgoals, work out a plan, and finally evaluate whether the distal goal was met (Copeland & Hughes, 2002).

Students with LDs

Students with diagnosed specific LDs may struggle with goal-setting for several reasons. First, when faced with complex or problem-solving tasks, they often feel more negative emotions, such as frustration and anxiety, than other students (Nelson & Harwood, 2011). Such emotions make goal-setting difficult because they squander working memory space (Moran, 2016), which can divert attention away from the goal. Second, we suggest that the low average achievement of students with LDs may undermine their motivation to set goals; why bother if you have previously experienced a low probability of success? Nevertheless, goal-setting is a strategy that can improve students’ achievement and is thus worthy of study and implementation. But, how do we help students learn to set goals effectively?

Students with diagnosed specific LDs benefit from direct instruction and explicit strategies (Kuder, 2017; Swanson, 1999; for related discussion, see Tricot et al., Chapter 15, this volume). When students with LDs receive explicit instruction in setting goals, they experience more achievement growth (Swanson, 1999). Explicit instruction in goal-setting for students with LDs has resulted in promising results for raising achievement compared with their peers without goal-setting strategies (Fuchs & Fuchs, 1986; Schunk, 1985). A meta-analysis found that both short- and long-term goal-setting for students with LDs had large effect sizes on their academic outcomes compared with peers without goal setting instruction ($d = .67$ and $.63$, respectively; Fuchs & Fuchs, 1986). In another study, when students with LDs were explicitly instructed on personally setting their own goals, taught how to set subgoals (action plans), and then participated in their own goal progress monitoring, the students met their goals (Wehmeyer, Palmer, Agran, Mithaug, & Martin, 2000). Moreover, the students reported being satisfied with their own progress and completion of their goals.

When students are allowed to have autonomy over setting their own goals, they may have more motivation to self-regulate their learning and complete their goals (Locke, 1996). Research, however, is mixed about whether the participation of students with LDs in their own goal-setting produces higher academic outcomes or improved goal completion. Some studies find that students struggle with setting appropriate and realistic goals for themselves, but, paired with careful scaffolding for goal-setting, students with LDs can learn successful goal-setting techniques (Buzza & Dol, 2015; Reed & Lynn, 2015; Swain, 2005).

In order to maximize the effectiveness of goal-setting, instructors of students with LDs should carefully scaffold students' goal-setting so that their goals are specific, have proximal subgoals, and are challenging, monitored with feedback, committed to, and accompanied by a plan for completion. When students' goals are concrete and specific, students with LDs tend to do better than if they do not set specific goals (Johnson, Graham, & Harris, 1997; Schunk, 1990). The components of effective goal-setting are displayed in Table 14.1. We will discuss each of these components in more detail.

Table 14.1 Goal-Setting Elements

Component	Description	Example
Goals should: Be specific (specificity)	Have an end in mind (what does the student want to achieve?). The goal is concrete and unambiguous	I want to read <i>The Hobbit</i>
Divide into smaller subgoals (proximity)	Smaller, proximal steps help scaffold the student toward the more distal goal. The proximal goals should be split over time with feedback given about each portion of the subgoal as it is completed	I will read a chapter each day
Be challenging (difficulty)	Goals should be appropriately challenging, that is, slightly beyond the student's current ability level, but not so difficult the student cannot anticipate success	Reading this book is challenging because it is long, has multiple characters to follow, and has a higher reading level than I've previously read
Provide feedback (progress monitoring)	A recording technique, coach, teacher, expert, or peer can provide feedback on goal progress and strategies for improvement	I will make a chart with 19 blanks for the 19 chapters so I can keep track of my progress. My mom really likes reading and has read this book, so she can talk to me about my understanding of the story
Gain student commitment to goal	The student needs to be fully committed to achieving the goal so that he or she is willing to forego alternative activities	I really liked the movie and really want to finish reading this book even if I have less time to play video games

Component	Description	Example
Have a plan for completion (scaffolding and implementation intentions)	Help the student devise strategies for self-regulation and plans to overcome stumbling blocks	I plan to read a chapter every day after school before I watch TV. If I want to read more than a chapter, I can. I want to read before it gets too late in the evening so I don't get too tired. If I get distracted by temptations like television, I will go to my room and read without distractions

Specificity

Specific goals can increase goal-setting effectiveness for all students, but may be particularly important for students with LDs. For example, an assignment might be: *Write a persuasive essay about whether students should be paid for good grades.* Writing persuasive essays is an ill-defined problem-solving task. Writers must figure out what argument they want to make and what kind and quantity of supports they need in order to make their argument. Many decisions are required, which places high cognitive load on the writer's working memory. In two studies of writing, students with LDs who were prompted to write very concretely about a specific number of points wrote more convincing essays. In the first study, middle school students with LDs were given the specific goal of adding three writing elements to make their already-written papers stronger. These students had stronger papers than students who were merely told to "revise" (Graham, MacArthur, & Schwartz, 1995). In the second study, students with LDs in seventh and eighth grades were asked to write a persuasive paper; students who were given the goal of a specific number of arguments and counterarguments produced longer, more persuasive, and better-written papers than students who were not given such specific goals (Page-Voth & Graham, 1999).

In another study of writing, Feretti, MacArthur, and Dowdy (2000) randomly assigned students with and without LDs to control and intervention groups. For a persuasive essay, the intervention group was asked to state their belief, provide two or three reasons for their belief, provide support for each reason, list two or three reasons why some people might disagree, and point out why those reasons are wrong. Sixth-graders with LDs wrote less elaborated essays than normally achieving students, but both groups benefited equally from the intervention. It should be noted that improvement was not seen for fourth-graders; perhaps in a complex task such as writing persuasive essays, fourth-graders are less likely to benefit from specific goals.

Proximity

When long-term goals (distal goals) are broken down into subgoals (proximal goals), students make better progress toward the distal goal. For example, proximal subgoals for a persuasive essay might be: *Start with one paragraph at a time. Each paragraph should focus on one argument (a pro or con argument) with three supporting sentences.*

When students have subgoals, they can better visualize meeting each smaller goal as they build toward their bigger, more distal goal (Schunk, 1990). Proximal goal-setting was a component of the Page-Voth and Graham (1999) intervention discussed above in which seventh- and eighth-graders with LDs were assigned a series of proximal writing goals; they performed better than their peers without the proximal goal strategy.

Goal-setting that combines proximal goals with explicit scaffolded strategy instruction may be particularly effective. In one study, students with a diagnosed specific LD in reading set a goal for learning a strategy called “story retell” that included identifying main ideas and story details (Johnson et al., 1997). The students then received explicit instruction about how to set proximal goals that led to successful “story retell.” After using the strategy with goal-setting, the students with LDs were able to transfer their story retell skills to other tasks. They also started to perform similarly to their peers without LDs.

Challenge

Students with LDs struggle to set appropriately difficult goals for themselves (Reed & Lynn, 2015; Schunk, 1985; Williams-Diehm, Palmer, Lee, & Schroer, 2010). Reed and Lynn (2015) studied middle school students with LDs who used goal-setting both individually and as a group. They found that the students who were tasked to set their own goals were either over- or under-ambitious and struggled to find an appropriate goal-setting plan. However, when they negotiated an appropriately difficult learning goal with their group members, they were more likely to set appropriately difficult goals and had higher-quality outcomes. This suggests that, with scaffolding and feedback, they can be successful in setting appropriately challenging goals.

In addition, explicit instruction on how to set appropriately difficult goals may benefit students with LDs (Williams-Diehm et al., 2010). Students who received longer-term, explicit instruction on goal-setting strategies and monitoring tended to be more successful in meeting their difficult goals (Buzza & Dol, 2015; Copeland & Hughes, 2002), suggesting that students with LDs need ongoing, explicit, and scaffolded instruction for successful goal setting. For example, a long-term goal might be: *The final paper should consist of at least three different “pro” and three different “con” paragraphs that create a longer paper.* A lengthy paper is doable for students with LDs when they have teacher-supported scaffolding, feedback, and the smaller, proximal goals of individual paragraph development.

Monitoring with Feedback

Progress monitoring that provides feedback is a crucial element of successful goal-setting for students with LDs (Solis et al., 2011). It is important for them to understand whether they are making progress toward their goals. Feedback can come from external sources, such as the teacher or a computer program, or from internal sources through self-monitoring. Self-monitoring techniques help students independently check their progress and understanding. Feedback and self-monitoring techniques improve their learning (Solis et al., 2011; for related discussion, see Perry et al., Chapter 13, this volume).

Another frequently used tool to monitor struggling students' progress is curriculum-based measurement (CBM), which is designed to track students' progress toward a specific academic goal (Fuchs, 2017; Stecker, Fuchs, & Fuchs, 2005). CBM is a set of progress monitoring tools that provide feedback about students' learning progress and guide appropriate interventions throughout the learning process. Teachers who use CBM tend to adapt their instructional techniques, implement specific goal-setting, and use objective assessments of their students' progress (Ardoin, Christ, Morena, Cormier, & Lingbeil, 2013). For example, one objective measure for reading is proficient oral reading measured as the number of words a student can read correctly in 1 minute (Jenkins & Terjeson Kari, 2011); for mathematics, ability to use grade-appropriate computational skills is used (Stecker et al., 2005; for related discussion, see, in this volume, Jordan, Barbieri, Dyson, & Devlin, Chapter 19; Morsanyi, Chapter 21). Proximal goals can change frequently as a result of progress monitoring. CBM used in conjunction with an individual education program (IEP) helps teachers and students with LDs understand if the students are meeting their proximal goals and making progress toward their distal goals. CBM data support students' goal-setting knowledge as they work through their proximal goals toward their distal goal (Swain, 2005). Students' progress toward their goals should be measured frequently to make sure they are on track.

Commitment to the Goal

Commitment to a goal is a vital part of achieving a goal. One way to gain goal commitment is by having students set their own goals. However, as mentioned above, some students experience difficulty setting goals at an appropriate level of challenge, and so teacher intervention may be useful. Research shows that people are more likely to commit to goals if they view the goals as important and attainable (Locke & Latham, 2002). Teachers and parents have an important role in achieving goal commitment because they can use their roles as authoritative, knowledgeable adults to convince students that challenging goals are important and attainable. They can inspire students to feel that the goal is worthwhile and within reach. This persuasion from adults may be especially important for students with LDs because they tend to feel low academic self-concept (Chapman, 1988; Zeleke, 2004; for related discussion, see Tracey, Merom, Morin, & Maïano, Chapter 24, this volume), and thus seem less likely to feel committed to relevant academic goals. Respected adults can play an important role in persuading students that certain goals are worth pursuing, leading to goal commitment (Locke, Latham, & Erez, 1988).

Confidence or self-perceptions of efficacy are also important for goal commitment. Self-efficacy is students' personal perception about how well they believe they can succeed in an activity (Bandura, 1997). The higher the student's sense of self-efficacy for the goal activity, the more likely the student is to persevere through challenges, and the higher the likelihood of goal achievement (Bandura, 1997). Students will not commit to goals that they do not believe they can achieve. Self-efficacy is a motivational factor that is particularly important to support students with LDs who may face difficulties learning academic material (Schunk, 1985; for related discussion, see Schunk & DiBenedetto, Chapter 11, this volume).

There are four major influences on self-efficacy: previous success or failure, observing others succeed or fail, persuasion from credible others, and physiological responses such as anxiety (Bandura, 1997; Usher & Pajares, 2008). Teachers can affect all four. They can assign appropriate tasks and teach effective strategies that lead to success. They can point out peers who are successful. They can persuade students that they can be successful. They can help students interpret anxiety in a way that avoids pernicious undermining of efficacy (e.g., saying that most people feel anxiety in these sorts of situations).

Some students who lack self-efficacy may avoid effort and engage in self-handicapping strategies to protect their feelings of self-worth (for related discussion, see Martin, Chapter 16, this volume). In such cases, if they try hard and fail, they may feel incompetent (because lack of ability is the likely explanation), so they do not try hard and thereby avoid inferences that they lack ability. Self-handicapping behaviors also include procrastination and claiming illness or anxiety (Schwinger, Wirthwein, Lemmer, & Steinmayr, 2014). These behaviors act as alibis in the event of poor performance and help students protect perceptions of self-worth and self-esteem (by deflecting the cause of poor performance onto the alibi and away from a lack of ability). At the same time, however, they also tend to undermine performance and make goal commitment unlikely. Perhaps surprisingly, we could find no research on self-handicapping among students with LDs, but it is clear that students who use self-handicapping strategies tend to have lower achievement compared with other students (Schwinger et al., 2014). There is little experimental field evidence supporting interventions to avoid self-handicapping. Correlational field evidence suggests that fostering mastery approach goals (discussed below) could reduce self-handicapping (Schwinger et al., 2014; Urdan & Midgley, 2001). This means emphasizing effort and effective strategies (such as goal-setting), reducing social comparison, and focusing on improving competence.

As teachers scaffold successful goal-setting, students learn how to participate in their own goal-setting activities, which can strengthen their self-efficacy and goal commitment (Locke, 1996). Evidence suggests that teaching students how to set goals that are specific, proximal, and challenging helps students' self-regulation for completing their goals, and success in completing those goals can raise students' self-efficacy for approaching more challenging academic work (Buzza & Dol, 2015).

Schunk (1985) found that, when students with LDs participated in their own goal-setting and action plans, they reported stronger growth in self-efficacy and goal attainment. Successful completion of goals appears to have a cascading upward effect on self-efficacy, meaning that, with each success, students feel more efficacious to work toward increasingly difficult or challenging goals (Schunk, 1985). In addition, as students successfully complete each of their proximal goals, they feel more efficacious for future goal attainment. This appears to be especially important for students with LDs, because they tend to have lowered perceptions of academic self-efficacy and self-competence, and they often have higher self-doubts about their academic abilities (Schunk, 1985; for related discussion, see Schunk & DiBenedetto, Chapter 11, this volume).

Having a Plan

Students benefit from strategies for self-regulation and steps toward goal completion (for related discussion, see Perry et al., Chapter 13, this volume). As required by United

States law, all students with LDs who are served under IDEA will have an IEP. These are year-long, individualized goal-setting plans for students diagnosed with LDs. The IEP is meant to be an agreement between the teachers, student, and parents and, therefore, includes major stakeholders in the process to develop the student's annual learning and behavior goals, which tend to be distal (Pierangelo & Giuliani, 2007). Teachers can use the IEP to scaffold the distal year-long goal into smaller, specific, proximal, appropriately challenging goals and use the IEP as a tool to monitor progress toward the goals. IEPs are important supportive tools because students with specific LDs may struggle with setting appropriate and obtainable goals for themselves (Reed & Lynn, 2015). Teachers' support, scaffolding, progress monitoring, feedback, and guidance across grade levels are important to help students' successful distal goal completion.

Another component of having a plan is implementation intentions. Gollwitzer (1999) pointed out that setting goals may not be enough to foster goal achievement because temptations and stumbling blocks may arise that undermine progress. The goal setter needs an anticipatory plan to overcome such barriers, an if-then plan, such as "If barrier 'x' occurs, then I will perform response 'y.'" For example, "If I get frustrated that I cannot figure out the words in the text, I will go ask the teacher for help." In a meta-analysis, Gollwitzer and Sheeran (2006) found a substantial effect size of $d = .65$ for the influence of implementation intentions on goal attainment. Although we did not find any research for students with LDs, a laboratory study of boys diagnosed with attention-deficit/hyperactivity disorder (ADHD) found that implementation intentions benefited their performance (Gawrilow, Gollwitzer, & Oettingen, 2011).

In summary, studies point to the effectiveness of scaffolding students with LDs to set their own specific, proximal, challenging goals. In line with this, a literature review of 17 studies revealed that students who had intellectual disabilities (not LDs) and learned how to manage their goal progress tended to complete goals at higher rates than students who did not use goal-setting (Copeland & Hughes, 2002).

Implications for Practice

The goal-setting literature suggests that students with LDs can raise their achievement when they learn to use goal-setting effectively. However, not all research shows positive effects of goal-setting compared with other teaching practices. For example, Gersten and colleagues (2009) found in a meta-analysis of mathematics learning that goal-setting was not more effective than providing feedback for students with LDs, but they only found three relevant studies. On the other hand, they cited a study of third-graders at risk for mathematics disability (Fuchs, Fuchs, & Prentice, 2004) that found strong positive effects for an intervention that included personal best goal-setting (set a goal to beat their highest score).

The research suggests that the extent to which goal-setting is effective depends on several factors. Teachers who want to maximize the effectiveness of goal-setting for students with LDs may want to review Table 14.1 and also consider the following guidelines:

- *Provide explicit instruction.* Do not assume students with LDs know how to use goal-setting. Instead, provide explicit instruction and scaffold their proximal goals so they can achieve their distal, long-term goals.

- *Help students to set their own appropriately challenging goals.* Students with LDs tend to struggle setting their own goals that are appropriately challenging (not too easy or too difficult). Provide ongoing, direct instruction about how to set their own goals for growth and achievement. Using personal best goals motivates them to work through personally optimal challenges. Students need frequent feedback in order to be able to select appropriately challenging goals.
- *Foster self-efficacy for goal achievement.* Teachers can influence efficacy by fostering success, persuading, directing attention to successful peer models, and helping students avoid anxiety. Efficacy is important for goal commitment.
- *Make goals explicit and specific.* Be very specific in the outcomes students are aiming to complete.
- *Set subgoals (proximal).* Help students understand how to break down large, distal goals into smaller chunks. Successfully meeting these smaller goals helps boost students' self-efficacy as they celebrate smaller successes toward the larger (distal) goal.
- *Regularly monitor students' progress.* Help students track their success toward their goals. This also helps build their self-efficacy for goal-setting. Teach them to self-monitor. When students are involved in their progress and receive feedback, they demonstrate better performance.

These goal-setting strategies boost students' academic self-efficacy and self-regulation for managing their own goal-setting processes and their academic learning outcomes. A 20-year longitudinal study of children with LDs found that those who were more successful in young adulthood tended to set goals as described in this section; those who were less successful did not—their goals tended to show little planning, were not specific, and lacked proximal subgoals (Goldberg, Higgins, Raskind, & Herman, 2003).

ACHIEVEMENT GOALS

Background

Achievement goal theory states that there are two major purposes for striving in achievement situations: (1) learning in order to gain understanding, termed mastery goals, or (2) learning in order to perform better than others or to demonstrate ability, termed performance goals (Anderman & Wolters, 2006). Those two major goals can be divided so that there is an approach and an avoidance dimension of each, resulting in four major achievement goals: mastery approach, mastery avoidance, performance approach, and performance avoidance. Because of conceptual and measurement problems with mastery avoidance goals (Ciani & Sheldon, 2010), this chapter will focus on the three-goal model, also termed the trichotomous goal model—comprising mastery approach, performance approach, and performance avoidance goals. A *mastery approach* goal refers to striving to learn and master material. A *performance approach* goal refers to striving to demonstrate ability and to do better than others. A *performance avoidance* goal refers to striving to avoid appearing unable and doing worse than others. Approach goals tend to predict higher achievement, and avoidance goals tend to predict lower achievement (Hulleman, Schrager,

Bodmann, & Harackiewicz, 2010; Van Yperen, Blaga, & Postmes, 2014). Thus, performance approach and mastery approach goals facilitate achievement, though with some inconsistency, whereas performance avoidance goals undermine achievement, with considerable consistency.

Achievement goals predict performance because students tend to engage in different cognitive activities depending on the goal for which they are striving (see Table 14.2). A student holding a mastery approach goal may persist in the face of failure, experience interest, and use deep learning strategies. A student holding a performance approach goal may use more superficial strategies and might cheat, but might also have high performance. A student holding a performance avoidance goal may avoid difficult tasks, experience anxiety, and have low performance. These patterns are supported by research (Friedel, Cortina, Turner, & Midgley, 2010; Kaplan, Gheen, & Midgley, 2002; Schunk, Pintrich, & Meece, 2014; Senko, Hulleman, & Harackiewicz, 2011; Shim, Ryan, & Anderson, 2008).

Table 14.2 contrasts mastery approach, performance approach, and performance avoidance goals. Note that two types of performance *approach* goals have been described: those that focus on appearing talented (appearance goals) and those that focus on outperforming others (normative goals). Evidence suggests that normative goals lead to better outcomes than appearance goals (Hulleman et al., 2010; Senko & Dawson, 2017). Although one might expect that mastery approach goals would lead to higher achievement than other types of goal, research does not consistently support that view. Performance approach goals, especially of the normative variety, are more consistently linked with achievement. However, there has been little research explicitly examining how students with LDs experience achievement goals.

Although mastery approach goals have not been consistently linked with achievement, they have been consistently linked with other desirable outcomes such as deep

Table 14.2 Student Perceptions Associated with Three Achievement Goals

Students' Perceptions	Mastery Approach Goal	Performance Approach Goal	Performance Avoidance Goal
Questions in an achievement setting	How can I do it? How can I learn more?	Will I appear able and talented? Will I outperform others?	Will I appear unable and not talented? Will I perform worse than others?
Focus	Process of improving competence	Outcome and others' judgments of competence	Outcome and others' judgments of incompetence
Optimal tasks	Maximize learning but might require some failure	Maximize looking smart Maximize doing better than others	Minimize looking stupid
Standards for success	Personal, long-term, flexible, and criterion-referenced	Normative, positive comparison to other people Appear competent	Normative, absence of negative comparison to other people Avoid the appearance of incompetence

Source: Table is adapted from Maehr and Meyer (1997).

learning strategies, persistence, effort, self-efficacy, positive affect, interest, and general well-being (Grant & Dweck, 2003; Harackiewicz, Durik, Barron, Linnenbrink-Garcia, & Tauer, 2008; Kaplan & Maehr, 2007). The positive outcomes illustrate why it is advantageous to encourage mastery goals in the classroom (guidelines are provided below in implications for practice).

Although it might seem that desire for high grades is a part of the definition of performance approach goals, Ames (1992) pointed out that the effect on grades depends on how they are emphasized and the degree to which students are compared based on their grades. If comparison is not emphasized and students have the opportunity to improve their grades, then a desire for high grades is not necessarily reflective of performance approach goals (Dweck, 2010; Elliot & Murayama, 2008). (However, there is some evidence that grades do lead to performance avoidance goals, at least in college students; Pulfrey, Buchs, & Butera, 2011.) Some activities have built-in goals that everyone holds to some degree. In sports, most people would like to win. In academic settings, most would like to have high grades. Whether they *expect* to have high grades, or are willing to work for high grades, is another matter. Thus, grades influence achievement goals depending on how they are discussed, distributed, and emphasized. Some settings assign grades in a normative fashion, so that not everyone can achieve high grades. This is likely to foster performance goals. Other settings distribute grades in a criterion-based manner such that everyone who achieves specified levels of competence can achieve high grades. This is likely to foster mastery goals (unless there are other factors that push students toward performance goals).

Goal Orientations and Students with LDs

Students with LDs tend to experience lower achievement than other students and may struggle to understand and keep up with academic material (Cortiella & Horowitz, 2014). They may thus be more likely to hold performance avoidance goals owing to their history of poor performance and academic difficulty (Schwab & Hessels, 2014; for related discussion, see Martin, Chapter 16, this volume). As one mother we talked to wearily said, after being told her son with disabilities would be given the state proficiency test the next week, “He doesn’t need yet another test to tell him he isn’t up to par. He already knows that.” In order to protect their sense of well-being, students with LDs might avoid situations that could result in failure. Indeed, a study of seventh-graders found that students with special needs had significantly higher performance avoidance orientation, whereas students without special needs had significantly higher mastery orientation (Schwab & Hessels, 2014), although the differences were small and are not consistent across studies (O’Shea et al., 2017). We argue that students with LDs in particular would benefit from mastery approach goals. If they hold mastery approach goals, they are more likely to enjoy what they are learning, try to find appropriate strategies for learning, and persist in the face of failure. They are less likely to feel compelled to monitor other students’ performance and how they are performing in comparison.

Failure can be debilitating to self-worth (Covington, 2000). After experiencing failure, students with and without LDs are at risk of using strategies to avoid situations that highlight their low ability and use strategies that protect their ego and self-worth

(for related discussion, see Martin, Chapter 16, this volume). Such strategies could include the following (Covington, 1998; Schwinger et al., 2014):

- Procrastination and self-handicapping: if they procrastinate studying and receive a low grade, they can attribute the low grade to low effort.
- Avoidance of learning situations: if they can get sent to the principal's office or wander the halls looking for a bathroom, then they are absent during instruction and can attribute their low achievement to low exposure to instruction.
- Repetition of tasks that they already know how to do: learning new material can be threatening, so they prefer to keep working on the same thing that they can already do.
- Avoidance of seeking help: seeking help can indicate low ability, so they may avoid seeking help even when it would be useful.
- Cheating: they may avoid failure, or the appearance of failure, by cheating.

In addition, research shows that students with LDs tend to have higher anxiety than other students (Nelson & Harwood, 2011). Anxiety is linked with rigid and superficial learning strategies, mere memorization, and impaired achievement outcomes (Pekrun, Lichtenfeld, Marsh, Murayama, & Goetz, 2017). Performance goals, especially performance avoidance goals, are more likely to result in anxiety compared with mastery approach goals (Linnenbrink & Pintrich, 2002; Pekrun & Linnenbrink-Garcia, 2012). Students with LDs score higher on measures of depression than other students, though this does not necessarily mean that they experience higher rates of clinical depression (Maag & Reid, 2006; for related discussion, see, in this volume, Cassady & Thomas, Chapter 3; Pekrun & Loderer, Chapter 18; Wigfield & Ponnock, Chapter 17). There is some research that links achievement goals with depression, such that goals for growth and mastery are related to positive affect, and goals for self-validation and performance avoidance are related to anxiety and symptoms of depression (Dykman, 1998; Sideridis, 2007). These are good reasons to foster mastery approach goals in the classroom and to avoid comparing students in terms of their competence and achievement.

Implications for Practice

Achievement goals can be represented as relatively stable individual differences (traits) or as results of situational influence. Teachers have more control over the situation than over the existing predispositions that students bring to the classroom. Teachers influence students' achievement goals through their classroom behaviors. The following are guidelines that may help teachers foster mastery approach goals among students with LDs.

Focus on Personal Best Goals

Martin (2012) found that focusing on personal improvement rather than relative standing was correlated with better performance for students with ADHD. He and his colleagues examined personal best goals in which students strived to improve on their previous achievement (Martin, 2006; Martin & Liem, 2010; for related self-based goals

under the achievement goal framework, see Elliot, Murayama, Kobeisy, & Lichtenfeld, 2015; Elliot, Murayama, & Pekrun, 2011). They pointed out that such goals are advantageous because the target mark is known (goal specificity), the goals are challenging but within reach (as discussed above in the goal-setting section), and the reference is to self-improvement rather than besting others (mastery rather than performance goals). Martin (2012) suggested that the positive effects of personal best goals for at-risk students with ADHD have potential to generalize to other at-risk populations.

Foster Mastery Goals Using the TARGET Framework

How can instructional leaders foster mastery goals? Table 14.3 provides an overview of principles that can guide the design of educational settings following the TARGET model (Ames, 1992; Epstein, 1989; Kaplan & Maehr, 2007; Maehr & Anderman, 1993; Meece, Anderman, & Anderman, 2006).

TASK

When students are asked to do boring or, to them, meaningless tasks, they may go through the motions, but they are not engaged or trying to master the content. Therefore, educators should do all they can to make tasks interesting and meaningful (Bergin, 1999, 2016; Turner, Warzon, & Christensen, 2011).

AUTHORITY/AUTONOMY

Students with LDs benefit when they are provided autonomy support, choice, and self-determination (Deci, Hodges, Pierson, & Tomassone, 1992; Wehmeyer & Shogren, 2016; for related discussion, see, in this volume, Strnadová, Chapter 4; Wehmeyer & Shogren, Chapter 12).

RECOGNITION

When students with LDs perform well, educators and parents may be tempted to recognize them with extrinsic rewards and comparative statements. It is best to resist this urge and recognize their persistence, diligence, and strategy use so as to avoid diverting them from mastery goals (Dweck, 1986; Wehmeyer & Shogren, 2016). This is linked to growth mindset, discussed below.

GROUPING

Students with LDs may be especially sensitive to the social comparison inherent in ability grouping because they tend to have a history of poor performance compared with fellow students. Heterogeneous groups seem more likely to foster mastery goals instead of performance avoidance goals. However, grouping is a complex issue. There is international evidence that being placed in low-achieving groups is associated with lower achievement and achievement gaps (Schofield, 2010), which suggests avoidance of grouping. On the other hand, there is evidence that students with disabilities have higher self-concept when they are grouped with students of similar achievement levels

(Chapman, 1988; Marsh, Tracey, & Craven, 2006; for related discussion, see Tracey et al., Chapter 24, this volume). More research is needed on this topic to design optimal settings for students with LDs.

EVALUATION

Principles for evaluation overlap with principles for recognition. Evaluation should direct student attention toward what they have learned and mastered and away from how they are doing compared with others or whether their ability is adequate (Dweck, 1986). Classroom emphasis on social comparison may be particularly pernicious for students with special education needs, who commonly experience low achievement compared with other students (Renick & Harter, 1989). When they feel that they cannot compete, they may be pushed toward performance avoidance goals.

TIME

Allow students to progress at an appropriate rate for them (Maehr & Anderman, 1993). Student attention should be directed away from how quickly they achieve competence or how quickly they complete tasks compared with others and toward learn-

Table 14.3 Using the TARGET Model to Foster Mastery Goals

Domain of Environment	Focus	Guidelines for Enhancing Mastery Goals
Task	What are the students asked to do? What is the product? How interesting and meaningful is the task?	Use tasks that are interesting, meaningful, and challenging. Products should be meaningful or useful. This will vary by person (including as a function of LD)
Authority/Autonomy	Who makes decisions? Does the student have appropriate authority and autonomy to make decisions regarding how and why they do the task?	The student participates in decision-making and can decide on strategies for task completion. The student has freedom to make choices and take responsibility. Some supporting structure and guidance may be needed as appropriate
Recognition	What achievements and actions are recognized and rewarded?	Behaviors that are recognized include the following: effort, risk-taking, creativity, idea-sharing, learning from mistakes, personal best
Grouping	What criteria are used to assign students to groups?	Rather than level of ability, there are some tasks/activities for which students are grouped based on interests or diversity that would enhance learning. There is a focus on social interactions that foster learning
Evaluation	What evaluation and assessment procedures are used?	Rather than focusing on comparisons, evaluation focuses on improvement, creativity, mastery of skills, progress. Evaluation is private
Time	How are time and tasks managed and scheduled?	Time is flexible, and students work at their own pace. The focus is on learning rather than completing tasks within a schedule. Teachers might have students start the same tasks at different times so that they do not compete to complete the task at the same pace as others

ing and mastery. This may be especially pertinent for students with LDs because they may require more time to complete tasks.

A study of low-achieving students with and without LDs was carried out in mathematics in Grades 2–4 over a 17-week period (Fuchs et al., 1997). Teachers were randomly assigned to a control group and to an experimental group that implemented a mastery-focused intervention. In the mastery intervention, students focused on individual improvement, progress, effort, frequent feedback, and errors as opportunities for learning. They had weekly peer tutoring sessions. On average, the students with LDs achieved lower mathematics test scores than low achievers without LDs, which was expected. Although students with LDs in the mastery groups did not experience higher achievement than the control group, low-achieving students in the mastery groups did experience higher achievement than the control group.

Communicate Mastery Goals Clearly

If teachers intend to influence achievement goals, they need to communicate clearly. Research in elementary special education classrooms found that 74% of teachers' phrases were vague and could undermine student understanding of teacher intentions (Hollo & Wehby, 2017). Examples of such vague language included fillers (um, uh, like), false starts, hesitations, ambiguous language, mental state verbs (think, believe, imagine, appreciated), and figurative language (play it by ear, true blue, in the dark, etc.). Although mental state verbs are useful for fostering theory of mind, and figurative language can be useful in some situations, students diagnosed with LDs (or language impairment) benefit from concrete, fluent, and clear language during instruction (Bradlow, Kraus, & Hayes, 2003).

Even when goals are communicated clearly, students may not adopt them. Lichtinger and Kaplan (2015) found that some students with LDs stated that their teachers wanted to improve student learning and abilities, and the students claimed that they wanted to get good grades and to learn, and yet their behavior suggested goals of mere task completion without much attention to learning or correctness. They did not adopt the goals that were being communicated, even though they recognized the goals that their teachers emphasized.

Foster Growth Mindset

Dweck (1986) observed that the type of achievement goal was not linked to level of ability; that is, both high- and low-ability students were equally likely to adopt mastery and performance goals. Her insight was that students' *beliefs* or theories about what *causes* ability are linked with achievement goals. Students who have a fixed mindset (sometimes referred to as an entity theory of intelligence) and believe that ability is relatively fixed and unchangeable tend to adopt performance goals (Dweck, 1986) and thoughts such as "I am not good at math and that will never change." They are highly sensitive to the possibility of judgments about their ability and competence. They fear failure and see setbacks as threatening. Students who have a growth mindset (sometimes referred to as an incremental theory of intelligence) and believe that ability can be developed through effort, time, and effective strategies tend to adopt mastery goals

and thoughts such as “I am not good at math, but if I practice I will get good at it.” They like challenges and have little fear of failure because they believe that they learn from failure.

Teachers can communicate that ability is a changeable attribute; that is, they can focus on a growth mindset and avoid a fixed mindset. Mindset can be changed. For example, Blackwell, Trzesniewski, and Dweck (2007) implemented an intervention with urban low-achieving seventh-graders that used eight 25-minute periods over 8 weeks. They taught students that learning changes the brain by forming new connections, and that students influence their brain growth through what they do. The information was presented in the form of a reading stating that the brain is like a muscle that strengthens with use. The reading pointed out that learning results in changes in nerve cells and measureable physical changes in the brain. Students who participated in the intervention group increased in their growth mindset and had higher grades compared with the students who did not receive the intervention.

However, research on the effects of mindset on achievement for students with and without LDs is mixed. A meta-analysis of mindset interventions found little evidence of general effects (Sisk, Burgoyne, Sun, Butler, & Macnamara, 2018), though the authors pointed out evidence that interventions might be most effective for students from low socioeconomic backgrounds or students at risk (with LD diagnosis being a form of at-risk status). Some studies, such as the aforementioned Blackwell et al. (2007) investigation as well as a large-scale intervention in 13 geographically diverse high schools (Paunesku et al., 2015), have found significant positive effects. The Paunesku et al. study, for example, found significant effects specifically for low-achieving students. Another meta-analysis concluded that the strongest mediators between mindset and achievement “are the adoption of mastery-oriented strategies and the avoidance of negative emotions regarding evaluations of goal pursuits” (Burnette, O’Boyle, VanEpps, Pollack, & Finkel, 2013, p. 679). In addition, we know of no mindset studies that show a negative effect of growth mindset. Given the low cost of the intervention, it is worth considering. However, note that Haimovitz and Dweck (2017) reported that mindsets are more difficult to communicate to children than one might expect.

FUTURE RESEARCH INTO GOAL SETTING AND ACHIEVEMENT GOALS

Research on goal-setting and achievement goal orientation suggests that both are important motivational processes that show promising outcomes for students with special needs, including those with LDs. However, more research is needed on goal-setting in this population. Studies that address the effect of goal-setting on achievement in students with LDs are relatively few. For example, meta-analyses of interventions for students with LDs have not included goal-oriented interventions (Asha et al., 2017; Solis et al., 2011; Swanson & Hoskyn, 1998; Therrien, Taylor, Hosp, Kaldenberg, & Gorsh, 2011). In fact, given the generally positive effects of goal-setting on academic achievement, it is surprising that recent reviews of effective study strategies for all students do not include goal-setting at all (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013; Pashler et al., 2007; Putnam, Sungkhasettee, & Roediger, 2016). Considering the promise of various components of goal-setting on students’ learning

achievement, interventions should address specific, proximal, and appropriately challenging goals for students with LDs. Such a concrete focus on studying goal-setting within any curricular context could better inform educators about the power of goal-setting on students' learning outcomes. In addition, research is needed on if-then implementation intentions for students with LDs so that *if* they encounter specific barriers, *then* they have a plan for overcoming those barriers. It would be useful to test different types of implementation intention, such as purely cognitive responses to distraction versus physical responses (e.g., leaving the distracting setting).

In addition, transfer is a struggle for all students. Students do not generally transfer learning strategies spontaneously (Barnett & Ceci, 2002). Research suggests that settings promoting mastery goals and self-efficacy are more likely than other settings to foster transfer of training (Pugh & Bergin, 2006), but there is little or no research on this topic among students with LDs. Further research is needed to support instructors on how to promote goal-setting transfer for students with LDs, especially considering such students already struggle to set appropriate goals for themselves.

Achievement goal theories predict that the effect of mastery or performance goals on achievement will depend on perceptions of ability (Dweck & Leggett, 1988; Nicholls, 1989). People who believe they have high ability will tend to perform equally well in mastery and performance situations, but people who believe they have low ability will perform better in mastery situations. This prediction has been supported in college classrooms (Bergin, 1995; Covington & Omelich, 1984; Greene & Miller, 1996), but there has been little attention to this distinction in K-12 classrooms and none that we are aware of among students with LDs. It seems likely that students with LDs, who tend to earn lower average grades compared with other students, would tend to have lower perceptions of ability as typically measured in schools. They would be especially sensitive to situations that emphasize performance goals because they would want to protect their self-esteem; they might engage in self-handicapping and avoid seeking help even when they need it.

Research on achievement goals that specifically addresses students with LDs is rare. Meta-analyses of achievement goals have examined differences due to sex, age, topic (e.g., work, school, sports), but not academic ability or special education status (Hulleman et al., 2010; Van Yperen et al., 2014). More research on achievement goals in the context of LDs would be useful for understanding and improving motivation. In addition, recent research on the reasons that go with achievement goals has shown promise but has been done mostly with adults, often outside educational settings (Sommet & Elliot, 2017; Vansteenkiste, Lens, Elliot, Soenens, & Mouratidis, 2014). This line of research examines patterns of response such as interest, emotion, help-seeking, and performance when mastery and performance goals are paired with autonomous reasons for pursuing the goal (e.g., I like the activity) versus externally controlled reasons for pursuing the goal (e.g., I will get a reward). Research in schools comprising students with LDs would push our understanding forward.

CONCLUSION

Goal concepts provide promising supports to boost the motivation, learning, and achievement of students with LDs. This area of motivation has been under-studied as applied to students with LDs and should be an area for future research. Carefully

implemented goal-setting interventions are well placed to help students with LDs raise their achievement and also their perceptions of competence. To do so, goals would need to be specific and challenging, and students would need feedback, commitment to the goal, and a plan for goal implementation. Effective goal-setting also has potential for reducing self-handicapping and avoidance of help-seeking. Attention to fostering mastery goals and avoiding social comparison could further help students with LDs by promoting greater intrinsic interest and motivation in their schoolwork that, in turn, will underpin enhanced learning and achievement.

REFERENCES

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: Author.
- Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology*, 84, 261–271. doi:10.1037/0022-0663.84.3.261
- Anderman, E., & Wolters, C. (2006). Goals, values, and affect: Influences on student motivation. In P. Alexander & P. Winne (Eds.), *Handbook of educational psychology* (2nd. Ed., pp. 369–389). Abingdon: Routledge. doi:10.4324/9780203874790.ch17.
- Ardoin, S. P., Christ, T. J., Morena, L. S., Cormier, D. C., & Klingbeil, D. A. (2013). A systematic review and summarization of the recommendations and research surrounding curriculum-based measurement of oral reading fluency (CBM-R) decision rules. *Journal of School Psychology*, 51, 1–18. doi:org/10.1016/j.jsp.2012.09.004
- Asha, K. J., Amy, E. L., Soo-hyun, I., Ahmed, A. A., Scott, B. H., & John, M. (2017). Mathematical interventions for secondary students with learning disabilities and mathematics difficulties: A meta-analysis. *Exceptional Children*, 84, 177–196. doi:10.1177/0014402917737467
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.
- Barnett, S. M., & Ceci, S. J. (2002). When and where do we apply what we learn? A taxonomy for far transfer. *Psychological Bulletin*, 128, 612–637. doi:10.1037/0033-2909.128.4.612
- Bergin, D. A. (1995). Effects of a mastery versus competitive motivation situation on learning. *Journal of Experimental Education*, 63, 303–314. doi:10.1080/00220973.1995.9943466
- Bergin, D. A. (1999). Influences on classroom interest. *Educational Psychologist*, 34, 87–98. doi:10.1207/s15326985ep3402_2
- Bergin, D. A. (2016). Social influences on interest. *Educational Psychologist*, 51, 7–22. doi:10.1080/00461520.2015.1133306
- Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development*, 78, 246–263. doi:10.1111/j.1467-8624.2007.00995.x
- Bradlow, A. R., Kraus, N., & Hayes, E. (2003). Speaking clearly for children with learning disabilities: Sentence perception in noise. *Journal of Speech, Language, and Hearing Research*, 46, 80–97. doi:10.1044/1092-4388(2003/007)
- Burnette, J. L., O'Boyle, E. H., VanEpps, E. M., Pollack, J. M., & Finkel, E. J. (2013). Mind-sets matter: A meta-analytic review of implicit theories and self-regulation. *Psychological Bulletin*, 139, 655–701. doi:10.1037/a0029531
- Buzza, D. C., & Dol, M. (2015). Goal setting support in alternative math classes: Effects on motivation and engagement. *Exceptionality Education International*, 25, 35–66.
- Chapman, J. W. (1988). Learning disabled children's self-concepts. *Review of Educational Research*, 58, 347–371. doi:10.3102/00346543058003347
- Ciani, K. D., & Sheldon, K. M. (2010). Evaluating the mastery-avoidance goal construct: A study of elite college baseball players. *Psychology of Sport and Exercise*, 11, 127–132. doi:10.1016/j.psychsport.2009.04.005
- Copeland, S. R., & Hughes, C. (2002). Effects of goal setting on task performance of persons with mental retardation. *Education and Training in Mental Retardation and Developmental Disabilities*, 37, 40–54. www.jstor.org/stable/23879582
- Cortiella, C., & Horowitz, S. (2014). *The state of learning disabilities* (3rd ed.). New York: National Center for Learning Disabilities.

- Covington, M. V. (1998). *The will to learn*. Cambridge: Cambridge University Press.
- Covington, M. V. (2000). Goal theory, motivation, and school achievement: An integrative review. *Annual Review of Psychology*, 51, 171–200. doi:10.1146/annurev.psych.51.1.171
- Covington, M. V., & Omelich, C. L. (1984). Task-oriented versus competitive learning structures: Motivational and performance consequences. *Journal of Educational Psychology*, 76, 1038–1050. doi:10.1037/0022-0663.76.6.1038
- D'Intino, J. S. (2017). Learning disabilities in Canada: Definitions and accommodations. *Canadian Psychology/Psychologie Canadienne*, 58, 228–237. doi:10.1037/cap0000116
- Deci, E. L., Hodges, R., Pierson, L., & Tomassone, J. (1992). Autonomy and competence as motivational factors in students with learning disabilities and emotional handicaps. *Journal of Learning Disabilities*, 25, 457–471. doi:10.1177/002221949202500706
- Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, 14, 4–58. doi:10.1177/1529100612453266
- Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist*, 41, 1040–1048. doi:10.1037/0003-066X.41.10.1040
- Dweck, C. S. (2010). Even geniuses work hard. *Educational Leadership*, 68, 16–20.
- Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Bulletin*, 95, 256–273. doi:10.1037/0033-295X.95.2.256
- Dykman, B. M. (1998). Integrating cognitive and motivational factors in depression: Initial tests of a goal-orientation approach. *Journal of Personality and Social Psychology*, 74, 139–158. doi:10.1037/0022-3514.74.1.139
- Elliot, A., Murayama, K., Kobeisy, A., & Lichtenfeld, S. (2015). Potential-based achievement goals. *British Journal of Educational Psychology*, 85, 192–206. doi:10.1111/bjep.12051
- Elliot, A. J., & Murayama, K. (2008). On the measurement of achievement goals: Critique, illustration, and application. *Journal of Educational Psychology*, 100, 613–628. doi:10.1037/0022-0663.100.3.613
- Elliot, A. J., Murayama, K., & Pekrun, R. (2011). A 3 x 2 achievement goal model. *Journal of Educational Psychology*, 103, 632–648. doi:10.1037/a0023952
- Epstein, J. L. (1989). Family structures and student motivation: A developmental perspective. In C. Ames & R. Ames (Eds.), *Research on motivation in education* (Vol. 3, pp. 259–295). New York: Academic Press.
- Ferretti, R. P., MacArthur, C. A., & Dowdy, N. S. (2000). The effects of an elaborated goal on the persuasive writing of students with learning disabilities and their normally achieving peers. *Journal of Educational Psychology*, 92, 694–702. doi:10.1037/0022-0663.92.4.694
- Fletcher, J. M., & Vaughn, S. (2009). Response to intervention: Preventing and remediating academic difficulties. *Child Development Perspectives*, 3, 30–37. doi:10.1111/j.1750-8606.2008.00072.x
- Friedel, J. M., Cortina, K. S., Turner, J. C., & Midgley, C. (2010). Changes in efficacy beliefs in mathematics across the transition to middle school: Examining the effects of perceived teacher and parent goal emphases. *Journal of Educational Psychology*, 102, 102–114. doi:10.1037/a0017590
- Fuchs, L. S. (2017). Curriculum-based measurement as the emerging alternative: Three decades later. *Learning Disabilities Research and Practice*, 32, 5–7. doi:10.1111/ldrp.12127
- Fuchs, L. S., & Fuchs, D. (1986). Curriculum-based assessment of progress toward long-term and short-term goals. *Journal of Special Education*, 20, 69–82. doi:10.1177/002246698602000108
- Fuchs, L. S., Fuchs, D., Karns, K., Hamlett, C. L., Katzaroff, M., & Dutka, S. (1997). Effects of task-focused goals on low-achieving students with and without learning disabilities. *American Educational Research Journal*, 34, 513–543. doi:10.2307/1163248
- Fuchs, L. S., Fuchs, D., & Prentice, K. (2004). Responsiveness to mathematical problem-solving instruction: Comparing students at risk of mathematics disability with and without risk of reading disability. *Journal of Learning Disabilities*, 37, 293–306. doi:10.1177/00222194040370040201
- Gawrilow, C., Gollwitzer, P. M., & Oettingen, G. (2011). If-then plans benefit executive functions in children with ADHD. *Journal of Social and Clinical Psychology*, 30, 616–646. doi:10.1521/jscp.2011.30.6.616
- Geary, D. C. (2011). Consequences, characteristics, and causes of mathematical learning disabilities and persistent low achievement in mathematics. *Journal of Developmental and Behavioral Pediatrics*, 32, 250–263. doi:10.1097/DBP.0b013e318209edef
- Geary, D. C., Hoard, M. K., Nugent, L., & Bailey, D. H. (2012). Mathematical cognition deficits in children with learning disabilities and persistent low achievement: A five-year prospective study. *Journal of Educational Psychology*, 104, 206–223. doi:10.1037/a0025398

- Gersten, R., Chard, D., Jayanthi, M., Baker, S., Morphy, P., & Flojo, J. (2009). Mathematics instruction for students with learning disabilities: A meta-analysis of instructional components. *Review of Educational Research*, 79, 1202–1242. doi:10.3102/0034654309334431
- Goldberg, R. J., Higgins, E. L., Raskind, M. H., & Herman, K. L. (2003). Predictors of success in individuals with learning disabilities: A qualitative analysis of a 20-year longitudinal study. *Learning Disabilities Research & Practice*, 18, 222–236. doi:10.1111/1540-5826.00077
- Gollwitzer, P. M. (1999). Implementation intentions: Strong effects of simple plans. *American Psychologist*, 54, 493–503. doi:10.1037/0003-066X.54.7.493
- Gollwitzer, P. M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances in Experimental Social Psychology*, 38, 69–119. doi:10.1016/S0065-2601(06)38002-1
- Graham, S., MacArthur, C., & Schwartz, S. (1995). Effects of goal setting and procedural facilitation on the revising behavior and writing performance of students with writing and learning problems. *Journal of Educational Psychology*, 87, 230–240. doi:10.1037/0022-0663.87.2.230
- Grant, H., & Dweck, C. S. (2003). Clarifying achievement goals and their impact. *Journal of Personality and Social Psychology*, 85, 541–553. doi:10.1037/0022-3514.85.3.541
- Greene, B. A., & Miller, R. B. (1996). Influences on achievement: Goals, perceived ability, and cognitive engagement. *Contemporary Educational Psychology*, 21, 181–192. doi:10.1006/ceps.1996.0015
- Haimovitz, K., & Dweck, C. S. (2017). The origins of children's growth and fixed mindsets: New research and a new proposal. *Child Development*, 88, 1849–1859. doi:10.1111/cdev.12955
- Hale, J., Alfonso, V., Berninger, V., Bracken, B., Christo, C., Clark, E., ... Yalof, J. (2010). Critical issues in response-to-intervention, comprehensive evaluation, and specific learning disabilities identification and intervention: An expert white paper consensus. *Learning Disability Quarterly*, 33, 223–236. doi:10.1177/073194871003300310
- Harackiewicz, J. M., Durik, A. M., Barron, K. E., Linnenbrink-Garcia, L., & Tauer, J. M. (2008). The role of achievement goals in the development of interest: Reciprocal relations between achievement goals, interest, and performance. *Journal of Educational Psychology*, 100, 105–122. doi:10.1037/0022-0663.100.1.105
- Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. London: Routledge.
- Hollo, A., & Wehby, J. H. (2017). Teacher talk in general and special education elementary classrooms. *The Elementary School Journal*, 117, 616–641. doi:10.1086/691605
- Hulleman, C. S., Schrager, S. M., Bodmann, S. M., & Harackiewicz, J. M. (2010). A meta-analytic review of achievement goal measures: Different labels for the same constructs or different constructs with similar labels? *Psychological Bulletin*, 136, 422–449. doi:10.1037/a0018947
- Individuals with Disabilities Education Act. (2004). Sec. 300.8 (c) (10). Retrieved December 2, 2019 from <https://sites.ed.gov/idea/regs/b/a/300.8/c/10>
- Jenkins, J., & Terjeson Kari, J. (2011). Monitoring reading growth: Goal setting, measurement frequency, and methods of evaluation. *Learning Disabilities Research & Practice*, 26, 28–35. doi:10.1111/j.1540-5826.2010.00322.x
- Johnson, E. S., Humphrey, M., Mellard, D. F., Woods, K., & Swanson, H. L. (2010). Cognitive processing deficits and students with specific learning disabilities: A selective meta-analysis of the literature. *Learning Disability Quarterly*, 33, 3–18. doi:10.1177/073194871003300101
- Johnson, L., Graham, S., & Harris, K. R. (1997). The effects of goal setting and self-instruction on learning a reading comprehension strategy: A study of students with learning disabilities. *Journal of Learning Disabilities*, 30, 80–91. doi:10.1177/002221949703000107
- Kaplan, A., Gheen, M., & Midgley, C. (2002). Classroom goal structure and student disruptive behaviour. *British Journal of Educational Psychology*, 72, 191–211. doi:10.1348/000709902158847
- Kaplan, A., & Maehr, M. L. (2007). The contributions and prospects of goal orientation theory. *Educational Psychology Review*, 19, 141–184. doi:10.1007/s10648-006-9012-5
- Kuder, S. J. (2017). Vocabulary instruction for secondary students with reading disabilities: An updated research review. *Learning Disability Quarterly*, 40, 155–164. doi:10.1177/0731948717690113
- Lichtinger, E., & Kaplan, A. (2015). Employing a case study approach to capture motivation and self-regulation of young students with learning disabilities in authentic educational contexts. *Metacognition and Learning*, 10, 119–149. doi:10.1007/s11409-014-9131-1
- Linnenbrink, E. A., & Pintrich, P. R. (2002). Achievement goal theory and affect: An asymmetrical bidirectional model. *Educational Psychologist*, 37, 69–78. doi:10.1207/s15326985ep3702_2

- Locke, E. A. (1996). Motivation through conscious goal setting. *Applied & Preventative Psychology*, 5, 117–124. doi:10.1016/S0962-1849(96)80005-9
- Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist*, 57, 705–717. doi:10.1037/0003-066X.57.9.705
- Locke, E. A., & Latham, G. P. (2006). New directions in goal-setting theory. *Current Directions in Psychological Science*, 15, 265–268. doi:10.1111/j.1467-8721.2006.00449.x
- Locke, E. A., Latham, G. P., & Erez, M. (1988). The determinants of goal commitment. *The Academy of Management Review*, 13, 23–39. doi:10.2307/258352
- Maag, J., & Reid, R. (2006). Depression among students with learning disabilities: Assessing the risk. *Journal of Learning Disabilities*, 39, 3–10. doi:10.1177/00222194060390010201
- Maehr, M. L., & Anderman, E. (1993). Reinventing schools for early adolescents: Emphasizing task goals. *Elementary School Journal*, 93, 593–610. doi:10.1086/461742
- Maehr, M. L., & Meyer, H. A. (1997). Understanding motivation and schooling: Where we've been, where we are, and where we need to go. *Educational Psychology Review*, 9, 371–409. doi:10.1023/A:1024750807365
- Marsh, H. W., Tracey, D. K., & Craven, R. G. (2006). Multidimensional self-concept structure for pre-adolescents with mild intellectual disabilities: A hybrid multigroup-MIMC approach to factorial invariance and latent mean differences. *Educational and Psychological Measurement*, 66, 795–818. doi:10.1177/0013164405285910
- Martin, A. J. (2006). Personal bests (PBs): A proposed multidimensional model and empirical analysis. *British Journal of Educational Psychology*, 76, 803–825. doi:10.1348/000709905X55389
- Martin, A. J. (2012). The role of personal best (PB) goals in the achievement and behavioral engagement of students with ADHD and students without ADHD. *Contemporary Educational Psychology*, 37, 91–105. doi:10.1016/j.cedpsych.2012.01.002
- Martin, A. J., & Liem, G. A. D. (2010). Academic personal bests (PBs), engagement, and achievement: A cross-lagged panel analysis. *Learning and Individual Differences*, 20, 265–270. doi:10.1016/j.lindif.2010.01.001
- Mazzocco, M. M. M., Myers, G. F., Lewis, K. E., Hanich, L. B., & Murphy, M. M. (2013). Limited knowledge of fraction representations differentiates middle school students with mathematics learning disability (dyscalculia) versus low mathematics achievement. *Journal of Experimental Child Psychology*, 115, 371–387. doi:10.1016/j.jecp.2013.01.005
- Meece, J. L., Anderman, E. M., & Anderman, L. (2006). Classroom goal structure, student motivation, and academic achievement. *Annual Review of Psychology*, 57, 487–503. doi:10.1146/annurev.psych.56.091103.070258
- Moran, T. P. (2016). Anxiety and working memory capacity: A meta-analysis and narrative review. *Psychological Bulletin*, 142, 831–864. doi:10.1037/bul0000051
- National Center for Education Statistics. (2019). Table 204.30. Children 3 to 21 years old served under Individuals with Disabilities Education Act (IDEA), Part B, by type of disability: Selected years, 1976–77 through 2017–18. Retrieved December 2, 2019 from https://nces.ed.gov/programs/digest/d18/tables/dt18_204.30.asp
- Nelson, J., & Harwood, H. (2011). Learning disabilities and anxiety: A meta-analysis. *Journal of Learning Disabilities*, 44, 3–17. doi:10.1177/0022219409359939
- Nicholls, J. G. (1989). *The competitive ethos and democratic education*. Cambridge, MA: Harvard University Press.
- O'Shea, A., Booth, J. L., Barbieri, C., McGinn, K. M., Young, L. K., & Oyer, M. H. (2017). Algebra performance and motivation differences for students with learning disabilities and students of varying achievement levels. *Contemporary Educational Psychology*, 50, 80–96. doi:10.1016/j.cedpsych.2016.03.003
- Page-Voth, V., & Graham, S. (1999). Effects of goal setting and strategy use on the writing performance and self-efficacy of students with writing and learning problems. *Journal of Educational Psychology*, 91, 230–240. doi:10.1037/0022-0663.91.2.230
- Pashler, H., Bain, P., Bottge, B., Graesser, A., Koedinger, K., McDaniel, M., & Metcalfe, J. (2007). *Organizing instruction and study to improve student learning*. Washington, DC: National Center for Education Research, U.S. Department of Education.
- Paunesku, D., Walton, G. M., Romero, C., Smith, E. N., Yeager, D. S., & Dweck, C. S. (2015). Mind-set interventions are a scalable treatment for academic underachievement. *Psychological Science*, 26, 784–793. doi:10.1177/0956797615571017

- Pekrun, R., Lichtenfeld, S., Marsh, H. W., Murayama, K., & Goetz, T. (2017). Achievement emotions and academic performance: Longitudinal models of reciprocal effects. *Child Development*, 88, 1653–1670. doi:10.1111/cdev.12704
- Pekrun, R., & Linnenbrink-Garcia, L. (2012). Academic emotions and student engagement. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 259–282). New York: Springer.
- Pierangelo, R., & Giuliani, G. (2007). *Understanding, developing, and writing effective IEPs*. Thousand Oaks, CA: Corwin Press.
- Prewett, S., Mellard, D. F., Deshler, D. D., Allen, J., Alexander, R., & Stern, A. (2012). Response to intervention in middle schools: Practices and outcomes. *Learning Disabilities Research and Practice*, 27, 136–147. doi:10.1111/j.1540-5826.2012.00359.x
- Pugh, K. J., & Bergin, D. A. (2006). Motivational influences on transfer. *Educational Psychologist*, 41, 147–160. doi:10.1207/s15326985ep4103_2
- Pulfrey, C., Buchs, C., & Butera, F. (2011). Why grades engender performance-avoidance goals: The mediating role of autonomous motivation. *Journal of Educational Psychology*, 103, 683–700. doi:10.1037/a0023911
- Putnam, A. L., Sungkhasettee, V. W., & Roediger, H. L. (2016). Optimizing learning in college: Tips from cognitive psychology. *Perspectives on Psychological Science*, 11, 652–660. doi:10.1177/1745691616645770
- Reed, D. K., & Lynn, D. (2015). The effects of an inference-making strategy taught with and without goal setting. *Learning Disability Quarterly*, 39, 133–145. doi:10.1177/0731948715615557
- Renick, M. J., & Harter, S. (1989). Impact of social comparisons on the developing self-perceptions of learning disabled students. *Journal of Educational Psychology*, 81, 631–638. doi:10.1037/0022-0663.81.4.631
- Root, M. M., Marchis, L., White, E., Courville, T., Choi, D., Bray, M. A., ... Wayte, J. (2017). How achievement error patterns of students with mild intellectual disability differ from low IQ and low achievement students without diagnoses. *Journal of Psychoeducational Assessment*, 35, 94–110. doi:10.1177/0734282916669208
- Sarah, C., Stephen, T., & Everarda, C. (2013). Identifying learning disabilities through a cognitive deficit framework: Can verbal memory deficits explain similarities between learning disabled and low achieving students? *Journal of Learning Disabilities*, 48, 271–280. doi:10.1177/0022219413497587
- Schofield, J. (2010). International evidence on ability grouping with curriculum differentiation and the achievement gap in secondary schools. *Teachers College Record*, 112, 1492–1528.
- Schunk, D. H. (1985). Participation in goal setting: Effects on self-efficacy and skills of learning-disabled children. *The Journal of Special Education*, 19, 307–317. doi:10.1177/002246698501900307
- Schunk, D. H. (1990). Goal setting and self efficacy during self regulated learning. *Educational Psychologist*, 25, 71–86. doi:10.1207/s15326985ep2501_6
- Schunk, D. H., Pintrich, P. R., & Meece, J. L. (2014). *Motivation in education: Theory, research, and applications* (4th ed.). Upper Saddle River, NJ: Pearson.
- Schwab, S., & Hessels, M. G. P. (2014). Achievement goals, school achievement, self-estimations of school achievement, and calibration in students with and without special education needs in inclusive education. *Scandinavian Journal of Educational Research*, 59, 461–477. doi:10.1080/00313831.2014.932304
- Schwinger, M., Wirthwein, L., Lemmer, G., & Steinmayr, R. (2014). Academic self-handicapping and achievement: A meta-analysis. *Journal of Educational Psychology*, 106, 744–761. doi:10.1037/a0035832
- Senko, C., & Dawson, B. (2017). Performance-approach goal effects depend on how they are defined: Meta-analytic evidence from multiple educational outcomes. *Journal of Educational Psychology*, 109, 574–598. doi:10.1037/edu0000160
- Senko, C., Hulleman, C. S., & Harackiewicz, J. M. (2011). Achievement goal theory at the crossroads: Old controversies, current challenges, and new directions. *Educational Psychologist*, 46, 26–47. doi:10.1080/00461520.2011.538646
- Shim, S. S., Ryan, A. M., & Anderson, C. J. (2008). Achievement goals and achievement during early adolescence: Examining time-varying predictor and outcome variables in growth-curve analysis. *Journal of Educational Psychology*, 100, 655–671. doi:10.1037/0022-0663.100.3.655
- Sideridis, G. (2007). Why are students with LD depressed? A goal orientation model of depression vulnerability. *Journal of Learning Disabilities*, 40, 526–539. doi:10.1177/00222194070400060401
- Sisk, V. F., Burgoyne, A. P., Sun, J., Butler, J. L., & Macnamara, B. N. (2018). To what extent and under which circumstances are growth mind-sets important to academic achievement? Two meta-analyses. *Psychological Science*, 29, 549–571. doi:10.1177/0956797617739704

- Solis, M., Ciullo, S., Vaughn, S., Pyle, N., Hassaram, B., & Leroux, A. (2011). Reading comprehension interventions for middle school students with learning disabilities: A synthesis of 30 years of research. *Journal of Learning Disabilities, 45*, 327–340. doi:10.1177/0022219411402691
- Sommet, N., & Elliot, A. J. (2017). Achievement goals, reasons for goal pursuit, and achievement goal complexes as predictors of beneficial outcomes: Is the influence of goals reducible to reasons? *Journal of Educational Psychology, 109*, 1141–1162. doi:10.1037/edu0000199
- Stecker, P., Fuchs, L. S., & Fuchs, D. (2005). Using curriculum-based measurement to improve student achievement: Review of research. *Psychology in the Schools, 42*, 795–819. doi:10.1002/pits.20113
- Swain, K. D. (2005). CBM with goal setting: Impacting students' understanding of reading goals. *Journal of Instructional Psychology, 32*, 259–265.
- Swanson, H. L. (1999). Instructional components that predict treatment outcomes for students with learning disabilities: Support for a combined strategy and direct instruction model. *Learning Disabilities Research & Practice, 14*, 129–140. doi:10.1207/sldrp1403_1
- Swanson, H. L., & Hoskyn, M. (1998). Experimental intervention research on students with learning disabilities: A meta-analysis of treatment outcomes. *Review of Educational Research, 68*, 277–321. doi:10.2307/1170599
- Therrien, W. J., Taylor, J. C., Hosp, J. L., Kaldenberg, E. R., & Gorsh, J. (2011). Science instruction for students with learning disabilities: A meta-analysis. *Learning Disabilities Research & Practice, 26*, 188–203. doi:10.1111/j.1540-5826.2011.00340.x
- Tolar, T. D., Fuchs, L., Fletcher, J. M., Fuchs, D., & Hamlett, C. L. (2016). Cognitive profiles of mathematical problem solving learning disability for different definitions of disability. *Journal of Learning Disabilities, 49*, 240–256. doi:10.1177/0022219414538520
- Turner, J. C., Warzon, K. B., & Christensen, A. (2011). Motivating mathematics learning. *American Educational Research Journal, 48*, 718–762. doi:10.3102/0002831210385103
- Urdan, T., & Midgley, C. (2001). Academic self-handicapping: What we know, what more there is to learn. *Educational Psychology Review, 13*, 115–138. doi:10.1023/A:1009061303214
- Usher, E. L., & Pajares, F. (2008). Sources of self-efficacy in school: Critical review of the literature and future directions. *Review of Educational Research, 78*, 751–796. doi:10.3102/0034654308321456
- Van Yperen, N. W., Blaga, M., & Postmes, T. (2014). A meta-analysis of self-reported achievement goals and nonself-report performance across three achievement domains (work, sports, and education). *Plos One, 9*, e93594. doi:10.1371/journal.pone.0093594
- Vansteenkiste, M., Lens, W., Elliot, A. J., Soenens, B., & Mouratidis, A. (2014). Moving the achievement goal approach one step forward: Toward a systematic examination of the autonomous and controlled reasons underlying achievement goals. *Educational Psychologist, 49*, 153–174. doi:10.1080/00461520.2014.928598
- Wehmeyer, M. L., Palmer, S. B., Agran, M., Mithaug, D. E., & Martin, J. E. (2000). Promoting causal agency: The self-determined learning model of instruction. *Exceptional Children, 66*, 439–453. doi:10.1177/001440290006600401
- Wehmeyer, M. L., & Shogren, K. A. (2016). Self-determination and choice. In N. N. Singh (Ed.), *Handbook of evidence-based practices in intellectual and developmental disabilities* (pp. 561–584). Switzerland: Springer.
- Williams-Diehm, K., Palmer, S., Lee, Y., & Schroer, H. (2010). Goal content analysis for middle and high school students with disabilities. *Career Development for Exceptional Individuals, 33*, 132–142. doi:10.1177/0885728810380230
- Zelege, S. (2004). Self-concepts of students with learning disabilities and their normally achieving peers: A review. *European Journal of Special Needs Education, 19*, 145–170. doi:10.1080/08856250410001678469

15

USING COGNITIVE LOAD THEORY TO IMPROVE TEXT COMPREHENSION FOR STUDENTS WITH DYSLEXIA

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INTRODUCTION: COGNITIVE LOAD THEORY AND DYSLEXIA

Cognitive load theory (CLT) is a theory of instructional design based on our knowledge of human cognitive architecture (Sweller, Ayres, & Kalyuga, 2011). It provides guidelines to manage learning tasks and the cognitive demands imposed by learning materials in order to increase knowledge. These guidelines have been verified empirically and replicated. The theory distinguishes between cognitive demands required to process and acquire information intrinsic to the material and task, known as intrinsic load—by, for example, elaborating knowledge—and processing useless information imposed by instructional procedures, known as extraneous load (Sweller, 2010).

During text reading, we can distinguish between reading itself (i.e., recognizing words) and comprehension (i.e., elaborating a situation model; see, e.g., Gough & Tunmer, 1986). When Grade 1 students (approximately 5–6 years of age) start to learn to read, they face this double cognitive demand: They expend cognitive resources on recognizing words and, at the same time, they try to understand the text. This demanding double task is very challenging for many novices, but, after months and years, students in Grades 2 and 3 (approximately 7–9 years of age) progressively automatize word recognition, depending on the regularity of the correspondence between the spoken and written language they are learning (for example, students learn to read Italian or Spanish faster than English; correspondences between sounds and letters are more regular in Spanish and Italian than in English; Ziegler & Goswami, 2005). The more that recognizing words is automatized, the more resources are available for comprehension.

According to the *Diagnostic and Statistical Manual of Mental Disorders* (DSM 5; American Psychiatric Association, 2013), dyslexia is a specific learning disorder involving reading. Many students with dyslexia have a specific difficulty in automatizing word recognition, probably based on phonological skill deficiencies associated

with phonological coding deficits (Vellutino, Fletcher, Snowling, & Scanlon, 2004). Therefore, whereas most students after Grade 3 have automatized reading and are able to understand texts, students with dyslexia have difficulty understanding texts, not because of the comprehension process itself, but because they lack resources to deal with it. Nevertheless, recommendations on how to present text for readers with dyslexia (e.g., see the British Dyslexia Association, 2014) are “not based on empirical evidence and [do] not include recent findings” (Schiavo & Buson, 2014, p. 2). Furthermore, those recommendations are not specific to readers with dyslexia (Evet & Brown, 2005). CLT may therefore be a relevant framework to consider how we should manage cognitive resources for students with dyslexia who are learning to comprehend written text, assuming text comprehension involves the double task of recognizing words and understanding text.

In this chapter, we first will present CLT (for related discussion, see, in this volume, Follmer & Sperling, Chapter 5; Swanson, Chapter 2); then, in the second section, we will discuss dyslexia and the way it decreases comprehension (for related discussion, see, in this volume, Dockrell & Lindsay, Chapter 6; Graham & Harris, Chapter 20; Hall, Capin, Vaughn, & Cannon, Chapter 7). In the third section, we will present and discuss previous results of research designed to improve reading and comprehension for students with dyslexia. Taken together, we will outline CLT from a specific perspective: decreasing extraneous mental effort to free resources to assess reading comprehension for students with dyslexia. Following this, implications for practitioners and future research directions are discussed.

THEORY

Cognitive Load Theory, Instructional Design, and Educational Psychology

CLT (Sweller, 2015, 2016; Sweller et al., 2011) is an educational psychology theory concerned with instructional design. The aim of this theory is to generate knowledge that teachers can use when they design learning tasks and materials in order to improve students' learning. The theory can be considered under four headings: categories of knowledge, human cognitive architecture, categories of cognitive load, and instructional design.

Categories of Knowledge

Knowledge can be categorized by its biological, evolutionary status (Geary, 2008, 2012; Geary & Berch, 2016). Biologically primary knowledge is knowledge we have evolved to acquire over many generations. Examples are learning to listen to and speak a native language, learning basic social activities, learning to recognize faces, and most generic-cognitive skills such as general problem-solving skills or self-regulation skills (Tricot & Sweller, 2014). Biologically primary knowledge is characterized by the relative ease and speed with which it is acquired, the fact that it does not need to be explicitly taught, and that it can be acquired unconsciously.

In contrast, biologically secondary skills are skills that we need for cultural reasons and that we have not specifically evolved to acquire. They tend to be acquired relatively slowly and with conscious effort. Acquisition is facilitated by explicit

instruction. Educational institutions were developed in order to teach biologically secondary knowledge, such as reading and writing, because otherwise most people will not acquire those skills. Most such skills are domain-specific in nature rather than generic-cognitive (Tricot & Sweller, 2014). As an instructional theory, CLT deals principally with the acquisition of biologically secondary knowledge such as learning to read.

According to his theory (Geary, 2008), several learning disorders are associated with primary knowledge (e.g., autism; for related discussion, see Gillies, Chapter 22, this volume), whereas other learning disorders are associated with secondary knowledge (e.g., dyslexia, dyscalculia; for related discussion, see, in this volume, Graham & Harris, Chapter 20; Jordan, Barbieri, Dyson, & Devlin, Chapter 19; Morsanyi, Chapter 21). Biologically primary neurodevelopmental disorders are considered as “general,” with several aspects of development impaired. Biologically secondary neurodevelopmental disorders are “specific,” with only one aspect of development impaired for a specific learning disorder (for related discussion, see, in this volume, Sigafos, Green, O’Reilly, & Lancioni, Chapter 8; Strnadová, Chapter 4; Swanson, Chapter 2). Biologically primary disorders are independent from cultural contexts, whereas biologically secondary disorders are highly dependent on a cultural context.

Human Cognitive Architecture

The manner in which biologically secondary knowledge is acquired mimics the manner in which evolution by natural selection allows the accumulation of genetic information. The process can be described by five basic principles, each of which provides an example of biologically primary information. We do not need to be taught how to drive the mechanisms that each principle describes.

- *The information store principle:* Human cognitive architecture relies on the acquisition of a huge store of information. Long-term memory provides that store.
- *The borrowing and reorganizing principle:* Because of the size of the information store, we require a procedure to rapidly acquire large amounts of information. We do so by borrowing information from others by listening to them, reading their texts, and imitating them. Borrowed information is altered by current information held in long-term memory.
- *The randomness as generation principle:* When required information is unavailable from others, we can generate it ourselves during problem-solving using generate-and-test procedures. Although much less efficient than borrowing information from others, random generate and test is the only available process when information from others is unavailable.
- *The narrow limits of change principle:* In order to protect the contents of long-term memory from random and deleterious alteration, a procedure is needed to ensure that changes to the memory store are slow and tested for effectiveness. Working memory has the necessary characteristics. When processing novel information for eventual storage in long-term memory, working memory is severely limited in capacity and duration. Those limitations prevent rapid, large alterations to long-term memory that could limit or even destroy its functionality. Until recently,

working memory was assumed to remain constant for any given individual. Chen, Castro-Alonso, Paas, and Sweller (2018) suggested that working memory resources depleted with cognitive activity and recovered with rest.

- *The environmental organizing and linking principle:* Environmental cues are used to allow working memory to retrieve information from long-term memory that can generate action appropriate to the environment. There are no known limits to the amount of information that working memory can retrieve from long-term memory. It is through this principle that education has its transformative effects. It allows us to engage in activities that we could not possibly otherwise contemplate.

This cognitive architecture provides a base for CLT. The aim of education is to store appropriate information in long-term memory. That information, via the environmental organizing and linking principle, then allows us to function effectively in a range of environments in which we otherwise would be unable to function. Of course, the information first must be acquired via a working memory that is severely limited when acquiring novel information. If working memory is overloaded, as frequently happens, it can cease to function. As indicated in the subsequent sections, although these processes apply to the general population, they are at least equally important, and may be even more important, to dyslexic learners (for related discussion, see, in this volume, Follmer & Sperling, Chapter 5; Swanson, Chapter 2).

Categories of Cognitive Load

There are two basic, independent categories of cognitive load, intrinsic and extraneous, as well as germane load, which is a third, derivative category (Sweller, 2010).

- *Intrinsic cognitive load:* This load refers to the basic properties of the task that only can be altered by either changing the task or changing the expertise of the learners. Intrinsic cognitive load depends on element interactivity. If elements of information that must be processed interact, they must be processed simultaneously in working memory, resulting in a working memory load. For example, when learning to read the word “cat,” there are three elements (C, A, and T) that must be processed simultaneously by someone who has learned the alphabet. For someone who has not learned the alphabet, there are many more than three elements that must be processed. For a person who is a skilled reader, “cat” may be processed as a single element: the written word “cat,” which corresponds to the spoken word /kæt/ and to the meaning of this word. Thus, element interactivity is a combination of the nature of the information and the expertise of the learner. Students with dyslexia do not easily automatize the recognition of written words; therefore, whereas the intrinsic cognitive load when reading reduces rapidly for the general population, it may remain very high for dyslexic readers.
- *Extraneous cognitive load:* The manner in which information is presented and the activities required of learners also affect element interactivity and, thus, cognitive load. In this case, cognitive load can be varied by instructional procedures and so is extraneous to the intrinsic properties of the task. For example, if students are required to learn by problem-solving, there are many more interacting

elements that must be processed than if they learn by studying worked examples. CLT has generated a large range of instructional procedures that can be used to reduce extraneous cognitive load by reducing the element interactivity of the instructional materials. If reading (i.e., decoding words) is the immediate learning goal, but instruction emphasizes comprehension (i.e., building the meaning of text), then that instruction will impose an extraneous cognitive load for students with dyslexia who cannot build the meaning of text if they cannot decode the text.

- *Germane cognitive load*: Although intrinsic and extraneous cognitive load are the only independent sources of cognitive load, the term *germane cognitive load* is sometimes used to refer to the working memory resources that are needed to deal with intrinsic load rather than extraneous load. If, in line with the above example, dyslexic students who have not learned to decode text are instead provided with instruction intended to assist them in deriving meaning from text (an impossible task if they cannot decode), then germane load will be low. Such instruction oriented towards deriving meaning will require students to devote working memory resources to issues irrelevant to decoding text. Germane cognitive load will be low because resources are not devoted to the intrinsic load associated with decoding text. If, instead, working memory resources are devoted to the intrinsic load, which is germane to decoding text rather than deriving meaning, germane load will be high.

Instructional Design

Since the mid-1980s, many randomized, controlled experiments on the use of CLT have been published (e.g., Owen & Sweller, 1985; Sweller & Cooper, 1985), most of them comparing an experimental group and a control group, with both groups subjected to the same pretest (if used) and post-test. These experiments investigated CLT effects to reduce extraneous, or even intrinsic, load in order to free as many cognitive resources as possible for learning. As far as we know, CLT has been used very rarely in the domain of special needs education, and so the possible relevance of this theory to this domain has not been extensively explored. Lee and So (2015) provide one example. Using CLT to analyze the difficulties of intellectually disabled students during inquiry learning, they showed that intellectually disabled students need to be carefully guided to participate in inquiry and to manage the cognitive loads. But, what the authors showed was also valid for any students (Lazonder & Harmsen, 2016). There is every reason to suppose that the theory could be used when designing materials for students with specific learning disabilities, such as dyslexia. Accordingly, when discussing dyslexia, we will present reading (decoding words) as a means and comprehension as a goal, in order to show that CLT is applicable to the problem of students who face specific difficulties in reading.

Reading and Comprehension

Reading is a complex activity. According to the simple view of reading model (Gough & Tunmer, 1986), reading comprehension is the product of two skills: decoding and oral comprehension. Decoding is defined as “the ability to rapidly derive a represen-

tation from printed input that allows access to the appropriate entry in the mental lexicon, and thus, the retrieval of semantic information at the word level” (Hoover & Gough, 1990, p. 130). It is biologically secondary in that we have not specifically evolved to read (Geary, 2008). For that reason, learning to decode must be taught explicitly in educational contexts.

Oral comprehension is defined as “the ability to take lexical information [i.e., semantic information at the word level] and derive sentence and discourse interpretations” (Hoover & Gough, 1990, p. 131). It is biologically primary because we have evolved to learn to listen and speak, and so oral comprehension can be acquired without schooling, unlike decoding. Although oral comprehension can be improved by schooling, all “typical” learners will learn oral comprehension. Accordingly, the cognitive architecture and cognitive load categories discussed above are more applicable to decoding than to oral comprehension.

High-level cognitive processes are implied in comprehension (Van Den Broek et al., 2005). Comprehension implies the construction of a coherent mental representation of what the text is about that the reader must memorize (Van Den Broek & Kremer, 2000). Situation is the basis of this mental representation (Van Dijk & Kintsch, 1983). To represent to themselves what the text says, the readers relate the discourse to some existing knowledge structure and relations between different aspects of information of the text so that they rebuild a new model of situation. There are many meaningful relations in a text, and two types are particularly important: causal and referential relations. In addition, readers need to make inferences that are not directly present in the text (McNamara & Magliano, 2009). Such high-level cognitive processes involve important attentional or working memory resources. Written comprehension depends on word identification too. The faster the letters and words can be processed during reading, the greater are the cognitive resources available for higher-level comprehension processes, such as inferences and logical relations (Florit & Cain, 2011; Snowling, 2013; Vellutino, Tunmer, Jaccard, & Chen, 2007).

So, it is very important for young readers to automatize word identification. This automatization is based on knowledge of the alphabetic principle—the relationships between the letters (graphemes) of written language and the individual sounds (phonemes) of spoken language. According to the dual-route cascade model for reading (Coltheart, 1978), two different routes exist by which word recognition can occur. The first is a direct lexical route. The reader accesses the representation of the word in memory. She or he does not need phonological abilities. This route allows the identification of real, including irregular, words that are known and present in the mental lexicon. The second is an indirect, non-lexical (assembled) route. Word identification is achieved by processing the graphemes, accessing their pronunciation, and then putting these sounds together. To read, the reader needs to use the grapheme–phoneme correspondence rules. With this route, the reader can decode unknown words and pseudo-words.

Good phonemic awareness (Oakhill, Cain, & Bryant, 2003; Vellutino et al., 2007) and phonological awareness (Bianco et al., 2012) are important early indicators of later reading ability. When word reading becomes fast and automatic, a greater proportion of these processing resources can be devoted to reading comprehension. In other words, comprehension difficulties are not specific: They are the result of different, interacting factors such as domain-specific knowledge about

the text topic, vocabulary knowledge, inadequate print exposure, comprehension monitoring difficulties, motivation, depth of processing, and so on (Cornoldi & Oakhill, 2013). One of these factors is reading skill—that is, recognizing or decoding words.

Dyslexia as a Specific Learning Disorder

Dyslexia is a specific learning disorder: that is, a developmental disorder that begins by the age children start school, but may not be identified until later in their school years—or even in post-school life (DSM-5; American Psychiatric Association, 2013), involving reading (for related discussion, see Swanson, Chapter 2, this volume). The prevalence of dyslexia depends “upon the precise definition and criteria that are used for its ‘diagnosis’ with estimates ranging from 3% to 10%” (Snowling, 2013, p. 8), and “it is generally agreed that more boys than girls are affected” (p. 7). It also depends on the language itself (e.g., if the written form is alphabetic or not) and how regular the correspondence between letters and sounds is (Ziegler & Goswami, 2005). According to the DSM-5 (American Psychiatric Association, 2013), dyslexia is persistent across the life span, and readers with dyslexia have decoding performances below the mean (< 1.5 standard deviation, which corresponds to a difference of at least 18 months between reading age and cognitive age). Exclusion criteria are normally used to define specific learning disorders such as dyslexia—for example, (low) IQ, emotional, vision, hearing, or motor skills problems are excluded from dyslexia (see also the International Classification of Diseases—ICD-10; World Health Organization, 2016).

The DSM-5 (American Psychiatric Association, 2013) specifies three areas with a deficit for specific reading disorder: (1) accuracy of reading words; (2) fluency in recognizing words and reading fluency (the ability to read a text by controlling prosody and punctuation, by incorporating pauses, and by segmenting the text in syntactic units); and (3) written text comprehension.

The relationships between reading comprehension difficulties and dyslexia are not simple. According to Snowling (2013, p. 9),

some children with dyslexia have problems with reading comprehension, which are attributable to slow and inaccurate word reading, leaving few attentional resources available for comprehension. However, reading comprehension impairment can occur in the absence of poor decoding, suggesting that it is a distinct disorder. Indeed, the profile of reading comprehension impairment contrasts markedly with dyslexia.

This quote provides insight into the different ways that have been explored in the literature to improve comprehension for students with dyslexia. Such techniques are general and focused on comprehension. Although they are generally efficient, most are nonspecific to students with dyslexia; however, as discussed below, others are specific to dyslexia and focused on reading. Therefore, dyslexia can be considered as a specific learning disorder that increases cognitive load during reading. For example, as indicated by Snowling in the above quote, if word reading requires considerable cognitive resources, fewer resources will be available for comprehension.

Causes of Dyslexia

According to Ramus and Ahissar (2012), there are many explanations for the aetiology of dyslexia, and they have implications for the application of CLT in assisting students with dyslexia. Although there is a dearth of knowledge of cognitive processes and diverse profiles owing to the nature of the testing tasks used in identifying the deficit, there is a consensus with respect to several points:

- Dyslexia is highly heritable (Snowling, Gallagher, & Frith, 2003; Snowling & Hulme, 2013). Studying monozygotic and dizygotic twins yields interesting results. If one twin is dyslexic, about 68% of the time, the second twin also will be dyslexic for monozygotic twins who are genetically identical. For dizygotic twins, the percentage is 38% (Fisher & DeFries, 2002).
- The most common psychological cause of dyslexia is a deficit in auditory processing of the sounds of the language (phonological processing). This phonological hypothesis is generally recognized as robust. During the last 30 years, the phonological explanation has been supported by many research studies in many different alphabetic-written languages such as Finnish, Italian, English, French, and Greek (Landerl et al., 2013), but also nonalphabetic languages such as Arabic (Elbeheri & Everatt, 2007) and Chinese (Ho, Law, & Ng, 2000). The main deficits correspond to difficulties with phonological coding and representation, phonological short-term memory, and mobilization of language sounds. Landerl et al. (2013) showed that phonological awareness (best indicators are rapid naming tasks and deletion phonemes tasks) for 8–11-year-old students with dyslexia (compared with a control group) is the best predictor of dyslexia. Nevertheless, these indicators are more significant for non-transparent languages (i.e., where reading a letter is not enough to guess what the corresponding sound is, because correspondence between sounds and letters is irregular) such as English and French. In addition, these deficits occur early (Carroll & Snowling, 2004).
- An auditory, phonological processing deficit clearly can be classed as biologically primary. In other words, although reading is highly domain-specific, classed as and requiring biologically secondary knowledge, it is based on general, biologically primary knowledge: the ability to hear and to segment spoken language (Landerl et al., 2013). When this primary ability is impaired, the consequence is a specific learning disorder called dyslexia. It is difficult to understand how the impairment of this primary ability is observable only during reading, not during understanding or producing oral language. A new hypothesis is needed to explain this phenomenon.

Towards a New Hypothesis

A new hypothesis concerning phonological deficit has been put forward in the last few years. According to this hypothesis, people with a specific reading disorder do not have their phonological abilities degraded, but, rather, it is their access to phonological representations that is affected. Ramus and Szenkovits (2008) conducted a series

of experiments that led them to conclude that, “the phonological representations of people with dyslexia may be intact, and that the phonological deficit surfaces only as a function of certain task requirements, notably short-term memory, conscious awareness, and time constraints” (p. 219). Persons with dyslexia fail to discriminate and repeat correctly verbal material, as soon as short-term memory load is significant—for example, in a letters span task when the length increases. But their performance is not different from “typical” readers in low memory load conditions. For example, when they have to recall phonologically different ([gum] and [taz]) and similar ([taz] and [taʒ]) words or nonwords, their performances are poorer when similarity is high, like typical readers). According to Ramus and Szenkovits (2008), this reflects the fact that, in the course of language acquisition, dyslexic children develop normal phonological representations.

Brain-based research (for related discussion, see Byrnes & Eaton, Chapter 27, this volume) into phonological representation by Gabrieli (2009) showed that dyslexics have alterations of white matter, the role of which is to ensure the conduction of nerve impulses between two consecutive nerve centers, or between a nerve center and a nerve. A study by Boets et al. (2013) conducted on 23 dyslexic adults and 22 “typical” readers confirmed this hypothesis. Participants were subjected to a series of functional magnetic resonance imaging tests. The results indicated slow access to phonological representations. The arched beam that transmits signals between the upper left temporal gyrus (where Wernicke’s area is located) and the lower left frontal gyrus (where Broca’s area is located) showed an alteration from normal white matter. Boets et al. (2013) and Ramus (2014) shared the same hypothesis.

Research on dyslexia also indicates a problem in working memory among dyslexic students (for related discussion, see, in this volume, Follmer & Sperling, Chapter 5; Swanson, Chapter 2). On the one hand, the processes involved in working memory are used for decoding at the expense of working memory resources for processing inferences (Cain, Oakhill, & Bryant, 2004). On the other hand, there is a shortfall in the supply of working memory resources, whether for storage or processing capacity (Fischbach, Könen, Rietz, & Hasselhorn, 2014; Malstädt, Hasselhorn, & Lehmann, 2012). This could explain comprehension deficits. The treatment of complex sentences (with passive tense, for example) would be more difficult for 10–11-year-old students with dyslexia, because of phonological and working memory deficits (Leikin & Bouskila, 2004). But it still remains very difficult to understand how this working memory deficit could be a cause and not just a consequence of a word recognition deficit (Cain et al., 2004).

It therefore appears that reading comprehension in dyslexic students may be deficient owing to a lack of word identification automation. In turn, this deficit causes a working memory deficit. How can we improve this identification so that the comprehension goal can be fully achieved? We now examine CLT perspectives on this issue. We will first examine how CLT can be used to increase learning for students with reduced cognitive resources, a relevant factor, but not specific to students with dyslexia. After that, we will examine CLT effects specifically designed to decrease load involved in recognizing words—that is, specifically relevant for students with dyslexia.

CLT EFFECTS CAN INCREASE LEARNING FOR STUDENTS WITH REDUCED COGNITIVE RESOURCES

In CLT, the expertise reversal effect is an effect that depends heavily on the environmental organizing and linking principle. Based on this principle, the accumulation of relevant knowledge in long-term memory increases the cognitive resources available to learners. There are no known limits to the amount of information sourced from long-term memory that can be processed in working memory. If students have reduced cognitive resources, the most straightforward way of rectifying that problem is to increase their expertise. Once expertise has been increased, the effectiveness of various instructional designs alters. According to the expertise reversal effect, instructional designs that are beneficial for novice learners might be detrimental for more expert learners. This effect was identified almost 20 years ago (Kalyuga, Chandler, & Sweller, 1998), with the first synthesis and extensive theorizing published 5 years later (Kalyuga, Ayres, Chandler, & Sweller, 2003), followed by a special issue of the journal *Instructional Science* (Kalyuga & Renkl, 2010). The expertise reversal effect partly corresponds to an effect previously known as aptitude–treatment interactions (Cronbach & Snow, 1977; Tobias, 1976).

Expertise reversal is a compound effect that can be applied to any primary effect obtained in CLT. This makes it possible to predict, for example, that the most advanced students will learn more efficiently when solving problems, whereas the least advanced students will be more effective with the same problem presented with its solution—that is, a worked example (Kalyuga, Chandler, Tuovinen, & Sweller, 2001). Thus, within the same classroom, different students can achieve the same learning, with the same problems, but presented differently. In this way, it is possible to differentiate task and materials and, at the same time, maintain the same learning goal for all.

This approach is very promising because it considers students' prior knowledge as a major source of the difference between individuals. As indicated above, this knowledge is considered domain-specific (Tricot & Sweller, 2014). Thus, the level of difficulty each student faces depends on the distance between the student's prior knowledge and the knowledge that needs to be acquired, plus the characteristics of the task. Difficulty is, therefore, understood as a characteristic of the situation, not the student, and, in this approach, there is no reason to consider that a student may have a learning disability in general. This corresponds exactly to the definition of specific learning disorders.

CLT has been used to formulate a set of concrete procedures for adapting a task or the presentation of materials according to students' levels of relevant domain-specific knowledge (see Sweller et al., 2011). Next, we will explore CLT procedures that are specifically relevant for students with dyslexia.

SPECIFIC CLT EFFECTS THAT CAN INCREASE COMPREHENSION FOR STUDENTS WITH DYSLEXIA

If reading is very demanding for students with dyslexia and is not the learning goal itself, then, based on CLT, we should try to decrease the extraneous load associated with reading in order to free germane resources for the intrinsic load devoted to comprehension. Four CLT effects seem relevant for this purpose.

The Modality Effect

This occurs when spoken text is better than written text. This effect could support the hypothesis that listening to text instead of reading should improve comprehension by reducing the cognitive load involved in reading. (Note that listening is only superior to reading for low element interactivity material owing to the transient information effect, discussed below.) This hypothesis is supported by research in the domain of improving text comprehension for students with dyslexia. Several experiments tested if oral presentation of textual material (vs. written presentation) increased comprehension for students with dyslexia (see Wood, Moxley, Tighe, & Wagner, 2018, for a review). These experiments showed that oral presentation decreases reading demand, therefore increasing comprehension.

In a slightly different way, Kendeou, van den Broek, Helder, and Karlsson (2014) argued that, with struggling readers, non-written media can be used to foster skills that are important to reading comprehension. According to them (p. 13), “the use of different media preserves their working memory resources (which would otherwise be expended on decoding) and allows them to engage in higher level processes.” But these researchers were more focused on teaching comprehension (making inferences) than on directly increasing comprehension. According to CLT, making inferences and comprehension are based on biologically primary knowledge. They cannot be taught to “typical” students because they are learned automatically. For students missing this biologically primary skill, it may be possible to compensate, with considerable effort, via the biologically secondary system. Students with limited working memory resources during reading may be taught to focus their attention on comprehension and making inferences. As for any complex activity that involves several subgoals, it is possible to remind students that they have to reach this or that subgoal.

Ginns (2005) published a meta-analysis on the modality effect. This extensive review showed that, even if the modality effect is robust, it applies to multimedia materials, where the goal is to understand complex and interactive text–picture presentations. In these cases, presenting the comments orally instead of in written form decreases cognitive load and increases learning. According to Ginns (p. 320), the modality effect’s main hypothesis is:

presenting instructional materials using a combination of an auditory mode for textual information, such as spoken text, and a visual mode for graphical information, such as illustrations, charts, animations, etc., will be more effective than presenting all information in a visual format, such as printed text with illustrations, charts or animations.

The modality effect may be particularly relevant to dyslexic students with listening skills that are more adequate than their reading skills.

The Transient Information Effect

This is a second cognitive load effect that may be relevant. It occurs when permanent instructions such as in written form are transformed into equivalent transient information such as in spoken form, resulting in a decrease in learning (Leahy & Sweller,

2011). This effect suggests that listening to high element interactivity text instead of reading may not improve comprehension because of the transience of spoken language. Note that the transient information effect is obtained with long, complex texts (Wong, Leahy, Marcus, & Sweller, 2012). With short texts, the classic modality effect is obtained, and the negative effect of transience disappears.

This hypothesis is supported by several negative results obtained in the domain of improving text comprehension for students with dyslexia when providing them oral presentations instead of textual material. These experiments failed to demonstrate increased comprehension when dyslexic students were presented text in oral rather than written form. We will present one of these studies later in this chapter. With this solution, there is no redundancy between two different presentations of the same text, but only one presentation, the oral one. This presentation is transient: once a student hears a word, the presentation of this word disappears, even if the student does not understand the word. Therefore, if, on the one hand, it appears that using an oral presentation might be a good way to reduce cognitive load for students with dyslexia by decreasing the load involved in reading, on the other hand, the transient information effect predicts that oral presentations will increase cognitive load, because they rely on transient information.

The Redundancy Effect

This effect may also be relevant to dyslexia. Reading and hearing the same text at the same time is redundant and decreases performance (Kalyuga, Chandler, & Sweller, 2004), but this result has been obtained with “typical” readers. With novices or students with specific reading disorders, the redundancy effect may disappear owing to the expertise reversal effect. Hearing text may be important, rather than being redundant, for learners who have difficulty reading.

Indeed, this is the main result of Wood et al.’s (2018) meta-analysis on read-aloud text presentation. Presenting spoken and written text at the same time increases comprehension for students with dyslexia. But, in this literature, several aspects are unclear. First, the average positive effect is not strong, with several experiments in the domain not obtaining a positive effect with a redundant presentation (e.g., Hodapp, Judas, Rachow, Munn, & Dimmitt, 2007). Second, it is usually impossible to know if the participants were reading and hearing the text at the same time, or just reading, or just hearing—online data are not available. Third, several results showed that older students with dyslexia gained more from the redundant presentation than younger ones. For example, Lundberg and Olofsson (1993) designed a computer-based system that allowed the reader to request immediate pronunciation of a problem word encountered. According to the authors, one reason for this differential effect might be related to the metacognitive demands implied by the request option. However, the interactive feature of the support system also seems to promote metacognitive development.

The Working Memory Resource Depletion Effect

This occurs when cognitive effort on one task depresses performance on a later task, with the two tasks having similar cognitive components. The depressed performance on the second task is due to a depleted working memory following cognitive effort on the first task. Those depleted resources can be restored during rest periods (e.g., Tyler

& Burns, 2008). CLT used this effect to explain the spacing effect (Chen et al., 2018)—that is, when information processing that is spaced over longer periods (spaced presentation) results in superior test performance compared with the same information processed over shorter periods (massed presentation).

The working memory resource depletion effect could be very important in improving text comprehension for students with dyslexia. Indeed, as we noted earlier, when reading a text in order to understand it, a reader needs to process two activities simultaneously: word decoding and comprehension. This dual task is very demanding, and that is why automatizing word recognition is so important, as it can free resources for comprehension. We can hypothesize that rest periods during reading should have a similar effect. During a pause, the reader has no words to recognize, freeing resources for comprehension. In the same way, rest periods during listening to a text should also increase comprehension. This hypothesized mechanism is analogous to the spacing effect (Chen et al., 2018)

As an example, it has been shown that, when students are trying to understand a spoken document in a foreign language, the addition of a facility to pause and rewind during listening increases comprehension for most of them (Roussel, 2011). (Note that, with lower-level students in the relevant foreign language, a pause facility tends not to be used by the participants, and, accordingly, their performance is not increased.) A similar result was obtained by Schüler, Scheiter, and Gerjets (2013) in a written condition. When their participants were allowed to “replay” the linguistics materials, they reread the single text segments more often. Replaying segments was positively correlated with learning outcomes. When learners can process the same material several times, it can improve learning (see meta-analysis by Therrien, 2004).

It is also worth noting that this expectation is supported by the time-based resource-sharing model of working memory (Barrouillet & Camos, 2015). When processing a dual task, the performance on one subtask is related not just to the number of information units to be processed to perform the other subtask, but also to time spent on processing the other subtask. If an individual has more time to process the same second task, then cognitive demand is decreased, and performance is increased on the primary task.

HYPOTHESES GENERATED BY CLT: WHAT SHOULD AND WHAT SHOULD NOT WORK

The four CLT effects we examined above can generate the following hypotheses with respect to increasing comprehension for students with dyslexia by decreasing load devoted to word recognition:

- a. Adding spoken presentation of texts to written presentation of texts increases comprehension only when the texts are short and simple;
- b. Using spoken presentation of texts instead of written presentation of texts decreases comprehension, especially when the texts are long and complex;
- c. More time to read, for example by adding pauses during reading, increases text comprehension;
- d. Younger students with dyslexia find text comprehension difficult under any condition.

RESEARCH: PREVIOUS RESULTS FOR IMPROVING READING AND COMPREHENSION FOR STUDENTS WITH DYSLLEXIA

Different strategies have been tested to improve reading and comprehension for students with dyslexia. In the sections to follow, we outline three sets of strategies that sought to enhance comprehension among students with dyslexia. One set of strategies addressed reading itself. Specific training materials were designed to train students with dyslexia in decoding words. Another set of strategies addressed the cognitive and metacognitive processes involved in comprehension. Students with dyslexia were trained to understand texts. The first two strategies were usually effective, but they were not specific to dyslexia and tended to be inefficient. They did not directly use CLT. They were based on the same general principles for teaching reading and comprehension as those for “typical” readers. The third set of strategies attempted to decrease the cognitive demands of reading to increase comprehension, typically by presenting reading material orally in addition to, or instead of, presenting written texts. This third set of strategies was specific to students with dyslexia and they directly concerned CLT. They were thus far less demanding than the first two sets of strategies, but they were not very efficient. We will now present these three strategies and use CLT to discuss the results obtained using the third set of strategies.

Improving Reading by Training

The first set of studies sought to improve reading through training. In the context of rehabilitation, the effects of morphological training in several languages have been positive. For example, Colé, Casalis, and Dufayard (2012) developed training software, Morphorem, for dyslexic students in fifth-grade classes. With this tool, students improved their performance in several areas: morphological analysis, comprehension of suffixed words, and decoding. This approach is interesting when we consider that the morphological abilities of dyslexic students would be less degraded than their phonological skills (Casalis, Colé, & Sopo, 2004), and that morphological knowledge determines the effectiveness of reading (Kirby et al., 2012).

Decoding skills training has also shown positive results with poor readers for decoding and phonemic awareness (McCandliss, Beck, Sandak, & Perfetti, 2003; Torgesen et al., 2001). A meta-analysis confirmed those results. Phonemic awareness instruction had a positive impact on reading for young children (preschoolers, kindergarten students, and first-graders), even for disabled readers (Ehri et al., 2001).

An alternative proposal was based upon the idea that readers with dyslexia have difficulty processing sounds rapidly (Tallal, Merzenich, Miller, & Jenkins, 1998). Fast ForWord is a reading and language intervention program for struggling readers, but it seemed that improvements, especially in phonemic awareness and reading, were not maintained over time (Hook, Macaruso, & Jones, 2001).

Ecalte, Kleinsz, and Magnan (2013) developed a syllabus-based, computer-assisted learning system. French Grade 1 and 2 poor readers improved silent word recognition, word reading aloud, and reading comprehension after graphosyllabic training. Another experiment that used similar training confirmed the results, with poor readers improving reading fluency (Potocki, Magnan, & Ecalte, 2015).

Improving Comprehension by Addressing Cognitive and Metacognitive Processes Involved in Comprehension

A second set of studies focused on improving cognitive and metacognitive processes. Literature reviews and meta-analysis of the research in this domain show that it is possible to use strategies that improve comprehension for every reader—that is, “typical” readers (Ehri et al., 2001), as well as readers with (general) learning difficulties (Gersten, Fuchs, Williams, & Baker, 2001; Joseph, Alber-Morgan, Cullen, & Rouse, 2016; Mastropieri & Scruggs, 1997; Scammacca et al., 2007; Therrien, 2004). These studies showed that it is efficient to teach vocabulary, text grammar (i.e., the structure of a text genre), strategies to process anaphors and to make inferences, but also metacognitive strategies such as answering questions about the text, self-questioning and self-explaining the text, monitoring and self-evaluating text comprehension, rereading, and so on (for related discussion, see Perry, Mazabel, & Yee, Chapter 13, this volume). Group discussions on the text and reciprocal teaching also improved text comprehension (Murphy, Wilkinson, Soter, Hennessey, & Alexander, 2009). Most of these studies agree with the evidence that multiple strategies were more efficient than single strategy approaches, especially when general comprehension was evaluated.

There was one other important result from these reviews and meta-analyses: “Across all studies, those with only participants with learning disabilities had significantly higher effects than those with no participants with learning disabilities” (Scammacca et al., 2007, p. 17). This conclusion was interesting: if dyslexia is caused by gaps in biologically primary skills that do not need to be taught to learners in the “typical” range, we might expect that the biologically secondary system is required to plug those gaps, thus explaining why the effects are larger when treating dyslexic learners.

Thus, improving comprehension for students with dyslexia is like improving text comprehension for every student, but specifically efficient for the dyslexic students. However, these strategies are general, demanding, and time-consuming. CLT is useful because it can lead us to design interventions that are less demanding and more specific for students with dyslexia.

Improving Comprehension by Decreasing Reading Demands

The third set of studies sought to improve reading by reducing reading demands. A key way to improve reading for dyslexic students is to change the format in which information is presented. Thus, Zorzi et al. (2012) manipulated the written material and obtained an important result: Increasing the spacing of letters in a word and words in a text improved the speed and quality of reading in Italian or French dyslexic children, without any previous training. They read an average of 20% faster and made half as many mistakes.

Schneeps and his colleagues (2013) replicated the positive effect of spacing letters on comprehension for readers with dyslexia. But they also investigated line length, asking participants to read a text on a small device. The results showed that reading speeds increased by 27%, reducing the number of eye fixations by 11% and, importantly, reducing the number of regressive saccades by more than a factor of 2. But there was no effect on comprehension.

ALECTOR (Gala, 2016) is a project that aims to generate tools to help with the automatic transformation of texts in order to make content more accessible for children with dyslexia and weak readers. Gala and Ziegler (2016) conducted an experiment with simplified versions of texts with lexical, syntactic, and discursive (like anaphor deletion) levels. The results indicated a high reading speed and fewer reading errors (mainly lexical ones) with simplified versions.

Wood et al. (2018) published a meta-analysis on the effects of oral presentation of textual material on reading comprehension for students with dyslexia. The basic assumption of these approaches is that oral presentation of written material decreases the demands of reading, thus enabling comprehension (Olson, 2000). Previous literature reviews concluded that results in this domain were inconsistent. Wood et al.'s analysis concerned 22 studies. These studies included experiments where the output was not just comprehension but more general knowledge of a particular subject matter (e.g., reading, writing, math, science, etc.). The meta-analysis showed that the use of text-to-speech tools had a significant impact on reading comprehension scores with $d = .35$. Wood et al.'s analysis showed, like previous reviews, that the results in the domain were inconsistent, partially explaining the small effect size. For the moderator analyses, only a single, significant moderator emerged, namely, whether the study design was a between-subjects or within-subject study. The average weighted effect size for between-subjects studies alone was $d = .61$. For within-subject studies, the average weighted effect size dropped to $d = .15$.

In their meta-analysis, Wood et al. (2018) did not discuss two important aspects. Was it possible for the participants to pause during listening? Was the text listened to several times? It was not easy to discuss these two aspects, because, in several experiments they examined, these aspects were not accurately described. For example, Meloy, Deville, and Frisbie (2002) obtained a strong effect size ($d = 1.10$, computed by Wood et al.), but, in this study, the texts were presented "several times." When one reads Meloy et al.'s paper, it is difficult to determine what text and what question were presented "several times," and how many is meant by "several."

In another study (Vandenbroucke & Tricot, 2018), researchers investigated the supposed positive effect of oral presentation with long texts, using the kind of text that is frequently presented orally: stories. According to the transient information effect, we should obtain a null or negative effect of this oral presentation for every reader, including for students with dyslexia. In a second experiment, we lengthened presentation time, by adding self-paced or system-paced pauses. We compared story comprehension for Grade 5 students with or without dyslexia. For each experiment, 20 students with dyslexia were asked to read a story and then to listen to another one (or in reverse—listen first, read after), and 20 students without dyslexia of the same age were asked to do the same. The 40 students with dyslexia (20 per experiment) were diagnosed by the disorders unit of a paediatric hospital or by a speech therapist. Diagnostic tests showed no attentional deficit or discrete attentional deficit and no intellectual, oral language, or motor coordination deficits. All students had French as their native language. Two stories (fictional narrative texts) tested by the French Education Ministry for national evaluation of comprehension were used (466 words per sound track, 3 min 52 s, for one; 275 words per sound track, 2 min 26 s, for the other). In the "reading" condition, there was no time limit. Comprehension questions were presented orally, as were the students' answers, which were recorded.

For the first experiment, every student read one text and listened to the other one. For the second experiment, in a test of the spacing effect, every student listened to a text without pauses and listened to the other one with system-paced pauses (each pause was 7 s long, one pause after each sentence) or self-paced (the student stopped the sound track whenever she or he wanted). Each participant answered nine questions immediately after reading or listening: three literal comprehension questions (explicit information in the text), three local comprehension questions (processing of inferences and relations between different information in the text), and three global comprehension questions (the reader needed to use her or his knowledge to understand the whole text). A total score was measured for every text in every condition. Reading time was recorded.

Experiment 1 results showed that, whether the text was presented in written or oral form, students with dyslexia obtained lower comprehension scores than those without dyslexia. Oral presentation did not improve comprehension for students with dyslexia (the rate of correct answers was 0.44 in the reading condition and 0.46 in the listening condition). Their reading time was more than twice as long (average = 5 min 46 s) as the average-level participants with no dyslexia (average = 2 min 08 s). Reading time for students with dyslexia was longer than listening time, with the opposite result for average-level students. Although the transient information effect was not obtained, the students with dyslexia spent much more time reading than listening.

Experiment 2 results showed that students with dyslexia performed better in the system-paced pauses condition, indicating the spacing effect. In this condition, students with dyslexia performed at the same level as students without dyslexia (rate of correct answers = 0.51). In the self-paced pauses condition, students with dyslexia (except 1 out of 10) made no pauses. Unsurprisingly, the rate of correct answers (0.37) was, therefore, very close to the no-pause condition (0.40). In the self-paced pauses condition, 7 out of 10 students without dyslexia made one or several pauses and their rate of correct answers was far better (average = 0.62) than students with dyslexia. In sum, in the system-paced pauses condition, students with and without dyslexia performed at the same level, although students with dyslexia performed at almost half of the level of students without dyslexia in the self-paced pauses condition.

Time is an important parameter for students with dyslexia. According to Gabrieli (2009), it is the second important source of difficulty for students with dyslexia, with phonological deficit, even for adults. When there is no time limit, adults with dyslexia obtain similar comprehension scores to good readers (Parrila, Georgiou, & Corkett, 2007).

In sum, reducing cognitive load during reading for students with dyslexia is complex. Visual presentations can be improved, but encouraging results must be replicated. It is possible to use oral presentations, but the results obtained are contradictory. If time pressure decreases performance, it seems that, conversely, increasing time on reading leads to better performance.

CLT May Explain These Diverse Results

Earlier, we indicated several hypotheses generated by CLT intended to increase text comprehension for students with dyslexia. It is difficult to conclude from the examination of the meta-analyses in the domain that these hypotheses can be confirmed or

rejected, because these meta-analyses do not control variables such as text length or time spent on reading. The results also confirmed that more time to read—for example, by adding pauses during reading—increased text comprehension, but self-paced pauses may be unused by students with dyslexia.

When testing the effects of allowing pauses and allowing multiple opportunities to listen to the text with Grade 5 students, we found that listening to text did not improve text comprehension for students with dyslexia. These participants spent more time on reading than readers of the same age with no dyslexia. Adding pauses during text listening increased comprehension for students with dyslexia and reduced the difference from other participants. These results suggested that the transient information effect was obtained here (Leahy & Sweller, 2011; Spanjers, Wouters, Van Gog, & Van Merriënboer, 2011), but they also confirmed that time on task was a component of instructional design. This suggestion was supported by a new working memory model that included time as a key resource in working memory (Barrouillet & Camos, 2015). Other CLT effects could be tested in trying to improve text comprehension for students with dyslexia.

IMPLICATIONS FOR PRACTITIONERS

Even if our knowledge in this domain is sketchy, based on the research reviewed thus far, it is possible to consider that students with dyslexia should benefit from:

- Read-aloud presentation of text added to written text, but the benefits are modest and variable.
- Read-aloud presentation of text added to written text, with a longer time to process the text, probably based on system-paced pauses.
- Text presentation with spaced letters and words and short lines (even if replications of these recent results are needed).
- General CLT principles for students with low cognitive resources (i.e., novices), such as the use of worked examples, the integration of the information (in space and time) that the student will have to link mentally, the elimination of all unnecessary or decorative information.
- Explicit instruction in several domains such as vocabulary, text grammar, processing anaphors, and making inferences; also metacognitive strategies such as answering questions on the text, self-questioning and self-explaining the text, monitoring and self-evaluating text comprehension; group discussions on the text and reciprocal teaching; and rereading.
- Reduced use of spoken presentation of extensive texts and greater use of written presentations.

The above strategies are likely particularly fruitful for students in mid-elementary school and above. Earlier in elementary school, students with dyslexia (or who are at risk of being identified as dyslexic) should benefit from reinforced training in reading—for example, morphological training, decoding skills training, phonemic awareness instruction, and graphosyllabic training. These were discussed earlier in the chapter.

Another recent development in the instructional space that draws heavily on CLT involves load reduction instruction (LRI; Martin, 2016; Martin & Evans, 2018; for

related discussion, see Martin, Chapter 16, this volume). This promising work places a heavy emphasis on the expertise reversal and guidance fading effects by suggesting that detailed guidance is needed for novices, but, with increasing expertise, reduced guidance becomes increasingly effective. Furthermore, this work emphasizes the importance of motivation, an area that is largely neglected by CLT.

FUTURE DIRECTIONS

CLT can be used to generate hypotheses and to focus our attention on important variables relevant to the improvement of reading for students with dyslexia. Inconsistent results to date in improving text comprehension for students with dyslexia could be linked to a lack of control of several variables or the need to improve research design. Following is a summary of the more important issues going forward.

The transient information effect should be further investigated; sentence length (Rowe, Rowe, & Pollard, 2004), text genre, and text length should be controlled. According to CLT, it is possible to hypothesize that substituting spoken for written presentation of texts increases comprehension for students with dyslexia only when the texts are short and simple (Leahy & Sweller, 2011). Long and complex texts should not result in any benefits of additional spoken text. This could be a critical variable in explaining incoherent results in text-to-speech strategies for students with dyslexia.

The modality effect and the redundancy effect should be investigated. When students with dyslexia have to understand a text referring to a map, graph, diagram, or tabular information, do they understand better if the text is presented orally? Reciprocally, when they have to understand a text, do they understand better if this text is illustrated by a relevant picture? Do they understand movies as well as students without dyslexia? We need an exhaustive understanding of the Matthew effect (Stanovich, 2009, provided a general view of Matthew effects in reading) in different media (text, pictures, animations, film movies), because poor reading skills may have general negative consequences for learning, and we need to know if processing different media produces or decreases these general negative consequences.

The working memory resource depletion effect should be investigated. When students with dyslexia read a text, do their working memory resources deplete? Is this possible depletion comparable to that of students without dyslexia? Does this possible depletion depend on text length? The effect of pauses during reading and listening should be investigated, but also the effects of facilitating rewinding on electronic spoken texts, rereading sentences, and decreasing spoken text speed (for related discussion, see Okolo & Ferretti, Chapter 26, this volume).

Recent extensions of CLT should also be investigated among students with dyslexia. For example, the Load Reduction Instruction Scale (LRIS) has been validated among “typical” students in the “regular” classroom (Martin & Evans, 2018), and students taught by teachers scoring highly on the LRIS are also more motivated and higher achieving and report less intrinsic and extraneous cognitive load (for related discussion, see Martin, Chapter 16, this volume). How do these results generalize to students with dyslexia? Does LRI hold the same promise for these students’ academic development as it does for that of the general ability learners assessed in the Martin and Evans (2018) study? These important questions require additional investigation.

CONCLUSION

Increasing text comprehension for students with dyslexia is a major issue in the domain of special needs education. Several previous results are encouraging. These include: read-aloud presentation of text added to written text, with a longer time to process the text; text presentation with spaced letters and words; short lines; effective instructional principles for students with low cognitive resources (i.e., novices); and explicit instruction of linguistic and metacognitive aspects of reading. But also, the results in this area are diverse and sometimes contradictory. CLT can be used to explain and investigate this diversity and these contradictions, to generate more accurate and valid results, and to guide practice to increase text comprehension by decreasing the cognitive load involved in reading for students with dyslexia.

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REFERENCES

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders*. Washington, DC: Author. Retrieved from www.psychiatry.org/psychiatrists/practice/dsm/dsm-5
- Barrouillet, P., & Camos, V. (2015). *Working memory: Loss and reconstruction*. Hove: Psychology Press.
- Bianco, M., Pellenq, C., Lambert, E., Bressoux, P., Lima, L., & Doyen, A. L. (2012). Impact of early code skill and oral comprehension training on reading achievement in first grade. *Journal of Research in Reading*, 35, 427–455. doi:org/10.1111/j.1467-9817.2010.01479.x
- Boets, B., de Beeck, H. P. O., Vandermosten, M., Scott, S. K., Gillebert, C. R., Mantini, D., & Ghesquière, P. (2013). Intact but less accessible phonetic representations in adults with dyslexia. *Science*, 342, 1251–1254. doi:org/10.1126/science.1244333
- British Dyslexia Association. (2014). *Dyslexia style guide*. Retrieved from www.bdadyslexia.org.uk/common/ckeditor/filemanager/userfiles/About_Us/policies/Dyslexia_Style_Guide.pdf
- Cain, K., Oakhill, J., & Bryant, P. (2004). Children's reading comprehension ability: Concurrent prediction by working memory, verbal ability, and component skills. *Journal of Educational Psychology*, 96, 31–42. doi:dx.doi.org/10.1037/0022-0663.96.1.31
- Carroll, J. M., & Snowling, M. J. (2004). Language and phonological skills in children at high risk of reading difficulties. *Journal of Child Psychology and Psychiatry*, 45, 631–640. doi:org/10.1111/j.1469-7610.2004.00252.x
- Casalis, S., Colé, P., & Sopo, D. (2004). Morphological awareness in developmental dyslexia. *Annals of Dyslexia*, 54, 114–138. doi:org/10.1007/s11881-004-0006-z
- Chen, O., Castro-Alonso, J. C., Paas, F., & Sweller, J. (2018). Extending cognitive load theory to incorporate working memory resource depletion: Evidence from the spacing effect. *Educational Psychology Review*, 30, 483–501. doi:org/10.1007/s10648-017-9426-2
- Colé, P., Casalis, S., & Dufayard, C. (2012). *MORPHOREM software*. Retrieved from www.orthoedition.com/evaluations/morphorem-705.html
- Coltheart, M. (1978). Lexical access in simple reading tasks. In G. Underwood (Ed.), *Strategies of information processing* (pp. 151–216). London: Academic Press.
- Cornoldi, C., & Oakhill, J. V. (Eds.). (2013). *Reading comprehension difficulties: Processes and intervention*. New York: Routledge.
- Cronbach, L. J., & Snow, R. E. (1977). *Aptitudes and instructional methods: A handbook for research on interactions*. New York: Irvington.
- Ecalé, J., Kleinsz, N., & Magan, A. (2013). Computer-assisted learning in young poor readers: The effect of grapho-syllabic training on the development of word reading and reading comprehension. *Computers in Human Behavior*, 29, 1368–1376. doi:10.1016/j.chb.2013.01.041

- Ehri, L. C., Nunes, S. R., Willows, D. M., Schuster, B. V., Yaghoub-Zadeh, Z., & Shanahan, T. (2001). Phonemic awareness instruction helps children learn to read: Evidence from the National Reading Panel's meta-analysis. *Reading Research Quarterly*, 36, 250–287. doi:dx.doi.org/10.1598/RRQ.36.3.2
- Elbeheri, G., & Everatt, J. (2007). Literacy ability and phonological processing skills amongst dyslexic and non-dyslexic speakers of Arabic. *Reading and Writing*, 20, 273–294. doi:10.1007/s11145-006-9031-0
- Evett, L., & Brown, D. (2005). Text formats and web design for visually impaired and dyslexic readers-clear text for all. *Interacting with Computers*, 17, 453–472. doi:org/10.1016/j.intcom.2005.04.001
- Fischbach, A., Könen, T., Rietz, C. S., & Hasselhorn, M. (2014). What is not working in working memory of children with literacy disorders? Evidence from a three-year-longitudinal study. *Reading and Writing*, 27, 267–286. doi:org/10.1007/s11145-013-9444-5
- Fisher, S. E., & DeFries, J. C. (2002). Developmental dyslexia: Genetic dissection of a complex cognitive trait. *Nature Reviews Neuroscience*, 3, 767–780. doi:org/10.1038/nrn936
- Florit, E., & Cain, K. (2011). The simple view of reading: Is it valid for different types of alphabetic orthographies? *Educational Psychology Review*, 23, 553–576. doi:org/10.1007/s10648-011-9175-6
- Gabrieli, J. D. (2009). Dyslexia: A new synergy between education and cognitive neuroscience. *Science*, 325, 280–283. doi:doi:org/10.1126/science.1171999
- Gala, N. (2016). *ALECTOR project*. Retrieved from www.researchgate.net/project/Reading-Aids-to-leverage-Documents-Accessibility-for-Children-with-Dyslexia-ANR-project-2016-2020
- Gala, N., & Ziegler, J. (2016). Reducing lexical complexity as a tool to increase text accessibility for children with dyslexia. *Proceedings of the Workshop Computational Linguistics for Linguistic Complexity (CL4LC) at the 26th International Conference on Computational Linguistics (COLING-2016)*. Osaka, Japan.
- Geary, D. (2008). An evolutionarily informed education science. *Educational Psychologist*, 43, 179–195. doi:org/10.1080/00461520802392133
- Geary, D. (2012). Evolutionary educational psychology. In K. Harris, S. Graham, & T. Urdan (Eds.), *APA Educational Psychology Handbook* (Vol. 1, pp. 597–621). Washington, DC: American Psychological Association.
- Geary, D., & Berch, D. (2016). Evolution and children's cognitive and academic development. In D. Geary & D. Berch (Eds.), *Evolutionary perspectives on child development and education* (pp. 217–249). Cham, Switzerland: Springer.
- Gersten, R., Fuchs, L. S., Williams, J. P., & Baker, S. (2001). Teaching reading comprehension strategies to students with learning disabilities: A review of research. *Review of Educational Research*, 71, 279–320. doi:org/10.3102/00346543071002279
- Ginns, P. (2005). Learning and Instruction. *Meta-analysis of the Modality Effect*, 15, 313–331. doi:dx.doi.org/10.1016/j.learninstruc.2005.07.001
- Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability. *Remedial and Special Education*, 7, 6–10. doi:org/10.1177/074193258600700104
- Ho, C. S. H., Law, T. P. S., & Ng, P. M. (2000). The phonological deficit hypothesis in Chinese developmental dyslexia. *Reading and Writing*, 13, 57–79. doi:org/10.1023/A:1008040922662
- Hodapp, J., Judas, C., Rachow, C., Munn, C., & Dimmitt, S. (2007). *Summary report of the Iowa text reader longitudinal study 2006–2007*. Des Moines, IA: Iowa Assistive Technology Liaisons.
- Hook, P. E., Macaruso, P., & Jones, S. (2001). Efficacy of Fast ForWord training on facilitating acquisition of reading skills by children with reading difficulties: A longitudinal study. *Annals of Dyslexia*, 51, 73–96. doi:org/10.1007/s11881-001-0006-1
- Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing*, 2, 127–160. doi:org/10.1007/BF00401799
- Joseph, L. M., Alber-Morgan, S., Cullen, J., & Rouse, C. (2016). The effects of self-questioning on reading comprehension: A literature review. *Reading and Writing Quarterly*, 32, 152–173. doi:org/10.1080/10573569.2014.891449
- Kalyuga, S., Ayres, P., Chandler, P., & Sweller, J. (2003). The expertise reversal effect. *Educational Psychologist*, 38, 23–31. doi:org/10.1207/S15326985EP3801_4
- Kalyuga, S., Chandler, P., & Sweller, J. (1998). Levels of expertise and instructional design. *Human Factors*, 40, 1–17.
- Kalyuga, S., Chandler, P., & Sweller, J. (2004). When redundant on-screen text in multimedia technical instruction can interfere with learning. *Human Factors*, 46, 567–581. doi:org/10.1518/hfes.46.3.567.50405
- Kalyuga, S., Chandler, P., Tuovinen, J., & Sweller, J. (2001). When problem solving is superior to studying worked examples. *Journal of Educational Psychology*, 93, 579–588. doi:dx.doi.org/10.1037/0022-0663.93.3.579

- Kalyuga, S., & Renkl, A. (Eds.). (2010). Special issue: Expertise reversal effect. *Instructional Science*, 38, 209–323. doi:org/10.1007/s11251-009-9102-0
- Kendeou, P., Broek, P., Helder, A., & Karlsson, J. (2014). A cognitive view of reading comprehension: Implications for reading difficulties. *Learning Disabilities Research and Practice*, 29, 10–16. doi:org/10.1111/ldrp.12025
- Kirby, J. R., Deacon, S. H., Bowers, P. N., Izenberg, L., Wade-Woolley, L., & Parrila, R. (2012). Children's morphological awareness and reading ability. *Reading and Writing*, 25, 389–410. doi:org/10.1007/s11145-010-9276-5
- Landerl, K., Ramus, F., Moll, K., Lyytinen, H., Leppänen, P. H., Lohvansuu, K., & Kunze, S. (2013). Predictors of developmental dyslexia in European orthographies with varying complexity. *Journal of Child Psychology and Psychiatry*, 54, 686–694. doi:org/10.3389/fpsyg.2014.01169
- Lazonder, A. W., & Harmsen, R. (2016). Meta-analysis of inquiry-based learning: Effects of guidance. *Review of Educational Research*, 86, 681–718. doi:org/10.3102/0034654315627366
- Leahy, W., & Sweller, J. (2011). Cognitive load theory, modality of presentation and the transient information effect. *Applied Cognitive Psychology*, 25, 943–951. doi:org/10.1002/acp.1787
- Lee, T. T., & So, W. W. (2015). Inquiry learning in a special education setting: Managing the cognitive loads of intellectually disabled students. *European Journal of Special Needs Education*, 30, 156–172. doi:org/10.1080/08856257.2014.986907
- Leikin, M., & Bouskila, O. A. (2004). Expression of syntactic complexity in sentence comprehension: A comparison between dyslexic and regular readers. *Reading and Writing*, 17, 801–822. doi:org/10.1007/s11145-004-2661-1
- Lundberg, L., & Olofsson, Å. (1993). Can computer speech support reading comprehension? *Computers in Human Behavior*, 9, 283–293. doi:dx.doi.org/10.1016/0747-5632(93)90012-H
- Malstädt, N., Hasselhorn, M., & Lehmann, M. (2012). Free recall behaviour in children with and without spelling impairment: The impact of working memory subcapacities. *Dyslexia*, 18, 187–198. doi:org/10.1002/dys.1446
- Martin, A. J. (2016). *Using load reduction instruction (LRI) to boost motivation and engagement*. Leicester, UK: British Psychological Society.
- Martin, A. J., & Evans, P. (2018). Load reduction instruction: Exploring a framework that assesses explicit instruction through to independent learning. *Teaching and Teacher Education*, 73, 203–214. doi:org/10.1016/j.tate.2018.03.018
- Mastropieri, M. A., & Scruggs, T. E. (1997). Best practices in promoting reading comprehension in students with learning disabilities 1976 to 1996. *Remedial and Special Education*, 18, 198–213. doi:org/10.1177/074193259701800402
- McCandliss, B., Beck, I. L., Sandak, R., & Perfetti, C. (2003). Focusing attention on decoding for children with poor reading skills: Design and preliminary tests of the word building intervention. *Scientific Studies of Reading*, 7, 75–104. doi:dx.doi.org/10.1207/S1532799XSSR0701_05
- McNamara, D. S., & Magliano, J. (2009). Toward a comprehensive model of comprehension. *Psychology of Learning and Motivation*, 51, 297–384. doi:org/10.1016/S0079-7421(09)51009-2
- Meloy, L. L., Deville, C., & Frisbie, D. A. (2002). The effect of a read aloud accommodation on test scores of students with and without a learning disability in reading. *Remedial and Special Education*, 23, 248–255. doi:org/10.1177/07419325020230040801
- Murphy, P. K., Wilkinson, I. A., Soter, A. O., Hennessey, M. N., & Alexander, J. F. (2009). Examining the effects of classroom discussion on students' comprehension of text: A meta-analysis. *Journal of Educational Psychology*, 101, 740–764. doi:10.1037/a0015576
- Oakhill, J., Cain, K., & Bryant, P. E. (2003). The dissociation of single-word reading and text comprehension: Evidence from component skills. *Language and Cognitive Processes*, 18, 443–468. doi:org/10.1080/01690960344000008
- Olson, R. K. (2000). Individual differences in gains from computer-assisted remedial reading. *Journal of Experimental Child Psychology*, 77, 197–235. doi:org/10.1006/jecp.1999.2559
- Owen, E., & Sweller, J. (1985). What do students learn while solving mathematics problems? *Journal of Educational Psychology*, 77, 272–284. doi:dx.doi.org/10.1037/0022-0663.77.3.272
- Parrila, R., Georgiou, G., & Corkett, J. (2007). University students with a significant history of reading difficulties: What is and is not compensated? *Exceptionality Education International*, 17, 195–220.
- Potocki, A., Magnan, A., & Ecalte, J. (2015). Computerized trainings in four groups of struggling readers: Specific effects on word reading and comprehension. *Research in Developmental Disabilities*, 45, 83–92. doi:org/10.1016/j.ridd.2015.07.016

- Ramus, F. (2014). Neuroimaging sheds new light on the phonological deficit in dyslexia. *Trends in Cognitive Sciences*, 18, 274–275. doi:org/10.1016/j.tics.2014.01.009
- Ramus, F., & Ahissar, M. (2012). Developmental dyslexia: The difficulties of interpreting poor performance, and the importance of normal performance. *Cognitive Neuropsychology*, 29, 104–122. doi:org/10.1080/02643294.2012.677420
- Ramus, F., & Szenkovits, G. (2008). What phonological deficit? *The Quarterly Journal of Experimental Psychology*, 61, 129–141. doi:org/10.1080/17470210701508822
- Roussel, S. (2011). A computer assisted method to track listening strategies in second language learning. *ReCALL*, 23, 98–116. doi:org/10.1017/S0958344011000036
- Rowe, K., Rowe, K., & Pollard, J. (2004). “Literacy behaviour” and auditory processing: Building “fences” at the top of the “cliff” in preference to ambulance services at the bottom. https://research.acer.edu.au/research_conference_2004/6
- Scammacca, N., Roberts, G., Vaughn, S., Edmonds, M., Wexler, J., Reutebuch, C. K., & Torgesen, J. K. (2007). *Interventions for adolescent struggling readers: A meta-analysis with implications for practice*. Portsmouth: RMC Research Corporation, Center on Instruction.
- Schiavo, G., & Buson, V. (2014). Interactive e-books to support reading skills in dyslexia. *IBOOC2014, 2nd Workshop on Interactive eBook for Children, IDC’14*, June 17–20, Aarhus, Denmark.
- Schneps, M. H., Thomson, J. M., Sonnert, G., Pomplun, M., Chen, C., & Heffner-Wong, A. (2013). Shorter lines facilitate reading in those who struggle. *PloS One*, 8, e71161. doi:org/10.1371/journal.pone.0071161
- Schüler, A., Scheiter, K., & Gerjets, P. (2013). Is spoken text always better? Investigating the modality and redundancy effect with longer text presentation. *Computers in Human Behavior*, 29, 1590–1601. doi:org/10.1016/j.chb.2013.01.047
- Snowling, M. J. (2013). Early identification and interventions for dyslexia: A contemporary view. *Journal of Research in Special Educational Needs*, 13, 7–14. doi:org/10.1111/j.1471-3802.2012.01262.x
- Snowling, M. J., Gallagher, A., & Frith, U. (2003). Family risk of dyslexia is continuous: Individual differences in the precursors of reading skill. *Child Development*, 74, 358–373. doi:org/10.1111/1467-8624.7402003
- Snowling, M. J., & Hulme, C. (2013). Children’s reading impairments: From theory to practice. *Japanese Psychological Research*, 55, 186–202. doi:org/10.1111/j.1468-5884.2012.00541.x
- Spanjers, I. A., Wouters, P., Van Gog, T., & Van Merriënboer, J. J. (2011). An expertise reversal effect of segmentation in learning from animated worked-out examples. *Computers in Human Behavior*, 27, 46–52. doi:org/10.1016/j.chb.2010.05.011
- Stanovich, K. E. (2009). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Journal of Education*, 189, 23–55. doi:org/10.1177/0022057409189001-204
- Sweller, J. (2010). Element interactivity and intrinsic, extraneous and germane cognitive load. *Educational Psychology Review*, 22, 123–138. doi:org/10.1007/s10648-010-9128-5
- Sweller, J. (2015). In academe, what is learned, and how is it learned? *Current Directions in Psychological Science*, 24, 190–194. doi:org/10.1177/0963721415569570
- Sweller, J. (2016). Story of a research program. *Education Review//Reseñas Educativas*, 23. Retrieved from <http://edrev.asu.edu/index.php/ER/article/view/2025>
- Sweller, J., Ayres, P., & Kalyuga, S. (2011). *Cognitive load theory*. New York: Springer.
- Sweller, J., & Cooper, G. A. (1985). The use of worked examples as a substitute for problem solving in learning algebra. *Cognition and Instruction*, 2, 59–89. doi:org/10.1207/s1532690xci0201_3
- Tallal, P., Merzenich, M. M., Miller, S., & Jenkins, W. (1998). Language learning impairments: Integrating basic science, technology, and remediation. *Experimental Brain Research*, 123, 210–219. doi:org/10.1007/s002210050563
- Therrien, W. J. (2004). Fluency and comprehension gains as a result of repeated reading: A meta-analysis. *Remedial and Special Education*, 25, 252–261. doi:org/10.1177/07419325040250040801
- Tobias, S. (1976). Achievement treatment interactions. *Review of Educational Research*, 46, 61–74. doi:org/10.3102/00346543046001061
- Torgesen, J. K., Alexander, A. W., Wagner, R. K., Rashotte, C. A., Voeller, K. K., & Conway, T. (2001). Intensive remedial instruction for children with severe reading disabilities: Immediate and long-term outcomes from two instructional approaches. *Journal of Learning Disabilities*, 34, 33–58. doi:org/10.1177/002221940103400104
- Tricot, A., & Sweller, J. (2014). Domain-specific knowledge and why teaching generic skills does not work. *Educational Psychology Review*, 26, 265–283. doi:org/10.1007/s10648-013-9243-1

- Tyler, J. M., & Burns, K. C. (2008). After depletion: The replenishment of the self's regulatory resources. *Self and Identity*, 7, 305–321. doi:org/10.1080/15298860701799997
- Van Den Broek, P., Kendeou, P., Kremer, K., Lynch, J. S., Butler, J., White, M. J., & Lorch, E. P. (2005). Assessment of comprehension abilities in young children. In S. Stahl & S. Paris (Eds.), *Children's reading comprehension and assessment* (pp. 107–130). Mahwah: Erlbaum.
- Van Den Broek, P., & Kremer, K. E. (2000). The mind in action: What it means to comprehend during reading. In B. M. Taylor, M. F. Graves, & P. van Den Broek (Eds.), *Reading for meaning: Fostering comprehension in the middle grades* (pp. 1–31). New York: Teachers College Press.
- Van Dijk, T. A., & Kintsch, W. (1983). *Strategies of discourse comprehension*. New York: Academic Press.
- Vandenbroucke, G., & Tricot, A. (2018). La présentation orale de textes narratifs améliore-t-elle la compréhension d'élèves dyslexiques de CM2? [Does spoken presentation of stories increase comprehension for grade 5 students with dyslexia?]. *Analyse Neuropsychologique Des Apprentissages Chez l'Enfant*, 152, 111–121.
- Vellutino, F. R., Fletcher, J. M., Snowling, M. J., & Scanlon, D. M. (2004). Specific reading disability (dyslexia): What have we learned in the past four decades? *Journal of Child Psychology and Psychiatry*, 45, 2–40. doi:org/10.1046/j.0021-9630.2003.00305.x
- Vellutino, F. R., Tunmer, W. E., Jaccard, J. J., & Chen, R. (2007). Components of reading ability: Multivariate evidence for a convergent skills model of reading development. *Scientific Studies of Reading*, 11, 3–32. doi:org/10.1207/s1532799xssr1101_2
- Wong, A., Leahy, W., Marcus, N., & Sweller, J. (2012). Cognitive load theory, the transient information effect and e-learning. *Learning and Instruction*, 22, 449–457. doi:org/10.1016/j.learninstruc.2012.05.004
- Wood, S. G., Moxley, J. H., Tighe, E. L., & Wagner, R. K. (2018). Does use of text-to-speech and related read-aloud tools improve reading comprehension for students with reading disabilities? A meta-analysis. *Journal of Learning Disabilities*, 51, 73–84. doi:org/10.1177/0022219416688170
- World Health Organization. (2016). *International statistical classification of diseases and related health problems – ICD-10*. Retrieved from www.who.int/classifications/en/
- Ziegler, J. C., & Goswami, U. (2005). Reading acquisition, developmental dyslexia, and skilled reading across languages: A psycholinguistic grain size theory. *Psychological Bulletin*, 131, 3–29. doi:org/10.1037/0033-2909.131.1.3
- Zorzi, M., Barbiero, C., Facoetti, A., Lonciari, I., Carrozzi, M., Montico, M., & Ziegler, J. C. (2012). Extra-large letter spacing improves reading in dyslexia. *Proceedings of the National Academy of Sciences*, 109, 11455–11459. doi:10.1073/pnas.1205566109

16

SELF-WORTH THEORY AND STUDENTS WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER

Andrew J. Martin

According to self-worth theory (Covington, 2000, 2004, 2009), fear of failure and the implications this failure may have for one's ability and subsequent self-worth underpin students' motivation to protect their self-worth. Students can use a variety of strategies to deal with threats to their self-worth. These strategies are as wide-ranging as perfectionism through to self-handicapping and disengagement (Martin & Marsh, 2003). Thus, the motive to protect self-worth has significant implications for the ways students go about their academic life. There are some groups of students who experience disproportionate rates of academic failure. Students with attention-deficit/hyperactivity disorder (ADHD) are one such group (Barkley, 2014a, 2014b). Accordingly, in this chapter, key factors and processes under self-worth theory are explored, with particular focus on their implications for students with ADHD.

SELF-WORTH THEORY

Self-worth theory describes how the motivation to protect self-worth emanates from a fear of failure and the implications that failure has for one's ability and subsequent self-worth (Beery, 1975; Covington, 1992, 1997, 2000, 2004, 2009; Covington & Beery, 1976; Covington, von Hoene, & Voge, 2017; Elliot & Covington, 2001). Students who see failure as reflecting negatively on their ability are motivated to self-protect because (low) ability is typically equated with (low) self-worth (Covington, 1992, 1997, 2004, 2009; Covington et al., 2017; De Castella, Byrne, & Covington, 2013; Martin, Marsh, & Debus, 2001a, 2001b, 2003; Martin, Marsh, Williamson, & Debus, 2003). According to Covington (1992), "to be able is to be worthy, but to do poorly is evidence of inability and is reason for despair. The essence of achievement motivation according to self-worth theory resides in this formula" (p. 79). Given this, failure is to be avoided because it connotes low ability, and low ability connotes low self-worth.

The achievement-related foundations of self-worth occur early in life when young children come to learn that success is a primary basis upon which people are rewarded (Covington & Beery, 1976). From here, the child's "sense of worth is threatened by the belief that his value as a person depends on his ability to achieve, and that if he is incapable of succeeding, he will not be worthy of love and approval" (Covington & Beery, 1976, p. 6). Thus, children come to value success derived from ability and, in the face of potentially poor performance, are motivated to avoid failure (or its implications). Building on this, children learn that ability comes to be valued not only because it is instrumental in bringing about success, but also because self-worth is bound up with it (Covington, 2004, 2009; Thompson & Parker, 2007).

In high school, ability comes to be one of the major factors in determining how students perceive and define themselves academically (Covington et al., 2017). Many even come to value ability more than they value effort (Harari & Covington, 1981). Although effort yields pride and teacher reward (Covington & Omelich, 1979b), high school students' preferred path to success is through ability (Brown & Weiner, 1984; Covington & Omelich, 1979a; Nicholls, 1976). Thus, in early work, Covington and colleagues (Covington & Omelich, 1979a; Covington, Spratt, & Omelich, 1980) showed that students who fail after having tried hard experienced significant shame, whereas failure following little effort evoked much less shame.

Students who fear failure may, therefore, seek to strategically reduce the amount of effort they invest in a task. As Covington (1989) reports, "the central, activating principle behind such self-defeating tactics is that effort represents a potential threat to the student's sense of worth and self-esteem, because a combination of intense effort and failure implies lack of ability" (p. 89; see also Nurmi, Aunola, Salmela-Aro, & Lindroos, 2003; Zuckerman & Tsai, 2005). Research has shown that these tactics reduce fearful students' academic anxiety and offer an alibi or excuse in case they do not perform well (Martin & Marsh, 2003).¹

OTHER THEORIES IMPLICATED IN SELF-WORTH THEORY

Although the focus of this chapter is on self-worth theory, there are key processes and factors subsumed under this theory that have origins in or links to other seminal theories that also explain students' learning and achievement. Two of these are need achievement theory and attribution theory.

Need Achievement Theory

According to need achievement theory, students can be demarcated in terms of their motivation to avoid failure and their motivation to approach success (Atkinson, 1957; McClelland, 1965). The need achievement perspective (and subsequent refinements or adaptations; Martin & Marsh, 2003) suggests that students can be characterized in three ways: those who are success-oriented, those who are failure-avoidant, and those who are failure-accepting. Attributes characterizing success-oriented students include optimism, proactive and positive orientations to academic tasks, and adaptive responses to setback (Collie & Martin, 2017; Covington & Omelich, 1991; Martin & Marsh, 2003; Parker & Martin, 2011). From a self-worth theory perspective, these students' self-worth is robust, failure does not pose a threat to their self-worth, and they are not fearful of investing effort.

Failure-avoidant students are the classic failure fearers and represent the group of students to whom much of self-worth theory connects. Attributes characterizing these students include anxiety, fear of failure, self-doubt, and uncertain control and agency (Collie & Martin, 2017; Covington & Omelich, 1991; Martin & Marsh, 2003; Parker & Martin, 2011; for related discussion, see, in this volume, Pekrun & Loderer, Chapter 18; Wigfield & Ponnock, Chapter 17). Some of these students will work hard and achieve (though mainly to avoid the implications of failure), but they tend to be adversely affected by setback because setback confirms their doubts about their ability (Covington & Omelich, 1991; Martin et al., 2001a, 2001b). As described above, in response to this fear of failure, these students may withdraw effort (e.g., procrastinate, reduce effort, etc.) so that they have an excuse if they do not do so well. As articulated under self-worth theory, this excuse serves a protective function: Students can attribute poor performance to their procrastination, for example, and not to a lack of ability (Covington, 2009).

Failure-accepting – or learned helpless – students have abandoned all effort and engagement, not even trying to avoid failure or its implications (Abramson, Seligman, & Teasdale, 1978; see also Collie & Martin, 2017; Covington, 1992, 1997). As described under self-worth theory, there often comes a point where the effort withdrawal or excuses no longer serve their intended purpose. They no longer serve as an alibi in the event of poor performance and no longer reduce academic anxiety as others begin to doubt the student's ability (the very thing the student was at pains to avoid; Martin, 2010). At this point, there is no longer the motive to self-protect, and the student withdraws altogether.

Attribution Theory

Under attribution theory, how students attribute the causes of academic outcomes impacts their cognitive, affective, and behavioral responses on subsequent academic tasks (Weiner, 1985, 1994, 2010). The main attributions typically identified in the literature are: attributions to task difficulty, luck, ability, and effort. Respectively, for example, failure may be seen as owing to difficult questions, bad luck, low ability, or insufficient effort. Attributions can also be perceived in terms of locus, stability, and controllability (Weiner, 2010). Thus, a cause of an outcome may be located within the person or external to the person, may be stable or unstable, or may be controllable or uncontrollable.

Of the locus, stability, and controllability dimensions, the control dimension is often of distinct interest as it can be a major determinant of how students respond to setback and fear of failure (Borkowski, Carr, Rellinger, & Pressley, 1990; Collie, Martin, Malmberg, Hall, & Ginns, 2015; Groteluschen, Borkowski, & Hales, 1990; Thompson & Parker, 2007). Following success and failure, some students have a sense that they can invest effort and maintain success or avoid failure, whereas other students have less of a sense that they can maintain success or avoid future failure (Martin & Marsh, 2003). Especially if students develop an attributional style in which they attribute the causes of academic outcomes to external factors (e.g., the teacher, task difficulty, luck, etc.), they are likely to perceive relatively little control or agency in their capacity to attain future success or avoid future failure.

As stated under self-worth theory, failure fearers may seek to deflect the cause of a poor performance away from ability and onto effort or external factors (Covington, 2000). That is, they may seek to manipulate the causal attributions underlying an outcome. In shifting the cause away from a lack of ability and onto a lack of effort or onto external factors, they are not seen to be “dumb,” and their self-worth remains intact. Thus, attributions are exploited in the pursuit of self-protection. Indeed, attributions may be exploited in the pursuit of self-enhancement. In the event of success, students may be inclined to attribute the outcome to ability more than effort. Attributing the cause of success to ability in this case suggests the student is “smart” (Martin, 2010).

SUMMARY OF SELF-WORTH THEORY AND COGNATE THEORIES

For many students, the motivation to protect self-worth can be substantial and sometimes more important than the motivation to learn and achieve. Self-worth theory of motivation (Covington, 2000, 2004, 2009) contends that the motivation to protect self-worth largely emanates from a fear of failure and how this failure impacts one’s private and public sense of ability and subsequent self-worth. If students see failure as reflecting negatively on their ability, there is significant risk they will be motivated to self-protect, as (low) ability is often equated with (low) self-worth (Covington, 2000, 2004, 2009). There are some major factors implicated in self-worth theory (and cognate conceptualizing such as need achievement theory and attribution theory), including perceived competence (which students are motivated to protect), fear of failure (which performance scenarios evoke, and students are motivated to reduce), a sense of diminished personal control (based on attributional patterns that students manipulate to deflect the cause of failure away from the self, but that can also lead to the view that effort is futile), and self-handicapping and disengagement (which can be maladaptive responses to their fear of failure). Further below in this chapter, each of these is considered with particular reference to students with ADHD.

ATTENTION-DEFICIT/HYPERACTIVITY DISORDER (ADHD)

The potential for failure is higher for some students than for others. To the extent this is the case, self-worth theory has particular relevance for these students, including how they navigate achievement settings and how they navigate threats to their self-worth. This chapter focuses on students with ADHD and examines the application of self-worth theory to understand them and to identify directions for future practice and research to enhance their academic development. To appropriately frame the present discussion of ADHD, it is first important to define the disorder, identify prevalence and causes, and describe models that have been advanced to explain the condition.

Definitions and Prevalence

In the DSM-5, ADHD is classified under the broader domain of neurodevelopmental disorders. First indications of these neurodevelopmental disorders often occur early in

a child's development (typically before entering school or in the early years of school). They are signaled by deficits that impair a child's social, personal, educational, or occupational functioning. There is a wide range of such deficits, from quite specific limitations in executive function control or learning, through to more global or overarching deficits in social skills or cognitive functioning. Under the neurodevelopmental disorder category of the DSM-5, ADHD is identified alongside other disabilities and disorders such as intellectual disability, communication disorders, autism spectrum disorder, and motor disorders. It is not uncommon for children with ADHD to also experience one or more of these disabilities and disorders (American Psychiatric Association, 2013).

According to the DSM-5, ADHD is defined as "a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development" (American Psychiatric Association, 2013, p. 59). Approximately 5–7% of children are diagnosed with ADHD (Sayal, Prasad, Daley, Ford, & Coghill, 2017), but some population estimates put this higher at around 10% (Salmelainen, 2002; Woodruff et al., 2004). There is a 3:1 male-to-female ratio of children with ADHD (Purdie, Hattie, & Carroll, 2002). Approximately 50–70% of cases are estimated to persist into adolescence (Barkley, 2014a, 2014b; Purdie et al., 2002). Among adults, it is suggested that approximately 4–5% experience ADHD symptoms at a clinical level (Kessler et al., 2006).

The DSM-5 identifies three presentations of ADHD: predominantly inattentive, hyperactive-impulsive, and combined (American Psychiatric Association, 2013). The predominantly inattentive presentation includes symptoms such as failing to give close attention to details or making careless mistakes, difficulty sustaining attention, not listening, and struggling to follow through with instructions. The predominantly hyperactive-impulsive presentation includes symptoms such as fidgeting with hands or feet or squirming in the chair, difficulty remaining seated, running about or climbing excessively in children, and extreme restlessness in adolescents and adults. The combined presentation is when the individual meets the criteria for both inattention and hyperactive-impulsive ADHD presentations. Importantly, these symptoms can change over time; thus, as children move into adolescence and then adulthood, they may fit different presentations. Although not the focus of prior research, it is interesting to consider whether different presentations may intersect with self-worth theory in different ways. For example, those with a predominantly inattentive presentation may be at greater risk of academic failure (hence, potentially, the self-worth implications of failure dynamics), given the executive functions impaired here are ones that are pivotal to performing academic tasks (Barkley, 2006; for related discussion, see Follmer & Sperling, Chapter 5, this volume).

Causes and Models of ADHD

Numerous causes of ADHD have been proposed. Biological factors tend to receive the most endorsement, with ADHD very much a biological/genetic predisposition (Barkley, 2014a, 2014b). Research by Erlij and colleagues (2012) has indicated that abnormalities of dopamine signaling in the brain cause ADHD; among ADHD patients, there is an abnormality in the dopamine D4 receptor gene. Researchers have identified a network of nerve terminals where motor activity is depressed

through stimulation of dopamine D4 receptors. The administration of medication has been shown to be a means to enhance dopamine D4 transmission in the basal ganglia and the thalamus. Other research has also identified disturbances in different neurotransmitter and neurofunctional systems such as norepinephrine (as relevant to arousal) and serotonin (as relevant to inhibition and reward; Hunt, Hoehn, Stephens, & Osten, 1994; for related discussion, see Byrnes & Eaton, Chapter 17, this volume).

Following from these biochemical irregularities are psychological effects that have significant implications for students' academic and social well-being. Impairments in self-regulation and executive functioning are emphasized by major psychological models of ADHD (Barkley, 2014a, 2014b; Brown, 2005; Nigg, 2001). In regard to executive functioning, for example, researchers have identified impairments with the following executive neuropsychological abilities: working memory (holding information in mind, forethought, sense of time); self-regulation of motivation, affect, and arousal (self-control, goal-directed action, perspective taking); internalization of speech (reflecting on behavior, self-instruction, self-questioning); and reconstitution (accurate and efficient communication of information; Barkley, 2006, 2014a, 2014b). In turn, these impairments lead to problems with task-relevant responses, motor control, ability to execute goal-directed behavior, and engaging in tasks after being disrupted (Barkley, 2006, 2014a, 2014b; Pennington & Ozonoff, 1996; Purdie et al., 2002; see also Kendall, 2000; Wagner, 2000; for related discussion, see, in this volume, Follmer & Sperling, Chapter 5; Perry, Mazabel, & Yee, Chapter 13).

ADHD and Comorbidity with Other Disorders and Disabilities

Although the focus of this chapter is on ADHD, there are implications for other at-risk students. Although a detailed account of other at-risk groups is beyond the scope of the present chapter, a useful point of illustration is to consider the disorders and disabilities that are comorbid with ADHD. This also helps situate the present discussion of ADHD in the broader space of at-risk students and disability. One of the more consistently identified disorders associated with ADHD relates to disorders of behavior. For example, students with ADHD demonstrate higher levels of oppositional defiance disorder/conduct disorder (Ostrander, Crystal, & August, 2006; for related discussion, see, in this volume, Hue, Chapter 10; O'Donnell & Reschly, Chapter 23). Mental health is another domain of relevance, such that students with ADHD also demonstrate higher rates of depression (Blackman, Ostrander, & Herman, 2005; for related discussion, see, in this volume, Cassady & Thomas, Chapter 3; Pekrun & Loderer, Chapter 18; Wigfield & Ponnock, Chapter 17), and relatively poorer long-term psychiatric outcomes (Ollendick & King, 1994), suicide, aggression, and psychiatric hospitalization (Lewinsohn, Rohde, & Seeley, 1993; Treuting & Hinshaw, 2001). On the academic front, data in Carmichael et al. (1997) showed that co-existing ADHD was found among 41–80% of students diagnosed with learning disability (for related discussion, see, in this volume, Bergin & Prewett, Chapter 14; Hall, Capin, Vaughn, & Cannon, Chapter 7; Perry et al., Chapter 13; Schunk & DiBenedetto, Chapter 11; Strnadová, Chapter 4; Swanson, Chapter 2). Similarly, McKinney and colleagues (1993) found co-occurrence up to 63%.

ADHD AND SELF-WORTH THEORY

Under self-worth theory, the motivation to protect self-worth emanates from a fear of failure and the effects this failure may have on one's sense of ability and self-worth (Covington, 2000, 2004, 2009). As described, there are some major factors implicated in self-worth theory (and cognate conceptualizing such as need achievement theory and attribution theory), including perceived competence, fear of failure, perceived control, self-handicapping, and disengagement. To better understand ADHD from a self-worth theory perspective, this chapter considers each of these major factors and how they manifest in the academic lives of students with ADHD.

Perceived Competence and ADHD

According to Pisecco, Wristers, Swank, Silva, and Baker (2001), children's early school experiences create a foundation for their perceptions of academic competence. Unfortunately for students with ADHD, the nature of their condition can present academic and personal challenges (especially behavioral challenges) that create early patterns of negative relations with parents/carers and teachers (Krueger & Kendall, 2001). Over time, this negative interpersonal cycle adversely affects the development of the child's emerging self and their subsequent self-perceived competence (Martin, 2012).

Further into school, students with ADHD experience more task-relevant frustration and do not invest the effort needed to complete difficult tasks (Barkley, 2006, 2014a, 2014b). They tend to abandon tasks earlier than others, solve fewer problems, and thus progressively limit their academic success. They, therefore, have shaky foundations for the development of perceived academic competence (Martin, 2012; 2014; for related discussion, see, in this volume, Schunk & DiBenedetto, Chapter 11; Tracey, Merom, Morin, & Maïano, Chapter 24). In line with this, Tabassam and Grainger (2002) found that students with ADHD reported more negative academic self-concept and academic self-efficacy relative to non-ADHD peers. Dumas and Pelletier (1999) also found that children with ADHD were lower in self-reported scholastic competence.

Research also indicates deficits in perceived competence in nonacademic (e.g., perceived social competence) and general self (e.g., self-esteem) domains. For example, Ostrander and colleagues (2006) found that children with ADHD were lower in perceived social competence – an effect also found among university/college students with ADHD symptoms (Shaw-Zirt, Popali-Lehane, Chaplin, & Bergman, 2005). Edbom and colleagues found that children with ADHD symptoms were also lower in general self-esteem (Edbom, Granlund, Lichtenstein, & Larsson, 2008; see also Treuting & Hinshaw, 2001).

Interestingly, there is some other work suggesting that perceived competence is not significantly different from (or may be higher than) that found in the nonclinical population. As relevant to the present chapter, however, this may have self-protective origins that self-worth theory is well placed to explain. Hoza and colleagues (2004) found that children with ADHD were more likely than comparison children (of similar ability) to overrate their competence relative to an adult (e.g., teacher, parent) report (see also Owens, Goldfine, Evangelista, Hoza, & Kaiser, 2007; Sciberras, Efron,

& Iser, 2011). Interestingly, the largest overestimations of competence were in areas of greatest deficit (see also Hoza, Pelham, Dobbs, Owens, & Pillow, 2002; Hoza, Pelham, Milich, Pillow, & McBride, 1993). Similar to ideas under self-worth, Hoza et al. (2004) explained that these inflated self-estimates served a self-protective function to help students with ADHD cope with their deficits. Thus, the inflated self-estimates may be a defensive mechanism that is adaptive for students with ADHD in the event they encounter academic setback (Hoza et al., 2004). According to Hoza et al. (1993), accurate self-perceptions may be distressing for students with ADHD, and overestimations are an adaptive approach to ego-protection.

These findings suggest interesting alignments with contentions under self-worth theory, which is also very much concerned with the motive to self-protect in the face of poor achievement. However, it is pointed out that there is not uniform agreement on the stability of this effect. Some researchers have not found evidence of inflated competence reports among children with ADHD (Slomkowski, Klein, & Mannua, 1995; Treuting & Hinshaw, 2001) or any support for self-protection (Ohan & Johnston, 2002). Hoza and colleagues (2004) recommended further work investigating the self-protective consequences of positive illusion among children with ADHD.

Attributions, Perceived Control, and ADHD

As noted above, the cause(s) students attribute to academic outcomes has an impact on how they feel and behave (Weiner, 2010). From a self-worth motivation perspective, attributing failure to external factors (e.g., luck) or to internal factors that have few self-worth implications (e.g., effort) can be a way to deflect the cause of poor performance away from a lack of ability (and consequent self-worth). Considering attributions among students with ADHD is thus helpful for better understanding how these students are oriented with regard to dynamics central to self-worth theory.

In the main, researchers have suggested a generally maladaptive attributional pattern among students with ADHD. Carlson, Mann, and Alexander (2000) found that, relative to controls, children with ADHD reported a less adaptive attributional style. Similarly, Tabassam and Grainger (2002) found that students with ADHD reported a more maladaptive academic attributional style than typically achieving peers.

In line with the positive illusion for perceived competence found among children with ADHD (see above), Hoza et al. (1993, 2004) suggested that students with ADHD may also be prone to a positive illusory attributional bias in which they make internal attributions for positive outcomes and external attributions for negative outcomes. Research has found some support for this: Children with ADHD appear to take credit for their successes and disown their failures (Carlson, Pelham, Milich, & Hoza, 1993). It has also been suggested that students with ADHD are at risk of attributing their failures to their diagnosis, a medical condition for which they are not responsible (Hoza et al., 1993).

However, these self-protective attributions – especially to external factors beyond a student's control – may put students with ADHD at risk of helplessness. In their seminal work, Abramson et al. (1978) focused on attributions for failure experiences and the link with helplessness. According to them, individuals tend to feel helpless when they perceive a lack of control over salient events to which they are

exposed. Thus, the combination of attributional ascription and failure has implications for subsequent behavioral responses. Subsequently, in Chapman's (1988) self-perpetuating cycle of learning disability, children with a history of failure and negative perceptions of their own abilities hold maladaptive attributional patterns that give rise to a low sense of control and a high risk of helplessness. Thus, for example, Hoza and Pelham (1991) found that ADHD children's beliefs regarding the changeability of their own personal characteristics to meet task demands predicted how effective their responses were in future task demands. They observed that our understanding of ADHD students would be enhanced by continuing to examine the attributions they make and the level of personal control they perceive (Hoza et al., 1993).

Fear of Failure and ADHD

How students are oriented to failure (and success) is central to self-worth theory and cognate perspectives such as need achievement and attribution theories. Students at heightened risk of failure are at heightened risk of the failure factors and dynamics implicated in self-worth theory (e.g., perceived competence, control). Thus, in considering ADHD in the context of self-worth theory, it is important to consider the extent to which failure (and the extent to which students with ADHD are aware of it) characterizes their academic experience.

In regard to this, it is often the academic domain where most difficulties are encountered by students with ADHD. This is because the task activity required of students with ADHD entails core functions that ADHD impairs. Thus, for example, research demonstrates poor performance in mental arithmetic (Mariani & Barkley, 1997; Pennington & Ozonoff, 1996), higher rates of dyslexia (Harpin, 2005), academic motivation problems (Oosterlaan & Sergeant, 1998), and significantly lower grade point average (Heiligenstein, Guenther, Levy, Savino, & Fulwiler, 1999; Heiligenstein & Keeling, 1995). Taken together, then, academic failure in its diverse forms characterizes the academic lives of many students with ADHD. Because of this, empirical and conceptual accounts have suggested that they may be disproportionately fearful of failure and motivated to avoid it or protect themselves from its self-worth implications (Alesi, Rappo, & Pepi, 2012; Martin, 2010; Martin & Burns, 2014). Indeed, in an investigation of achievement goals, Barron and colleagues (2006) found that students with ADHD were more likely to endorse performance-avoidance goals than their non-ADHD peers (for related discussion, see Bergin & Prewett, Chapter 14, this volume).

Notably also, failure for these students is not limited to the academic domain. With respect to their personal and social lives, ADHD is associated with poorer relationships with peers (Harpin, 2005; for related discussion, see Gillies, Chapter 22, this volume), poorer quality of life (Greenwald-Mayes, 2002), delinquency (Krueger & Kendall, 2001), and poorer occupational outcomes (Slomkowski et al., 1995). Although the reasons for this are varied (e.g., self-regulatory problems leading to poor choices, etc.), "failure" is often perceived as the outcome, and along with this are the associated potential self-worth implications. Thus, notwithstanding the fact this chapter is focused on academic processes and outcomes, we might speculate similar motives to avoid failure in nonacademic domains and its self-worth implications.

Self-Handicapping and ADHD

Following self-worth theory, failure attributed to a lack of ability can have negative self-worth implications (Covington, 2000). However, if there are plausible other causes for failure available (e.g., due to external factors, due to effort), then attributing failure to a lack of ability becomes less likely. Self-handicapping is behavior in which students can engage to deflect the cause of failure away from a lack of ability and onto factors that are less threatening to self-worth, such as a lack of effort. Examples of self-handicapping include procrastination, doing little or no study, and clowning around in class (Martin, 2010). It is important, however, to disentangle self-handicapping (that has self-worth protection foundations) from behaviors that appear to be self-handicapping but are more grounded in executive function disorder itself (i.e., differentiating procrastination that is strategic for self-protection purposes from procrastination that is due to self-regulatory and self-organizational challenges).

Alongside attributional dynamics, noncontingent (or inconsistent) feedback and reward have been identified as other factors that play a role in self-handicapping (Rhodewalt & Tragakis, 2002; Thompson & Richardson, 2001). Noncontingent feedback (actual, or perceived) refers to feedback or rewards that are inconsistent or that students cannot obviously link to their efforts. In such cases, students become anxious and are not sure what they can do to maintain success or avoid future failure. Self-handicapping is one attempt at alleviating this anxiety and doubt (Covington, 2000, 2004, 2009). By establishing an alibi in case they fail, the self-handicapper has a means of self-worth protection and a means of certainty with regard to what the outcome can be attributed to.

According to Waschbusch, Craig, Pelham, and King (2007), there are numerous apparent alignments between features of self-handicapping and features of the ADHD academic profile. Both involve actual or feared failure (Pelham et al., 2002, 1990), both have been suggested to be self-protective (Hoza et al., 2004), and both involve inconsistent, noncontingent feedback (Johnston & Mash, 2001; Pelham & Lang, 1993). Consistent with this, Waschbusch et al. (2007) found greater self-reported self-handicapping among students with ADHD. Their results suggested that students with ADHD may use self-handicapping to reduce the effects of high rates of academic failure. Recently, Jaconis and colleagues (2016) found that self-reported self-handicapping was significantly higher in young adults with ADHD symptoms. Procrastination behavior, one type of self-handicapping, has also been found to be significantly associated with the ADHD presentation of inattention (Niermann & Scheres, 2014).

Disengagement and ADHD

Martin and Marsh (2003) described how the self-protective value of strategies such as self-handicapping may diminish over time. For example, the excuses offered under self-handicapping begin to lose their credibility. It is at this point that students are at risk of giving up altogether. Thus, whereas the self-handicapper (for example) is motivated and energized to establish an alibi to protect self-worth, there is no such motivation or energy for the disengaged student, except to withdraw completely. This is also consistent with the failure-accepting student typology under need achievement theory (Atkinson, 1964; McClelland, 1965). Thus, for students experiencing significant and disproportionate academic struggle, disengagement is not an uncommon outcome.

In line with this, research into disengagement (or various indicators of it) has shown that students with ADHD disproportionately struggle relative to their non-ADHD peers. For example, in terms of broader school outcomes, students with ADHD face increased risk of school non-completion, school refusal, and school exclusion (Barkley, 2006, 2014b; DuPaul, Rutherford, & Hosterman, 2008; DuPaul & Stoner, 2003; Martin, 2012, 2014; Pliszka, 2009; Purdie et al., 2002). In terms of specific task behaviors, students with ADHD experience higher rates of off-task behavior and poor task completion (Vile Junod, DuPaul, Jitendra, Volpe, & Cleary, 2006). In a recent study of academic risk among students with ADHD, Martin (2014) found that ADHD was a significant predictor of numerous academic adversities that were indicators of or implicated in disengagement, including schoolwork non-completion, school suspension, school expulsion, and changing schools.

In longitudinal data, Kent et al. (2011) found that adolescents with ADHD were more likely to be late or absent during the school year and were significantly more likely than non-ADHD peers to drop out of school. In other longitudinal work, Barbaresi, Katusic, Colligan, Weaver, and Jacobsen (2007) found that children with ADHD were absent more often than those without ADHD. In addition, children with ADHD were significantly more likely to repeat a grade and drop out before high school graduation.

Other Disorders and Disabilities Comorbid with ADHD

As noted earlier, ADHD resides under a broader banner of at-risk status, and to better understand the condition it is helpful to situate it alongside other disorders and disabilities. It was also described how there are various comorbidities with ADHD that provide a useful lens through which to consider ADHD in the scheme of special needs. As relevant to the present chapter, it is also the case that these comorbidities intersect with aspects of self-worth theory. As a case in point, perceived competence (one dimension of self-worth theory) varies not only as a direct function of ADHD, but also as a function of its comorbidities. Specifically, research has indicated that different patterns of comorbidity are associated with different patterns of self-conceptions (Hoza et al., 2004). For example, of the variance shared between ADHD and depression, about half is mediated by perceived competence (Ostrander et al., 2006). In fact, Hoza and colleagues (2004) suggest that, after controlling for depressive symptoms, self-esteem differences between students with and without ADHD are not so apparent (for related discussion, see, in this volume, Cassady & Thomas, Chapter 3; Pekrun & Loderer, Chapter 18; Wigfield & Ponnock, Chapter 17). More recently, Martin (2014) found that failure dynamics among students with ADHD were reduced when controlling for learning disability. Thus, although, this chapter essentially focuses on ADHD and self-worth theory, it is helpful to also understand that conditions under the broader banner of at-risk and disability status are comorbid with ADHD, and this comorbidity intersects with tenets of self-worth theory.

AN EMPIRICAL SNAPSHOT OF ADHD AND KEY FACTORS UNDER SELF-WORTH THEORY

As detailed above, there are some salient factors implicated in self-worth theory (and cognate conceptualizing such as need achievement theory and attribution theory) that characterize the academic lives of students with ADHD: perceived competence, fear of

failure, perceived control, self-handicapping, and disengagement. To date, however, it appears that no empirical work has harnessed self-worth theory to examine these key factors among students with ADHD. As summarized above, individual studies do address some factors implicated in self-worth theory, but they have not traversed them all and they have not done so from a self-worth perspective. The present chapter thus provides an opportunity to present a preliminary and descriptive snapshot for each of these factors among students with ADHD. It draws on data by Martin, Burns, and Collie (2017) that examined the role of personal and interpersonal agency in predicting achievement for students with ADHD.

As described by Martin et al. (2017), this sample included 164 students with ADHD, in Year 7 (34%), Year 8 (33%), and Year 9 (33%), from 20 mainstream urban schools on Australia's east and west coasts. These students had received a formal medical diagnosis of ADHD. Relative to the whole sample, this number corresponded to a 3.4% incidence, a prevalence broadly in accord with estimates of adolescents with ADHD (Barkley, 2006; Sayal et al., 2017). Under DSM-5 criteria (American Psychiatric Association, 2013), ADHD presentation types were in general alignment with meta-analytic results (Willcutt, 2012): thus, 52% were predominantly inattentive presentation, 15% were predominantly hyperactive-impulsive presentation, and 33% were combined presentation. More than half (57%) were on medication to manage ADHD symptoms. The mean age was 13.58 years ($SD = 0.94$). In line with statistics at the population level, there was a prevalence of males (77%) relative to females (33%). Just over a quarter (29%) reported a diagnosed academic comorbidity (e.g., difficulty in reading, writing, and/or mathematics).

Also as described in Martin et al. (2017), the non-ADHD comparison group comprised 4,658 students. They were from the same year levels and schools as the ADHD group. These students were in Year 7 (34%), Year 8 (33%), and Year 9 (33%). The mean age was 13.57 years ($SD = 0.94$). Around half (52%) were males (48% females). Very few (3%) students indicated a diagnosed academic comorbidity.

Students were administered a survey in class that explored the key factors described above: perceived competence, fear of failure, perceived control, self-handicapping, and disengagement. The Motivation and Engagement Scale – High School (Martin, 2013) was the instrument used to collect students' responses to these five factors. Each of the five factors comprised four items. For each item, students rated themselves on a scale of 1 ("strongly disagree") to 7 ("strongly agree").

Perceived competence (sample item: "If I try hard, I believe I can do my schoolwork well"; non-ADHD $\alpha = .83$; ADHD $\alpha = .89$) reflects students' belief and confidence in their ability to understand or to do well in their schoolwork and to perform to the best of their ability. Fear of failure or failure avoidance (sample item: "Often the main reason I work at school is because I don't want people to think that I'm dumb"; non-ADHD $\alpha = .84$; ADHD $\alpha = .85$) refers to students' motivation to do their schoolwork in order to avoid doing poorly or to avoid being seen to do poorly. Low or uncertain control (sample item: "When I get a good mark I'm often not sure how I'm going to get that mark again"; non-ADHD $\alpha = .83$; ADHD $\alpha = .85$) assesses students' uncertainty about how to do well or how to avoid doing poorly. Self-handicapping (sample item: "I sometimes don't study very hard before exams so I have an excuse if I don't do so well"; non-ADHD $\alpha = .86$; ADHD $\alpha = .87$) refers to students' behaviors that reduce their chances of success at school and offer an excuse or alibi in doing so.

Disengagement (sample item: “I’ve pretty much given up being involved in things at school”; non-ADHD $\alpha = .84$; ADHD $\alpha = .83$) reflects students’ motivation to give up in particular school subjects or in school generally; they tend to accept failure and behave in ways that reflect helplessness. Martin et al. (2017) provide further details on measurement.

Figure 16.1 shows the average scores on each of perceived competence, fear of failure, low control, self-handicapping, and disengagement for non-ADHD and ADHD groups (with scores ranging from 1 “strongly disagree” to 7 “strongly agree”). Also in Figure 16.1 are superscripts (*a* and *b*) that indicate if the two groups significantly differ (at $p < .05$) in average scores. As can be seen in Figure 16.1, students with ADHD scored significantly lower on perceived competence and significantly higher on fear of failure, low control, self-handicapping, and disengagement. It thus appears that they do reflect a profile consistent with what would be predicted under self-worth theory.

IMPLICATIONS FOR PRACTICE

There has been a vast body of literature identifying successful interventions for students with ADHD. The bulk of this tends to be focused on pharmacological intervention and behavioral interventions, both of which have a strong evidence base (Barkley, 2006, 2014a, 2014b; Martin, Collie, Roberts, & Nassar, 2018). In this section, the issue of treatment and intervention for ADHD symptoms is addressed from a self-worth motivation perspective. Following from the research review above and the empirical data just presented (Figure 16.1), intervention along these lines suggests promoting students’ perceived competence and sense of control and reducing their fear of failure, self-handicapping, and disengagement.

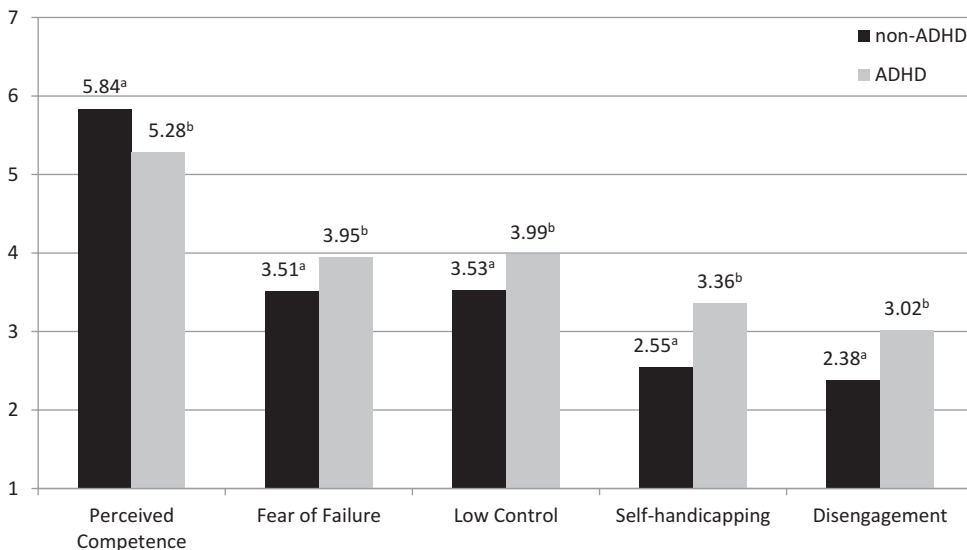


Figure 16.1 Average Scores (on a 1 “Strongly Disagree” to 7 “Strongly Agree” Scale) for Non-ADHD and ADHD Students on Key Factors Implicated in Self-Worth Theory. Note: *a* and *b* superscript pairs indicate factors on which non-ADHD and ADHD students significantly differ at $p < .05$

Boosting Perceived Competence

A key means of promoting perceived competence is to restructure learning so as to maximize opportunities for success. Examples include individualizing tasks (Martin & Burns, 2014; McInerney, 2000; Schunk & Miller, 2002); enhancing beliefs about self, academic capacity, and problem-solving ability (Beck, 1995; Meichenbaum, 1974; Wigfield & Tonks, 2002; Young & Bramham, 2012); and promoting effective goal-setting skills (Locke & Latham, 2002) that are likely to lead to success and that provide a foundation for enhancement of one's perceived competence (for related discussion, see, in this volume, Schunk & Di Benedetto, Chapter 11; Tracey et al., Chapter 24; Wigfield & Ponnock, Chapter 17). Educators might also look to build self-efficacy through breaking lessons and activities into manageable components to enhance task completion and a subsequent sense of competence (Martin & Burns, 2014). Research has found that school-based intervention for students with ADHD can promote multidimensional aspects of perceived competence (e.g., physical, social, etc.) as well as global self-worth (Frame, Kelly, & Bayley, 2003). In addition, Zwart and Kallemeyn (2001) found that peer-based coaching was effective for enhancing the self-efficacy (and self-regulatory skills) of college students with ADHD.

Enhancing a Sense of Control

There are numerous ways to improve students' sense of control and agency (for related discussion, see Pekrun & Loderer, Chapter 18, this volume). First, by encouraging students to see links between their effort (an internal and controllable factor) and their academic outcomes, they are more likely to have a greater sense of agency in their capacity to attain success or avoid failure (Martin, 2003). Second, control can be promoted by providing consistent and effective feedback. Here, educators provide task-based feedback that is clear about how students can improve (Craven, Marsh, & Debus, 1991). Third, control is enhanced when rewards (or punishment) are administered as a direct function of students' efforts or outcomes (or lack thereof). Reward and feedback that are not directly tethered to students' efforts or outcomes can elicit uncertainty in students' minds as to why they received that reward and how they can attain it next time (Thompson, 1994). Indeed, it is noteworthy that students with ADHD have a history of noncontingent reward and feedback (Johnston & Mash, 2001; Pelham & Lang, 1993), and, thus, striving for more consistency in feedback to them is important. Fourth, attribution retraining can enhance a sense of control. According to Treuting and Hinshaw (2001), interventions for students with ADHD that encourage them to focus on controllable aspects of their academic life lead to greater agency and perceptions of competence.

Reducing Fear of Failure and Self-Handicapping

Martin (2003) has proposed two ways to address students' fear of failure and self-handicapping. The first relates to students' orientation to mistakes (or poor performance and failure). Fear of failure tends to be low or nonexistent when students view mistakes as diagnostic information about how to do better next time (Covington, 1998). Orienting to mistakes in this way, students are less likely to consider that mistakes

reflect on them or their worth as a person (Martin, 2003; Martin & Marsh, 2003). When they are freed of the self-worth implications of poor performance, they fear failure less and are less inclined to engage in self-handicapping. The second relates to how fear of failure and self-handicapping can be tackled by reducing the link between students' achievement and their worth as a person (Covington, 1992, 1997; Martin et al., 2001a, 2001b, 2003; Martin et al., 2003; Thompson, 1994). For example, through an emphasis on effort and a reduction in the focus on marks, ranks, and ability, some of the dynamics that underpin failure avoidance and its self-worth implications are reduced. Thus, for example, negative performance outcomes are seen in terms of insufficient effort and not so much as due to lack of ability or incompetence. In this way, the link between students' ability and their academic outcomes is diminished – and, consequently, so is the threat to self-worth (Martin, 2012). These strategies can be implemented and/or supported by in-school counseling that has been effective in dealing with a range of maladaptive techniques (including self-handicapping) for students with disabilities (Bowen & Glenn, 1998).

Reducing Disengagement

Following need achievement and self-worth theories, disengagement is a form of failure acceptance (Atkinson, 1957; Collie & Martin, 2017; Martin & Marsh, 2003; McClelland, 1965; Parker & Martin, 2011). According to Covington (1998), efforts to assist these students involve targeting both “will” and “skill.” Will refers to the motivational factors that underlie disengagement. Some of these are discussed above, such as promoting students' perceived competence, boosting their sense of control and agency, targeting problematic attributional patterns, and reducing failure dynamics (see also Martin, 2003).

Skill refers to the cognitive and scholastic skill set needed to meet the ongoing demands of academic life. For students with ADHD, some research suggests that cognitive (brain) training can complement the positive effects of pharmacological intervention (Holmes et al., 2010). These cognitive interventions have been found to yield short-term benefits in relation to the specific task under focus (such as working memory, planning, etc.), but there has been some difficulty generalizing the efficacy of acquired cognitive strategies across different domains, including to school (Shipstead, Hicks, & Engle, 2012). Skill-based educational intervention might also address deficient academic skills (e.g., literacy, numeracy) and effective use of time (e.g., breaks between tasks, extending the time allowed on tasks and tests). Particularly for students with ADHD, other educational accommodations might entail decreased academic workload, daily planners, short-term goals, monitoring progress, and clear and concise instructions that do not tax working memory. These practices and interventions for students with ADHD have been effective when applied through educational instruction, and also when applied through other approaches such as coaching (e.g., Frame et al., 2003; Lougy, DeRuvo, & Rosenthal, 2007; Swartz, Prevatt, & Proctor, 2005).

Indeed, in relation to working memory, there are practices at the classroom level that can assist students with ADHD (for related discussion, see, in this volume, Follmer & Sperling, Chapter 5; Swanson, Chapter 2; Tricot, Vandenbroucke, & Sweller, Chapter 15). For example, load reduction instruction (LRI) has recently been introduced and suggested as a means to assist students with special needs (through

appropriately managing load on working memory), including those with ADHD (Martin, 2015, 2016; Martin & Evans, 2018; see also Liem & Martin, 2013; Mayer & Moreno, 2010; Sweller, 2012, for cognitive load principles more generally). Also at the classroom level, there are options for teachers to assist students with ADHD, including consistent daily and lesson routines, an orderly and uncluttered classroom, conditions that aid concentration (e.g., appropriate seating arrangements, management of noise and visual stimuli, etc.), and discipline that is proactive and preventive, not reactive after problems arise (Charles, 2005; DeRuvo, 2009; Lougy et al., 2007; McInerney, 2000).

FUTURE DIRECTIONS

In the research literature, there has been little consideration of ADHD from a self-worth theory perspective. Research conducted to date has focused on some of the factors residing under this theory, but not so much from the perspective of self-worth protection, failure fearing dynamics, and so on. The findings presented in Figure 16.1 suggest that students with ADHD travel more poorly across a diversity of factors implicated in self-worth theory. Given this, self-worth theory – as relevant to students with ADHD – is an area for further research and conceptualizing. As researchers do so, there are some potentially fruitful lines of investigation that warrant consideration. Some of these are discussed here.

Multimodal Intervention

Multimodal intervention typically involves two or more pharmacological, health, behavioral, cognitive-behavioral, or academic interventions. Ervin and colleagues (1996) reported that combined intervention is likely to lead to better outcomes for students with ADHD, and subsequent reviews support this (Purdie et al., 2002).

Pharmacological intervention (usually, stimulants) is the most common intervention response to ADHD and its symptoms (Barkley, 2006, 2014a, 2014b; Purdie et al., 2002), with increases in medication rates over the past three decades (Barkley, 2006, 2014a, 2014b; Hoagwood, Kelleher, Feil, & Comer, 2000) – though there can be debate among researchers and practitioners as to the emphasis given to medication in intervention, the length of time medication should be used, the age or severity of symptoms at which medication should (or should not) be administered, matters around dosage, and decisions about whether medication should be taken at weekends or during school holidays (or when schoolwork is not being done). Research demonstrates medication is effective at reducing ADHD symptoms (Barkley, 2006, 2014a, 2014b; Martin et al., 2018; Salmelainen, 2002; Vaughan, Roberts, & Needelman, 2009). Given this is such a prevalent (and effective) therapeutic response to ADHD, it might be important to understand its interface and interplay with factors implicated in self-worth theory. For example, cognitive training seeking to improve executive functioning among students with ADHD (e.g., working memory) has been suggested to augment pharmacological intervention; both intervention approaches tend to do better than either one alone (Holmes et al., 2010). To the extent this is the case, interventions involving both medication and self-worth motivation factors may have merit.

Indeed, medication is associated with positive outcomes in diverse indicators of perceived competence among students with ADHD (e.g., Alston & Romney, 1992; Frankel, Cantwell, Myatt, & Feinberg, 1999). Frankel and colleagues (1999) suggest that, with medication, domain-relevant behavior is under greater control (Barkley, 2014a, 2014b), and this control leads to improved functioning and improved interactions with others (Whalen, Henker, Hinshaw, Heller, & Huber-Dressler, 1991). In turn, these elevate a child's perceived competence and self-worth. In noting this, however, it is worth recognizing that findings on self-reported competence among ADHD students is not always straightforward (as described above, sometimes there is positive illusion identified, and sometimes reports seem to match actual competence levels), leading Hoza and colleagues (2004) to advise more research into self-protection and perceived competence among children with ADHD.

ADHD and Different Presentation Types

Earlier in the chapter, the DSM-5's three ADHD presentational types were described: predominantly inattentive, predominantly hyperactive-impulsive, and combined (American Psychiatric Association, 2013). In that section, the question was raised about the extent to which different presentations may intersect with self-worth theory in different ways. It was speculated that students with the predominantly inattentive presentation may be at greater risk of academic failure as a result of the particular executive functions impaired under that presentation (Barkley, 2006). To the extent this is the case, failure dynamics may loom larger for these students. Or, perhaps the hyperactive-impulsive presentation type connotes a public form of "failure" in the sense they may be more obviously unable to adhere to normative parameters of a classroom. According to self-worth theory, how one is viewed by others in part shapes one's self-conceptions (Covington, 2000). To the extent this is the case, the hyperactive-impulsive presentation may generate distinct public construal that in turn shapes their self-worth and their motivation to enhance or protect it. In addition to these well-recognized ADHD presentation types, there is emerging research and theorizing around "concentration deficit disorder" (or "sluggish cognitive tempo"; Becker et al., 2016). There is not a large body of research on these students, but, if research shows they do represent a valid presentation type (or, indeed, a distinct disorder), it will be important to understand how failure and success play out in their academic lives, including with regard to self-worth enhancement and protection motives.

A similar argument holds for "subthreshold" cases of ADHD. ADHD has typically been treated as a category – children are diagnosed as having ADHD, or not. However, it has been established that there are also children who fall short on one or two symptoms and, thus, are not formally diagnosed with ADHD – so-called subthreshold cases. Research by Biederman and colleagues (2018) has shown that these children's academic outcomes are also impaired – not always to the extent that formally diagnosed ADHD cases are impaired, but significantly more so than control children who have no ADHD symptomology. To what extent do the failure-fearing and self-worth protective orientations defined under self-worth theory manifest in subthreshold children's lives? Is it possible that practitioners successfully attending to these children's at-risk status on failure dynamics may reduce the chances of their subthreshold status negatively impacting academic outcomes? Further research is needed here.

Considering Other Special Needs Populations

Earlier in the chapter, issues around ADHD and comorbidity were discussed, including where relevant to self-worth theory. Following from this, there is a need to explore ideas under self-worth theory among other special needs populations in their own right – not just in terms of how these populations are placed with regard to ADHD. As relevant to the academic domain, learning disabilities are an important area for self-worth motivation research. Learning disabilities involve cognitive, attentional, and behavioral impairments that affect diverse outcomes in children’s development (Tabassam & Grainger, 2002; for related discussion, see, in this volume, Bergin & Prewett, Chapter 14; Hall et al., Chapter 7; Schunk & DiBenedetto, Chapter 11; Swanson, Chapter 2). Although these deficits considerably overlap deficits typical of ADHD (Pisecco, Baker, Silva, & Brooke, 1996; Tabassam & Grainger, 2002), they are also distinct from ADHD for many students. Thus, although the present discussion has focused on students with ADHD and its overlap with other conditions and disorders, there is sufficient variance in behavior, cognition, and affect that is not shared between them to justify the need to examine self-worth theory in these other disorders and conditions.

Relatedly, we might also consider children who are “twice exceptional.” These children are identified as gifted and diagnosed with ADHD (Lee & Olenchak, 2015). Although care needs to be taken to validly diagnose dual conditions of this nature (see Mullet & Rinn, 2015), there are potential self-worth implications where such cases exist. For example, these students may be capable of a level of self-reflection that makes them aware of the differential between what they are capable of achieving and what academic impediments they experience as a result of their ADHD. This difference may have implications for their self-worth. Similarly, their level of giftedness may have them achieving high enough to be deemed academically functional and be denied important intervention opportunities. In such cases, they may perform well below potential, and this may impact subsequent self-worth. Further research is needed to better understand these students, particularly as relevant to self-worth.

CONCLUSION

The motive to protect self-worth is paramount for many students and can outweigh the need to learn and achieve. Self-worth theory of motivation contends that the motivation to protect self-worth emanates largely from a fear of failure and how this failure may impact one’s sense of ability and self-worth. The motive to protect self-worth has significant implications for the ways students go about their academic life, including the sometimes maladaptive strategies they use to respond to it. Fear of failure and the motive to protect self-worth can be particularly salient among students who experience or are at risk of experiencing disproportionate rates of failure. Students with ADHD are identified as one such group. There are key factors and processes under self-worth theory (and cognate need achievement and attribution theories) that are especially salient among these students. In particular, research into perceived competence, perceived control, fear of failure, self-handicapping, and disengagement among students with ADHD has pertinence. Following this, implications for psycho-educational practice can be identified, especially as relevant to the key

factors implicated in self-worth theory. Directions for future research and practice are evident, including with respect to students who do not have ADHD but have other conditions and disorders that adversely affect their academic development and for whom self-worth theory may be relevant. Taken together, self-worth theory has clear implications for students with ADHD and offers guidance about how to assist these students through school – and beyond.

NOTE

- 1 One issue that is central to this chapter's assumptions is the extent to which students with ADHD are sensitive to and cognizant of the failure dynamics that are implicated in self-worth theory. This assumption is fundamental because self-worth dynamics and failure-avoiding strategies are in part premised on the fact students are aware of relative ability, failure, and the self-worth concerns these might elicit. Accordingly, later in the chapter, data are presented that compare ADHD and non-ADHD students' self-reports on key factors under self-worth theory. Without going into detail here (see chapter body), findings suggest that the self-reports of students with ADHD are attuned to the realities of the academic challenges before them (including orientations to failure and related self-concepts). Also discussed in this chapter are children who are likely to be particularly capable of and attuned to this awareness (e.g., "twice exceptional" children who are gifted and have ADHD). Thus, the present chapter proceeds on the understanding that students with ADHD are, in the main, aware of the relative ability, failure, and self-worth concerns implicated in self-worth theory.

REFERENCES

- Abramson, L. Y., Seligman, M. E. P., & Teasdale, J. (1978). Learned helplessness in humans: Critique and reformulation. *Journal of Abnormal Psychology*, 87, 49–74. doi:10.1037/0021-843X.87.1.49
- Alesi, M., Rappo, G., & Pepi, A. (2012). Self-esteem at school and self-handicapping in childhood: Comparison of groups with learning disabilities. *Psychological Reports*, 111, 952–962.
- Alston, C. Y., & Romney, D. M. (1992). A comparison of medicated and nonmedicated attention-deficit disordered hyperactive boys. *Acta Paedopsychiatrica: International Journal of Child & Adolescent Psychiatry*, 55, 65–70.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders*, (DSM-5). Washington, DC: Author. doi:10.1176/appi.books.9780890425596
- Atkinson, J. W. (1957). Motivational determinants of risk-taking. *Psychological Review*, 64, 359–372. <https://doi.org/10.1037/h0043445>
- Atkinson, D. W. (1964). *An introduction to motivation*. Princeton, NJ: Van Nostrand.
- Barbarese, W. J., Katusic, S. K., Colligan, R. C., Weaver, A. L., & Jacobsen, S. J. (2007). Long-term school outcomes for children with attention-deficit/hyperactivity disorder: A population-based perspective. *Journal of Developmental & Behavioral Pediatrics*, 28, 265–273. doi:10.1097/DBP.0b013e31811ff87d
- Barkley, R. A. (2006). A theory of ADHD. In R. A. Barkley (Ed.), *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment* (3rd ed., pp. 297–334). New York: Guilford Press.
- Barkley, R. A. (2014a). Etiologies of ADHD. In R. A. Barkley (Ed.), *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment* (4th ed.). New York: Guilford Press.
- Barkley, R. A. (2014b). History of ADHD. In R. A. Barkley (Ed.), *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment* (4th ed., pp. 3–50). New York: Guilford Press.
- Barron, K. E., Evans, S. W., Baranik, L. E., Serpell, Z. N., & Buvinger, E. (2006). Achievement goals of students with ADHD. *Learning Disability Quarterly*, 29, 137–158.
- Beck, A. T. (1995). *Cognitive therapy: Basics and beyond*. New York: Guilford Press.
- Becker, S. P., Leopold, D. R., Burns, G. L., Jarrett, M. A., Langberg, J. M., Marshall, S. A., ... Willcutt, E. G. (2016). The internal, external, and diagnostic validity of sluggish cognitive tempo: A meta-analysis and critical review. *Journal of the American Academy of Child & Adolescent Psychiatry*, 55, 163–178.
- Beery, R. G. (1975). Fear of failure in the student experience. *Personnel and Guidance Journal*, 54, 191–203. doi:10.1002/j.2164-4918.1975.tb04220.x

- Berglas, S. (1990). Self-handicapping: Etiological and diagnostic considerations. In R. L. Higgins, C. R. Snyder, & S. Berglas (Eds.), *Self-handicapping: The paradox that isn't* (pp. 151–182). New York: Plenum Press.
- Biederman, J., Fitzgerald, M., Kirova, A. M., Woodworth, K. Y., Biederman, I., & Faraone, S. V. (2018). Further evidence of morbidity and dysfunction associated with subsyndromal ADHD in clinically referred children. *The Journal of Clinical Psychiatry*, 79, 5.
- Blackman, G. L., Ostrander, R., & Herman, K. C. (2005). Children with ADHD and depression: A multisource, multimethod assessment of clinical, social, and academic functioning. *Journal of Attention Disorders*, 8, 195–207. doi:10.1177/1087054705278777
- Borkowski, J., Carr, M., Rellinger, E., & Pressley, M. (1990). Self-regulated cognition: Interdependence of metacognition, attributions, and self-esteem. In B. F. Jones & L. Idol (Eds.), *Dimensions of thinking and cognitive instruction* (pp. 53–92). Hillsdale, NJ: Lawrence Erlbaum.
- Bowen, M. L., & Glenn, E. E. (1998). Counseling interventions for students who have mild disabilities. *Professional School Counseling*, 2, 16.
- Brown, J., & Weiner, B. (1984). Affective consequences of ability versus effort ascriptions: Controversies, resolutions, and quandaries. *Journal of Educational Psychology*, 76, 146–158. doi:10.1037/0022-0663.76.1.146
- Brown, T. E. (2005). *Attention deficit disorder: The unfocused mind in children and adults*. New Haven: Yale University Press.
- Carlson, C. L., Mann, M., & Alexander, D. K. (2000). Effects of reward and response cost on the performance and motivation of children with ADHD. *Cognitive Therapy and Research*, 24, 87–98. doi:10.1023/A:1005455009154
- Carlson, C. L., Pelham, W. E., Milich, R., & Hoza, B. (1993). ADHD boys' performance and attributions following success and failure: Drug effects and individual differences. *Cognitive Therapy and Research*, 7, 269–287. doi:10.1007/BF01172950
- Carmichael, P., Adkins Gaal, I., Hutchins, P., Levey, F., McCormack, J., Oberklaid, F., ... Storm, V. (1997). *Attention deficit hyperactivity disorder*. Canberra: National Health and Medical Research Council.
- Chapman, J. W. (1988). Learning disabled children's self-concepts. *Review of Educational Research*, 58, 347–371. doi:10.3102/00346543058003347
- Charles, C. M. (2005). *Building classroom discipline*. Boston: Allyn & Bacon/Pearson.
- Collie, R. J., & Martin, A. J. (2017). Adaptive and maladaptive work-related motivation among teachers: A person-centered examination and links with well-being. *Teaching and Teacher Education*, 64, 199–210. doi:10.1016/j.tate.2017.02.010
- Collie, R. J., Martin, A. J., Malmberg, L.-E., Hall, J., & Ginns, P. (2015). Academic buoyancy, student achievement, and the linking role of control: A cross-lagged analysis of high school students. *British Journal of Educational Psychology*, 85, 113–130. doi:10.1111/bjep.12066
- Covington, M. V. (1989). Self-esteem and failure in school: Analysis and policy implications. In A. M. Mecca, N. J. Smelser, & J. Vasconcellos (Eds.), *The social importance of self-esteem* (pp. 72–124). Berkeley: University of California Press.
- Covington, M. V. (1992). *Making the grade: A self-worth perspective on motivation and school reform*. Cambridge: Cambridge University Press. doi:10.1017/CBO9781139173582
- Covington, M. V. (1997). A motivational analysis of academic life in college. In R. P. Perry & J. C. Smart (Eds.), *Effective teaching in higher education: Research and practice* (pp. 661–729). New York: Agathon Press.
- Covington, M. V. (1998). *The will to learn: A guide for motivating young people*. New York: Cambridge University Press.
- Covington, M. V. (2000). Goal theory, motivation, and school achievement: An integrative review. *Annual Review of Psychology*, 51, 171–200. doi:10.1146/annurev.psych.51.1.171
- Covington, M. V. (2004). Self-worth theory goes to college or do our motivation theories motivate? In D. M. McInerney & S. Van Etten (Eds.), *Big theories revisited* (pp. 91–114). Charlotte, NC: Information Age.
- Covington, M. V. (2009). Self-worth theory: Retrospection and prospects. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 141–170). New York: Routledge.
- Covington, M. V., & Beery, R. G. (1976). *Self-worth and school learning*. New York: Holt, Rinehart, & Winston.
- Covington, M. V., & Omelich, C. L. (1979a). Effort: The double-edged sword in school achievement. *Journal of Educational Psychology*, 71, 169–182. doi:10.1037/0022-0663.71.2.169
- Covington, M. V., & Omelich, C. L. (1979b). It's best to be able and virtuous too: Student and teacher evaluative responses to successful effort. *Journal of Educational Psychology*, 71, 688–700. doi:10.1037/0022-0663.71.5.688
- Covington, M. V., & Omelich, C. L. (1991). Need achievement revisited: Verification of Atkinson's original 2 × 2 model. In C. D. Spielberger, I. G. Sarason, Z. Kulcsar, & G. L. Van Heck (Eds.), *Stress and emotion Vol 14* (pp. 85–105). New York: Hemisphere.

- Covington, M. V., Spratt, M. F., & Omelich, C. L. (1980). Is effort enough, or does diligence count too? Student and teacher reactions to effort stability in failure. *Journal of Educational Psychology*, 72, 717–729. doi:10.1037/0022-0663.72.6.717
- Covington, M. V., von Hoene, L. M., & Voge, D. J. (2017). *Life beyond grades: Designing college courses to promote intrinsic motivation*. Cambridge: Cambridge University Press. doi:10.1017/9781139032896
- Craven, R. G., Marsh, H. W., & Debus, R. L. (1991). Effects of internally focused feedback and attributional feedback on the enhancement of academic self-concept. *Journal of Educational Psychology*, 83, 17–26. doi:10.1037/0022-0663.83.1.17
- De Castella, K., Byrne, D., & Covington, M. (2013). Unmotivated or motivated to fail? A cross-cultural study of achievement motivation, fear of failure, and student disengagement. *Journal of Educational Psychology*, 105, 861–880.
- DeRuvo, S. L. (2009). *Strategies for teaching adolescents with ADHD*. San Francisco, CA: Jossey-Bass.
- Dumas, D., & Pelletier, L. (1999). Perception in hyperactive children. *The American Journal of Maternal Child Nursing*, 24, 12–19. doi:10.1097/00005721-199901000-00004
- DuPaul, G. J., Rutherford, L. E., & Hosterman, S. J. (2008). Attention-deficit/hyperactivity disorder. In R. J. Morris & N. Mather (Eds.), *Evidence-based interventions for students with learning and behavioral challenges* (pp. 33–58). New York: Routledge.
- DuPaul, G. J., & Stoner, G. (2003). *ADHD in the schools: Assessment and intervention strategies* (2nd ed.). New York: Guilford Press.
- Edbom, T., Granlund, M., Lichtenstein, P., & Larsson, J. O. (2008). ADHD symptoms related to profiles of self-esteem in a longitudinal study of twins. *Journal of Child and Adolescent Psychiatric Nursing*, 21, 228–237. doi:10.1111/j.1744-6171.2008.00157.x
- Elliot, A. J., & Covington, M. V. (2001). Approach and avoidance motivation. *Educational Psychology Review*, 13, 73–92.
- Erlj, D., Acosta-García, J., Rojas-Márquez, M., González-Hernández, B., Escartín-Perez, E., Aceves, J., & Florán, B. (2012). Dopamine D4 receptor stimulation in GABAergic projections of the globus pallidus to the reticular thalamic nucleus and the substantia nigra reticulata of the rat decreases locomotor activity. *Neuropharmacology*, 62, 1111–1118. doi:10.1016/j.neuropharm.2011.11.001
- Ervin, R. A., Bankert, C. L., & DuPaul, G. J. (1996). Treatment of attention-deficit/hyperactivity disorder. In M. A. Reinecke & F. M. Dattilio (Eds.), *Cognitive therapy with children and adolescents: A casebook for clinical practice* (pp. 38–61). New York: Guilford Press.
- Frame, K., Kelly, L., & Bayley, E. (2003). Increasing perceptions of self-worth in preadolescents diagnosed with ADHD. *Journal of Nursing Scholarship*, 35, 225–229. doi:10.1111/j.1547-5069.2003.00225.x
- Frankel, F., Cantwell, D., Myatt, R., & Feinberg, D. T. (1999). Do stimulants improve self-esteem in children with ADHD and peer problems? *Journal of Child and Adolescent Psychopharmacology*, 9, 185–194. doi:10.1089/cap.1999.9.185
- Greenwald-Mayes, G. (2002). Relationship between current quality of life and family of origin dynamics for college students with attention-deficit/hyperactivity disorder. *Journal of Attention Disorders*, 5, 211–222. doi:10.1177/108705470100500403
- Groteluschen, A. K., Borkowski, J. G., & Hales, C. (1990). Strategy instruction is often insufficient: Addressing the interdependency of executive and attributional processes. In T. Scruggs & B. Wong (Eds.), *Intervention research in learning disabilities* (pp. 81–101). New York: Springer-Verlag. doi:10.1007/978-1-4612-3414-2_4
- Harari, O., & Covington, M. V. (1981). Reactions to achievement behavior from a teacher and student perspective: A developmental analysis. *American Educational Research Journal*, 18, 15–28. doi:10.3102/00028312018001015
- Harpin, V. A. (2005). The effect of ADHD on the life of an individual, their family, and community from preschool to adult life. *Archives of Disease in Childhood*, 90, 2–7. doi:10.1136/adc.2004.059006
- Heiligenstein, E., Guenther, G., Levy, A., Savino, F., & Fulwiler, J. (1999). Psychological and academic functioning in college students with attention deficit hyperactivity disorder. *Journal of American College Health*, 47, 181–185. doi:10.1080/07448489909595644
- Heiligenstein, E., & Keeling, R. P. (1995). Presentation of unrecognized attention deficit hyperactivity disorder in college students. *Journal of American College Health*, 43, 226–228. doi:10.1080/07448481.1995.9940481
- Hoagwood, K., Kelleher, K., Feil, M., & Comer, D. (2000). Treatment services for children with ADHD: A national perspective. *Journal of the American Academy Child and Adolescent Psychiatry*, 39, 198–206. doi:10.1097/00004583-200002000-00020

- Holmes, J., Gathercole, S. E., Place, M., Dunning, D. L., Hilton, K. A., & Elliott, J. G. (2010). Working memory deficits can be overcome: Impacts of training and medication on working memory in children with ADHD. *Applied Cognitive Psychology*, 24, 827–836. doi:10.1002/acp.1589
- Hoza, B., Gerdes, A. C., Hinshaw, S. P., Arnold, L. E., Pelham, W. E., Molina, B. S. G., ... Wigal, T. (2004). Self-perceptions of competence in children with ADHD and comparison children. *Journal of Consulting & Clinical Psychology*, 72, 382–391. doi:10.1037/0022-006X.72.3.382
- Hoza, B., & Pelham, W. E. (1991, December). Evidence for the moderating role of social cognitions in predicting social adjustment and treatment response of ADHD children. In B. Hoza & W. E. Pelham, (Chairs) (Eds.), *Cognitive biases as mediators of childhood disorders: What do we know?*. New York: Symposium presented at the Annual Meeting of the Association for the Advancement of Behavior Therapy.
- Hoza, B., Pelham, W. E., Dobbs, J., Owens, J. S., & Pillow, D. R. (2002). Do boys with attention-deficit/hyperactivity disorder have positive illusory self-concepts? *Journal of Abnormal Psychology*, 111, 268–278. doi:10.1037/0021-843X.111.2.268
- Hoza, B., Pelham, W. E., Milich, R., Pillow, D., & McBride, K. (1993). The self-perceptions and attributions of attention deficit hyperactivity disorder and nonreferred boys. *Journal of Abnormal Child Psychology*, 21, 271–286. doi:10.1007/BF00917535
- Hunt, R., Hoehn, R., Stephens, K., & Osten, C. (1994). Clinical patterns of ADHD: A treatment model based on brain functioning. *Comprehensive Therapy*, 20, 106–112.
- Jaconis, M., Boyd, S. J., Hartung, C. M., McCrea, S. M., Lefler, E. K., & Canu, W. H. (2016). Sex differences in claimed and behavioral self-handicapping and ADHD symptomatology in emerging adults. *ADHD Attention Deficit and Hyperactivity Disorders*, 8, 205–214. doi:10.1007/s12402-016-0200-y
- Johnston, C., & Mash, E. J. (2001). Families of children with attention-deficit/hyperactivity disorder: Review and recommendations for future research. *Clinical Child and Family Psychology Review*, 4, 183–207. doi:10.1023/A:1017592030434
- Kendall, J. (2000). Outlasting disruption: The process of reinvestment in families ADHD children. *Qualitative Health Research*, 8, 839–857. doi:10.1177/104973239800800609
- Kent, K. M., Pelham, W. E., Molina, B. S., Sibley, M. H., Waschbusch, D. A., Yu, J., ... Karch, K. M. (2011). The academic experience of male high school students with ADHD. *Journal of Abnormal Child Psychology*, 39, 451–462. doi:10.1007/s10802-010-9472-4
- Kessler, R. C., Adler, L., Barkley, R., Biederman, J., Conners, C. K., Demler, O., ... Spencer, T. (2006). The prevalence and correlates of adult ADHD in the United States: Results from the National Comorbidity Survey Replication. *American Journal of Psychiatry*, 163, 716–723. doi:10.1176/ajp.2006.163.4.716
- Krueger, M., & Kendall, J. (2001). Descriptions of self an exploratory study of adolescents with ADHD. *Journal of Child and Adolescent Psychiatric Nursing*, 14, 61–72. doi:10.1111/j.1744-6171.2001.tb00294.x
- Lee, K. M., & Olenchak, F. R. (2015). Individuals with a gifted/attention deficit/hyperactivity disorder diagnosis: Identification, performance, outcomes, and interventions. *Gifted Education International*, 31, 185–199.
- Lewinsohn, P. M., Rohde, P., & Seeley, J. R. (1993). Psychosocial characteristics of adolescents with a history of suicide attempt. *Journal of the American Academy of Child and Adolescent Psychiatry*, 32, 60–68. doi:10.1097/00004583-199301000-00009
- Liem, G. A. D., & Martin, A. J. (2013). Direct instruction and academic achievement. In J. Hattie & E. Anderman (Eds.), *International guide to student achievement* (pp. 366–368). Oxford: Routledge.
- Locke, E., & Latham, G. (2002). Building a practically useful theory of goal setting and task motivation. *American Psychologist*, 57, 705–717. doi:10.1037/0003-066X.57.9.705
- Lougy, R., DeRuvo, S., & Rosenthal, D. (2007). *Teaching young children with ADHD*. Thousand Oaks, CA: Corwin Press.
- Mariani, M., & Barkley, R. A. (1997). Neuropsychological and academic functioning in preschool children with Attention Deficit Hyperactivity Disorder. *Developmental Neuropsychology*, 13, 111–129. doi:10.1080/87565649709540671
- Martin, A. J. (2003). *How to motivate your child for school and beyond*. Sydney: Random House/Bantam.
- Martin, A. J. (2010). *Building classroom success: Eliminating academic fear and failure*. New York: Bloomsbury.
- Martin, A. J. (2012). Attention Deficit Hyperactivity Disorder (ADHD), perceived competence, and self-worth: Evidence and implications for students and practitioners. In D. Hollar (Ed.), *Handbook on children with special health care needs* (pp. 47–72). New York: Springer. doi:10.1007/978-1-4614-2335-5_3
- Martin, A. J. (2013). *Motivation and Engagement Scale*. Sydney, Australia: Lifelong Achievement Group. www.lifelongachievement.com

- Martin, A. J. (2014). The role of ADHD in academic adversity: Disentangling ADHD effects from other personal and contextual factors. *School Psychology Quarterly*, 29, 395–408. doi:10.1037/spq0000069
- Martin, A. J. (2015). Teaching academically at-risk students in middle school: The roles of explicit instruction and guided discovery learning. In S. Groundwater-Smith & N. Mockler (Eds.), *Big fish, little fish: Teaching and learning in the middle years* (pp. 29–39). Cambridge: Cambridge University Press.
- Martin, A. J. (2016). *Using load reduction instruction (LRI) to boost motivation and engagement*. Leicester, UK: British Psychological Society.
- Martin, A. J., & Burns, E. C. (2014). Academic buoyancy, resilience, and adaptability in students with ADHD. *The ADHD Report*, 22, 1–9. doi:10.1521/adhd.2014.22.6.1
- Martin, A. J., Burns, E. C., & Collie, R. J. (2017). ADHD, personal and interpersonal agency, and achievement: Exploring links from a social cognitive theory perspective. *Contemporary Educational Psychology*, 50, 13–22. doi:10.1016/j.cedpsych.2016.12.001
- Martin, A. J., Collie, R. J., Roberts, C. L., & Nassar, N. (2018). The role of medication in reducing the negative effects of hyperactivity-inattention on achievement: A population-based longitudinal investigation of students and their classrooms. *Contemporary Educational Psychology*, 55, 97–109.
- Martin, A. J., & Evans, P. (2018). Load reduction instruction: Exploring a framework that assesses explicit instruction through to independent learning. *Teaching and Teacher Education*, 73, 203–214.
- Martin, A. J., & Marsh, H. W. (2003). Fear of failure: Friend or foe? *Australian Psychologist*, 38, 31–38. doi:10.1080/00050060310001706997
- Martin, A. J., Marsh, H. W., & Debus, R. L. (2001a). A quadripolar need achievement representation of self-handicapping and defensive pessimism. *American Educational Research Journal*, 38, 583–610. doi:10.3102/00028312038003583
- Martin, A. J., Marsh, H. W., & Debus, R. L. (2001b). Self-handicapping and defensive pessimism: Exploring a model of predictors and outcomes from a self-protection perspective. *Journal of Educational Psychology*, 93, 87–102. doi:10.1037/0022-0663.93.1.87
- Martin, A. J., Marsh, H. W., & Debus, R. L. (2003). Self-handicapping and defensive pessimism: A model of self-protection from a longitudinal perspective. *Contemporary Educational Psychology*, 28, 1–36. doi:10.1016/S0361-476X(02)00008-5
- Martin, A. J., Marsh, H. W., Williamson, A., & Debus, R. L. (2003). Self-handicapping, defensive pessimism, and goal orientation: A qualitative study of university students. *Journal of Educational Psychology*, 95, 617–628. doi:10.1037/0022-0663.95.3.617
- Mayer, R.E., & Moreno, R. (2010). Techniques that reduce extraneous cognitive load and manage intrinsic cognitive load during multimedia learning. In J.L. Plass, R. Moreno, & R. Brunken (Eds.), *Cognitive load theory* (pp. 131–152). Cambridge: Cambridge University Press. <https://doi.org/10.1017/CBO9780511844744.009>
- McClelland, D. C. (1965). Toward a theory of motive acquisition. *American Psychologist*, 20, 321–333. doi:10.1037/h0022225
- McInerney, D. (2000). *Helping kids achieve their best*. Sydney, Australia: Allen & Unwin.
- McKinney, J. D., Montague, M., & Hocutt, A. M. (1993). Educational assessment of students with attention deficit disorder. *Exceptional Children*, 60, 125–131. doi:10.1177/001440299306000206
- Meichenbaum, D. (1974). *Cognitive behavior modification*. Morristown, NJ: General Learning Press.
- Mullet, D. R., & Rinn, A. N. (2015). Giftedness and ADHD: Identification, misdiagnosis, and dual diagnosis. *Roeper Review*, 37, 195–207.
- Nicholls, J. G. (1976). Effort is virtuous, but it's better to have ability: Evaluative response to perceptions of effort and ability. *Journal of Research in Personality*, 10, 306–315. doi:10.1016/0092-6566(76)90020-9
- Niermann, H., & Scheres, A. (2014). The relation between procrastination and symptoms of attention-deficit hyperactivity disorder (ADHD) in undergraduate students. *International Journal of Methods in Psychiatric Research*, 23, 411–421. doi:10.1002/mpr.1440
- Nigg, J. T. (2001). Is ADHD an inhibitory disorder? *Psychological Bulletin*, 125, 571–596. doi:10.1037/0033-2909.127.5.571
- Nurmi, J. E., Aunola, K., Salmela-Aro, K., & Lindroos, M. (2003). The role of success expectation and task-avoidance in academic performance and satisfaction: Three studies on antecedents, consequences and correlates. *Contemporary Educational Psychology*, 28, 59–90.
- Ohan, J. L., & Johnston, C. (2002). Are the performance overestimates given by boys with ADHD self-protective? *Journal of Clinical Child Psychology*, 31, 230–241. doi:10.1207/S15374424JCCP3102_08

- Ollendick, T. H., & King, N. J. (1994). Diagnosis, assessment, and treatment of internalizing problems in children: The role of longitudinal data. *Journal of Consulting and Clinical Psychology*, 62, 918–927. doi:10.1037/0022-006X.62.5.918
- Oosterlaan, J., & Sergeant, J. A. (1998). Effects of reward and response cost on response inhibition in AD/HD, disruptive, anxious, and normal children. *Journal of Abnormal Child Psychology*, 26, 161–174. doi:10.1023/A:1022650216978
- Ostrander, R., Crystal, D. S., & August, G. (2006). Attention deficit-hyperactivity disorder, depression, and self- and other-assessments of social competence: A developmental study. *Journal of Abnormal Child Psychology*, 34, 773–787. doi:10.1007/s10802-006-9051-x
- Owens, J. S., Goldfine, M. E., Evangelista, N. M., Hoza, B., & Kaiser, N. M. (2007). A critical review of self-perceptions and the positive illusory bias in children with ADHD. *Clinical Child and Family Psychology Review*, 10, 335–351.
- Parker, P. D., & Martin, A. J. (2011). Clergy motivation and occupational well-being: Exploring a quadripartite model and its role in predicting burnout and engagement. *Journal of Religion and Health*, 50, 656–674. doi:10.1007/s10943-009-9303-5
- Pelham, W. E., Hoza, B., Pillow, D. R., Gnagy, E. M., Kipp, H. L., Greiner, A. R., ... & Fitzpatrick, E. (2002). Effects of methylphenidate and expectancy on children with ADHD: Behavior, academic performance, and attributions in a summer treatment program and regular classroom setting. *Journal of Consulting and Clinical Psychology*, 70, 320–335. doi:10.1037/0022-006X.70.2.320
- Pelham, W. E., & Lang, A. R. (1993). Parental alcohol consumption and deviant child behavior: Laboratory studies of reciprocal effects. *Clinical Psychology Review*, 13, 763–784. doi:10.1016/S0272-7358(05)80005-4
- Pelham, W. E., McBurnett, K., Harper, G., Milich, R., Murphy, D. A., Clinton, J., & Thiele, C. (1990). Methylphenidate and baseball playing in ADHD children: Who's on first? *Journal of Consulting and Clinical Psychology*, 58, 130–133. doi:10.1037/0022-006X.58.1.130
- Pennington, B. F., & Ozonoff, S. (1996). Executive functions and development psychopathology. *Journal of Child Psychiatry*, 37, 51–87. doi:10.1111/j.1469-7610.1996.tb01380.x
- Pisecco, S., Baker, D. B., Silva, P. A., & Brooke, M. (1996). Behavioral distinctions in children with reading disabilities and/or ADHD. *Journal of the American Academy of Child and Adolescent Psychiatry*, 35, 1477–1484. doi:10.1097/00004583-199611000-00016
- Pisecco, S., Wristers, K., Swank, P., Silva, P. A., & Baker, D. B. (2001). The effect of academic self-concept on ADHD and antisocial behaviors in early adolescence. *Journal of Learning Disabilities*, 34, 450–461. doi:10.1177/002221940103400506
- Pliszka, S. R. (2009). *Treating ADHD and comorbid disorders: Psychosocial and psychopharmacological interventions*. New York: Guilford Press.
- Purdie, N., Hattie, J., & Carroll, A. (2002). A review of the research on interventions for attention deficit hyperactivity disorder: What works best? *Review of Educational Research*, 72, 61–99. doi:10.3102/00346543072001061
- Rhodewalt, F., & Tragakis, M. W. (2002). Self-handicapping and school: Academic self-concept and self-protective behavior. In J. Aronson (Ed.), *Improving academic achievement. Impact of psychological factors on education* (pp. 109–134). San Diego: Academic Press. doi:10.1016/B978-012064455-1/50009-9
- Salmelainen, P. (2002). *Trends in the prescribing of stimulant medication for the treatment of attention deficit hyperactivity disorder in children and adolescents in NSW*. Sydney, Australia: NSW Department of Health.
- Sayal, K., Prasad, V., Daley, D., Ford, T., & Coghill, D. (2017). ADHD in children and young people: Prevalence, care pathways, and service provision. *The Lancet Psychiatry*, 5, 175–186.
- Schunk, D. H., & Miller, S. D. (2002). Self-efficacy and adolescents' motivation. In F. Pajares & T. Urdan (Eds.), *Academic motivation of adolescents* (pp. 29–52). Greenwich, CT: Information Age.
- Sciberras, E., Efron, D., & Iser, A. (2011). The child's experience of ADHD. *Journal of Attention Disorders*, 15, 321–327.
- Shaw-Zirt, B., Popali-Lehane, L., Chaplin, W., & Bergman, A. (2005). Adjustment, social skills, and self-esteem in college students with symptoms of ADHD. *Journal of Attention Disorders*, 8, 109–120. doi:10.1177/1087054705277775
- Shipstead, Z., Hicks, K. L., & Engle, R. W. (2012). Cogmed working memory training: Does the evidence support the claims? *Journal of Applied Research in Memory and Cognition*, 1, 185–193. doi:10.1016/j.jarmac.2012.06.003
- Slomkowski, C., Klein, R. G., & Mannua, S. (1995). Is self-esteem an important outcome in hyperactive children? *Journal of Abnormal Child Psychology*, 23, 303–315. doi:10.1007/BF01447559

- Swartz, S. L., Prevatt, F., & Proctor, B. E. (2005). A coaching intervention for college students with attention deficit/hyperactivity disorder. *Psychology in the Schools, 42*, 647–656.
- Sweller, J. (2012). Human cognitive architecture: Why some instructional procedures work and others do not. In K. R. Harris, S. Graham., & T. Urdan (Eds.), *APA educational psychology handbook* (pp. 295–325). Washington, DC: American Psychological Association. doi:10.1037/13273-011
- Tabassam, W., & Grainger, J. (2002). Self-concept, attributional style and self-efficacy beliefs of students with learning disabilities with and without attention deficit hyperactivity disorder. *Learning Disability Quarterly, 25*, 141–151. doi:10.2307/1511280
- Thompson, T. (1994). Self-worth protection: Review and implications for the classroom. *Educational Review, 46*, 259–274. doi:10.1080/0013191940460304
- Thompson, T., & Parker, C. (2007). Diagnosing the poor performance of self-worth protective students: A product of future outcome uncertainty, evaluative threat, or both? *Educational Psychology, 27*, 111–134.
- Thompson, T., & Richardson, A. (2001). Self-handicapping status, claimed self-handicaps and reduced practice effort following success and failure feedback. *British Journal of Educational Psychology, 71*, 151–170. doi:10.1348/000709901158442
- Treuting, J. J., & Hinshaw, S. P. (2001). Depression and self-esteem in boys with attention-deficit/hyperactivity disorder: Associates with comorbid aggression and explanatory attributional mechanisms. *Journal of Abnormal Child Psychology, 29*, 23–39. doi:10.1023/A:1005247412221
- Vaughan, B. S., Roberts, H. J., & Needelman, H. (2009). Current medications for the treatment of attention-deficit/hyperactivity disorder. *Psychology in the Schools, 46*, 846–856. doi:10.1002/pits.20425
- Vile Junod, R. E., DuPaul, G. J., Jitendra, A. K., Volpe, R. J., & Cleary, K. S. (2006). Classroom observations of students with and without ADHD: Differences across types of engagement. *Journal of School Psychology, 44*, 87–104. doi:10.1016/j.jsp.2005.12.004
- Wagner, B. (2000). Attention deficit hyperactivity disorder: Current concepts and underlying mechanisms. *Journal of Child and Adolescents Psychiatric Nursing, 13*, 113–124. doi:10.1111/j.1744-6171.2000.tb00088.x
- Waschbusch, D. A., Craig, R., Pelham, W. E., & King, S. (2007). Self-handicapping prior to academic-oriented tasks in children with attention deficit/hyperactivity disorder (ADHD): Medication effects and comparisons with controls. *Journal of Abnormal Child Psychology, 35*, 275–286. doi:10.1007/s10802-006-9085-0
- Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review, 92*, 548–573. doi:10.1037/0033-295X.92.4.548
- Weiner, B. (1994). Integrating social and personal theories of achievement striving. *Review of Educational Research, 64*, 557–573. doi:10.3102/00346543064004557
- Weiner, B. (2010). The development of an attribution-based theory of motivation: A history of ideas. *Educational Psychologist, 45*, 28–36. doi:10.1080/00461520903433596
- Whalen, C. K., Henker, B., Hinshaw, S. P., Heller, T., & Huber-Dressler, A. (1991). Messages of medication: Effects of actual versus informed medication status on hyperactive boys expectancies and self-evaluations. *Journal of Consulting and Clinical Psychology, 59*, 602–606. doi:10.1037/0022-006X.59.4.602
- Wigfield, A., & Tonks, S. (2002). Adolescents' expectancies for success and achievement task values during middle and high school years. In F. Pajares & T. Urdan (Eds.), *Academic motivation of adolescents* (pp. 53–82). Greenwich, CT: Information Age.
- Willcutt, E. G. (2012). The prevalence of DSM-IV attention-deficit/hyperactivity disorder: A meta-analytic review. *Neurotherapeutics, 9*, 490–499. doi:10.1007/s13311-012-0135-8
- Woodruff, T. J., Axelrad, D. A., Kyle, A. D., Nweke, O., Miller, G. G., & Hurley, B. J. (2004). Trends in environmentally related childhood illnesses. *Pediatrics, 113*, 1133–1140.
- Young, S., & Bramham, J. (2012). *Cognitive behavioral therapy for ADHD in adolescents and adults: A psychological guide to practice* (2nd ed.). Malden, MA: John Wiley. doi:10.1002/9781119943440
- Zuckerman, M., & Tsai, F. F. (2005). Costs of self-handicapping. *Journal of Personality, 73*, 411–442.
- Zwart, L. M., & Kallemeyn, L. M. (2001). Peer-based coaching for college students with ADHD and learning disabilities. *Journal of Postsecondary Education and Disability, 15*, 1–15.

17

THE RELEVANCE OF EXPECTANCY-VALUE THEORY TO UNDERSTANDING THE MOTIVATION AND ACHIEVEMENT OF STUDENTS WITH COGNITIVE AND EMOTIONAL SPECIAL NEEDS

Focus on Depression and Anxiety

Allan Wigfield and Annette Ponnock

Children vary greatly in how well they do in school, and their performance has strong consequences for their developing beliefs about their capabilities to do their schoolwork and their affective reactions to school. Some children develop positive and strong beliefs about the likelihood they will do well in school and have positive affect about their school experiences (see Wigfield et al., 2015). Other children come to doubt their school abilities and develop negative beliefs and affect toward school. At the extremes, children can become either depressed or anxious about being in school, or their preexisting anxiety and depression can contribute to poor performance, which perpetuates a cycle of negative beliefs, depression/anxiety, and poor performance (Rodriguez & Routh, 1989). Motivation theories can help us understand the development of depression and anxiety. In this chapter, we discuss how constructs and processes included in expectancy-value theory (EVT) help us understand the development of anxiety and depression. The motivation theory on which we focus is thus EVT, and, more specifically, the EVT of performance and choice developed by Eccles-Parsons et al. (1983) and updated in Eccles (2005, 2009) and Wigfield, Tonks, and Klauda (2016)—now labeled SEVT for situated expectancy-value theory (see Eccles & Wigfield, in press, for the rationale for this change). Eccles, Wigfield, and their colleagues study developmental trajectories in children's motivational beliefs and values, how these beliefs and values explain individual and group differences in performance on different activities and choices of which activities to pursue, and how socializers in the home and school influence children's developing expectancies and values (Eccles-Parsons et al., 1983; Wigfield et al., 2016).

A major finding from the work on children's expectancy beliefs and values is that, at school entry and early on in elementary school, many (but, importantly, not all) young children have relatively positive expectancies for success for different academic activities and value doing them (see Wigfield et al., 2015, for review). As children get older, their expectancies and values became more realistic in the sense of being related more closely to their performance. Children doing poorly in school are most likely to lower their expectancies for how well they will do academically. Doubts about their ability to accomplish school-based tasks can lead these students to become anxious when their performance on such tasks is evaluated and ultimately they may become depressed about their future academic prospects (Nelson & Harwood, 2011; Rodriguez & Routh, 1989; Zeidner, 1998). This is particularly true for children who continue to value academic achievement; when children value achievement activities in which they struggle and doubt their abilities, they are more likely to develop low self-esteem, anxiety, and depression, and perhaps all three (for related discussion, see, in this volume, Pekrun & Loderer, Chapter 18; Schunk & DiBenedetto, Chapter 11; Tracey, Merom, Morin, & Maïano, Chapter 24).

In this chapter, we provide a brief overview of Eccles and colleagues' SEVT (Eccles, 2009; Eccles-Parsons et al., 1983; Wigfield et al., 2016). We then discuss work on how children's expectancies and values for different academic subject areas develop across the school years, and the ways in which they predict children's performance on different activities and choice of which activities to pursue. We next discuss how children's developing motivational beliefs and values can be impacted both positively and negatively by parents' socialization practices in the home and teacher–student relations. We then turn to definitions of depression and anxiety included in both the *Diagnostic and Statistical Manual of Mental Disorder*—5th edition (DSM-5) and the Individuals with Disabilities Education Act (IDEA), how depression and anxiety relate to each other, and both depression's and anxiety's relations to children's school performance. The definitions of depression and anxiety from the DSM-5 and IDEA are the two most commonly used diagnostic criteria used in educational contexts for determining if children have special emotional needs. Although there are similarities between the two definitions, there are differences too, the importance of which we will discuss in a later section. We next discuss developmental trajectories of children's depression and anxiety, as well as gender and race/ethnicity differences in them. We finish with discussion of interventions to reduce children's anxiety and depression and increase their values and expectations of success.

OVERVIEW OF ECCLES AND COLLEAGUES' SEVT

In SEVT, Eccles and her colleagues (Eccles, 2009; Eccles-Parsons et al., 1983; Wigfield et al., 2016) proposed the most proximal and direct predictors of performance and choice are individuals' beliefs, or expectancies, that they can succeed on a given task, or not, and the value they attach to the task. Individuals' expectancies and values are influenced by a host of different beliefs, positive and negative affective reactions to and memories about different tasks (anxiety is a primary negative affective reaction), and interpretations of their achievement outcomes. These, in turn, are influenced by many socialization and cultural factors, including individuals' perceptions of the attitudes and expectations of parents and teachers toward them, the cultural milieu in which

they live, and their identification with different social and cultural groups. We discuss the role certain parents' beliefs and behaviors have on children's developing expectancies and values and also the impact of teacher–student relations later in the chapter. We focus in this section on the central belief and value constructs in the model, and link them to the development of anxiety and depression.

Defining the Expectancy, Value, and Ability Belief Constructs in SEVT

Eccles-Parsons et al. (1983) defined expectancies for success as children's beliefs about how well they will do on an upcoming task (e.g., how well do you think you will do in math next year?). Ability (or competence) beliefs are children's evaluations of their current competence or ability, both in terms of their assessments of their own ability and also how they think they compare with other students. Although Eccles and colleagues distinguished these two beliefs theoretically, they strongly overlap empirically (Eccles & Wigfield, 1995; for related discussion, see, in this volume, Schunk & DiBenedetto, Chapter 11; Tracey et al., Chapter 24; Wehmeyer & Shogren, Chapter 12). Thus, in this chapter, we will use these terms interchangeably, for the most part. Expectancies and ability beliefs share somewhat similar meanings with other constructs having to do with perceived competence, such as self-efficacy (Bandura, 1977) and self-concept of ability, as defined in Marsh (e.g., Marsh, 1987). As discussed more below, although many children begin school with optimistic beliefs about how well they will do, there are some who enter school doubting their abilities (Heyman, Dweck, & Cain, 1992). Children who struggle with their schoolwork even in the early school years likely soon will have low competence beliefs in the areas in which they do poorly; as we will see, low competence beliefs relate to the development of depression.

Eccles and her colleagues defined values with respect to the qualities of different tasks and/or subject areas and how those qualities influence the individual's desire to do the task (Eccles, 2005; Eccles-Parsons et al., 1983; Wigfield & Eccles, 1992). Eccles-Parsons et al. (1983) proposed that individuals' overall subjective task values are positively influenced by three components—attainment value or importance, intrinsic value, and utility value or usefulness of the task—and negatively influenced by one component—cost (see Eccles-Parsons et al., 1983; Wigfield & Eccles, 1992; Wigfield, Rosenzweig, & Eccles, 2017, for more detailed discussion). They defined *attainment value* as the importance of doing well on a given task. Attainment value also includes identity issues; tasks are important when individuals view them as central to their own sense of themselves, or allow them to express or confirm important aspects of self (Eccles, 2009). *Intrinsic value* is the enjoyment one gains from doing the task. When children intrinsically value an activity, they often become deeply engaged in it and can persist at it for a long time. This component is similar in certain respects to intrinsic motivation and interest constructs (see Hidi & Renninger, 2006; Ryan & Deci, 2009; Schiefele, 2009). *Utility value* or usefulness refers to how a task fits into an individual's future plans, such as taking a math class to fulfill a requirement for a science degree. In certain respects, utility value is similar to extrinsic motivation (Ryan & Deci, 2016), because, when individuals do an activity out of utility value, the activity is a means to an end, rather than an end in itself. However, the utility of an activity also can reflect central goals that individuals hold deeply, such as attaining a certain occupation.

In contrast to the three components just described, Eccles-Parsons et al. (1983) defined cost as what the individual has to give up to do a task (e.g., If I do my math homework, I can't spend time on Instagram), as well as the anticipated effort one will need to put into task completion (e.g., Is working this hard to get an A in math worth it?; see Wigfield et al., 2017, for a review of recent work on cost). Eccles-Parsons et al. posited that cost is especially important to choice, because choosing one activity and investing time in it means that other potentially valued activities cannot be done. The research on cost has burgeoned in the last decade, and researchers (e.g., Flake, Barron, Hulleman, McCoach, & Welsh, 2015; Gaspard, Häfner, Parrisius, Trautwein, & Nagengast, 2017) proposed new dimensions of cost and developed measures of them. These dimensions include emotional cost (e.g., Working on a given activity makes me nervous, or annoyed), effort required (e.g., The amount of effort I'm exerting to do well exhausts me), and opportunity cost (e.g., If I spend time on this activity, it means I cannot do other activities I want to do). Although researchers have not yet examined the relations of perceived cost to anxiety, we believe that, when children perceive the emotional costs of different school tasks or subject areas to be too high, they will be anxious about the work they have to do in those areas and may try to withdraw from them.

Conley (2012) examined whether different patterns or clusters of students' expectancy and value beliefs could be identified and she found (in a large sample of Latino seventh-graders) seven clusters of students' expectancies, values, perceptions of cost, and goals for math. The two clusters most relevant to this chapter are the "low" cluster, who had low competence beliefs for and valuing of math, and few goals for it, and the average-high-cost cluster, who were in the mid-range of competence beliefs and values for math, but perceived math to be of high cost. Students in the low cluster had the most negative affect regarding math and lowest achievement in it; the average-high-cost group also had lower achievement in math and expressed more negative affect about it. Interestingly, students' cost perceptions differentiated these high and low clusters.

Rosenzweig and Wigfield (2017) also found different clusters of beliefs and values regarding reading in a diverse sample of seventh-grade students. The cluster of students with the least positive competence beliefs and values had lower reading comprehension test scores and grades in reading, and they were not committed to doing well in reading. This low cluster, and the low cluster of students identified by Conley (2012), may be at greater risk for later anxiety or depression, albeit for different reasons. However, to date, researchers have not included measures of depression or anxiety in SEVT-based person-centered studies focused on identifying clusters of children with varied competence beliefs and values; we believe this is an important direction for future research.

Development of Children's Expectancy Beliefs and Task Values

Researchers in different countries have found that the normative pattern of change in children's expectancies and values is one of decline (see Wigfield et al., 2015, for review). Many young children (but not all; see Heyman et al., 1992) are quite optimistic about their competencies in different areas, and this optimism changes during middle childhood to greater realism and (sometimes) pessimism; hence, the overall pattern

of decline. There is evidence that these declines slow or stop during high school, at least for some adolescents (Archambault, Eccles, & Vida, 2010; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002), but the prevailing pattern is decline. As discussed elsewhere (see Wigfield et al., 2016), the reasons for these changes include children's growing skill at understanding and evaluating the feedback they receive, and also a host of factors in the school environment; space does not allow us to detail these here.

Researchers are just beginning to examine the development of cost and the research, to date, has used cross-sectional designs to do so. Gaspard, Häfner, Parrisius, Trautwein, and Nagengast (2017), for example, studied 5th–12th-grade German students' task values and found that the students' positive valuing of the different subject areas (German, English, math, biology, physics) were higher among younger students, although perceived cost was higher among older students. These overall differences varied across subject areas and gender; for instance, boys' valuing of English went down across age (and cost perceptions went up) more than did girls' perceived values and cost; and the opposite was true in physics.

These gender differences reflect cultural stereotypes; girls valued English, German, and biology more than boys, and boys valued physics more. Interestingly, girls valued overall high achievement in school more than boys did. Gaspard et al.'s (2017) results regarding gender differences are similar to those of expectancy-value studies done in the U.S. over the last 20 years. An interesting change in the U.S. studies' results is that girls used to report both lower ability beliefs in math and lower value; increasingly, girls and boys report valuing math equally (Jacobs et al., 2002), reflecting the results of Gaspard et al.'s study. Boys continue to have both lower ability beliefs and express less value for reading and language arts than do girls.

Researchers have also begun to examine different patterns of change in children's expectancies and values and examined gender differences in these patterns. Archambault et al. (2010) found seven different trajectories of change in students' competence beliefs and values for reading/language arts. Although these trajectories generally showed a decline in children's competence beliefs and values, they were markedly different, and some showed increases across the high school years. Students whose literacy competence beliefs declined most strongly included boys and lower-SES students. Musu-Gillette, Wigfield, Harring, and Eccles (2015) also found different trajectories of change from fourth grade through high school in children's mathematics competence beliefs and values; several trajectories showed decline, but some were flat. Again, although these relations have not been assessed, students whose beliefs and values decline the most in a given subject area likely are more at risk for developing depression and anxiety. The gender differences in these patterns suggest that boys and girls may become anxious (and possibly depressed) about different subject areas and at different rates. We discuss gender differences in anxiety and depression later.

RELATIONS OF CHILDREN'S EXPECTANCIES AND VALUES TO PERFORMANCE AND CHOICE

Researchers from various countries show that children's, adolescents', and adults' expectancies for success and achievement values predict various achievement outcomes and choices of which activities to do (e.g., Bong, Cho, Ahn, & Kim, 2012; Durik, Vida, & Eccles, 2006; Meece, Wigfield, & Eccles, 1990; Musu-Gillette et al.,

2015; Trautwein et al., 2012). Students' expectancies for success and beliefs about ability are strong direct predictors of performance, and their task values directly predict both intentions and actual decisions to persist at different activities, such as taking mathematics and English courses (for related discussion, see, in this volume, Pekrun & Loderer, Chapter 18; Schunk & DiBenedetto, Chapter 11; Tracey et al., Chapter 24). Because children's expectancies and values relate positively to each other, their expectancies indirectly influence choice, and values indirectly influence performance. Several researchers have found that cost negatively predicts adolescents' and college students' achievement, plans to take advanced placement courses, and plans to pursue science careers or graduate school in general (Battle & Wigfield, 2003; Kirkpatrick, Chang, Lee, Tas, & Anderman, 2013; Perez, Cromley, & Kaplan, 2014; Safavian, Conley, & Karabenick, 2013).

The relations between children's expectancies and values and indicators of performance strengthen across the school years (Meece et al., 1990; Simpkins, Davis-Kean, & Eccles, 2006; Wigfield et al., 1997). Importantly, they also extend over time and become reciprocal (Durik et al., 2006; Musu-Gillette et al., 2015; Simpkins, et al., 2006). For instance, Musu-Gillette et al. (2015) found that students' valuing of math measured in elementary school predicted their college major choice. The findings that the strength of these relations increase across age and extend over time could mean that positive expectancies and values increasingly help children respond positively to challenges they face, and negative ones leave children increasingly likely to experience negative psychological outcomes, including depression and anxiety (for related discussion, see Pekrun & Loderer, Chapter 18, this volume). These relations have yet to be studied.

The Benefits of Synchrony in Expectancies and Values

Both Eccles (2009) and Harter (1990) discussed that, when children's expectancies and values are in synchrony with one another, they are more likely to have positive developmental outcomes such as higher self-esteem. Eccles stated that individuals develop hierarchies of both expectancies and values that influence their decisions about which activities to continue to pursue, and that, when children and adolescents choose activities in which they feel competent and value highly, they will have higher overall psychological adjustment. She also stated that reducing the value one places on activities at which one is doing poorly is an adaptive way to cope with failure. Harter discussed that one consequence of continuing to value activities in which children do not believe they are competent is that children are at risk for developing depression. We next turn to a discussion of the development of anxiety and depression in children and adolescents, starting with definitions of each, and then how they develop and relate to motivation and achievement.

WHAT ARE DEPRESSION AND ANXIETY?

Many studies examining depression and anxiety in children and adolescents and their relationship with school-based outcomes use the American Psychiatric Association's (APA) DSM-5 diagnosis criteria for depression and anxiety or other researcher-developed diagnostic measures (for related discussion, see Pekrun & Loderer, Chapter

18, this volume). However, because this handbook focuses on children with special needs in school, we will also focus on the criteria in the IDEA regarding the identification of depression and anxiety.

Depression

Clinicians diagnose depression and anxiety in children and adolescents using the criteria laid out in the DSM-5 (APA, 2013). Depression (or major depressive disorder; MDD) is diagnosed by way of five (or more) of the following symptoms, with at least one being either depressed mood or lack of interest or pleasure: (1) depressed mood (can be irritability in children and adolescents), (2) decreased interest or pleasure in activities, (3) significant weight loss or gain, (4) insomnia or hypersomnia, (5) feelings of restlessness or slowing down, (6) fatigue, (7) feelings of worthlessness or guilt, (8) indecisiveness or inability to think or concentrate, and (9) suicidal ideation or thoughts (APA, 2013). MDD episodes typically last approximately 7–9 months, with a 40% probability of recurrence by 2 years, and 70% probability of recurrence by 8 years (Birmaher et al., 1996).

Cognitive therapy (CT) provides a conceptualization of depression that has possible connections to SEVT. The CT theory of depression is based on an information-processing model. Individuals with depression form schemata (rigid, firmly held belief systems about the world) that are (often inaccurately) negatively biased (Beck, 2002). This causes children and adults with depression to selectively recall negative events, evaluate these events more harshly, create negative overgeneralizations about the events (Cole, Martin, Peeke, Seroczynski, & Fier, 1999), as well as use absolutist language to describe them (e.g., “always,” “never”; Al-Mosaiwi & Johnstone, 2018). These negatively biased schemata are likely to predispose children or adolescents with depression to low perceptions of their own ability and low expectations for success. We discuss this concept in greater detail below.

Depression is rarely found in children ages 11 years and younger (Kessler, Avenevoli, & Merikangas, 2001); its onset occurs more frequently in adolescence and can increase throughout it (Thapar, Collishaw, Pine, & Thapar, 2012). Although there are numerous factors or reasons why children and adolescents can become depressed (from biological/genetic factors to many socialization factors; see Levinson, 2006) and a variety of developmental pathways with respect to how it unfolds, given this chapter’s focus, we discuss the development of depression as it relates to academic achievement. We start with the role of externalizing and internalizing factors in relation to academic performance. Previous studies have linked externalizing behavior (e.g., aggression) and internalizing behavior (e.g., anxiety and depression) in childhood with depression in adolescence (Weeks et al., 2016). Some research suggests that externalizing behavior leads to lower academic performance, which then leads to greater internalizing (e.g., Patterson & Capaldi, 1990). For example, Masten et al. (2005) found support for a developmental cascading model wherein externalizing behavior at Time 1 leads to lower academic performance at Time 2, which leads to greater internalizing behavior at Time 3. Conversely, others suggest that the relationship may go the other way, with early internalizing leading to problems with academic competence (Grover, Ginsburg, & Ialongo, 2007) and to externalizing behavior (Englund & Siebenbruner, 2012). Still other research has found that poor

academic performance may cause students to be placed in classrooms with students who have more behavioral problems, which could then increase their own externalizing behavior (Moilanen, Shaw, & Maxwell, 2010). In summary, internalizing behavior, externalizing behavior, and academic performance in childhood are all related to each other (although the exact nature and direction of those relationships are unclear) and to depression in adolescence.

Depression is approximately two times more likely to develop in adolescent girls as it is in adolescent boys (Thapar et al., 2012). Some researchers state that the hormonal changes occurring at puberty can be a major cause of the postpubescent onset of depression (Thapar et al., 2012); however, hormonal changes alone do not produce the behavioral characteristics of depression. Rather, they are thought to sensitize the brain to stressors common during this stage of development (Thapar et al., 2012). Depression is likely to recur into adulthood (Birmaher et al., 1996), with adolescent depression associated with alcohol abuse, migraines, smoking, high stress, and low social support in adulthood (Naicker, Galambos, Zeng, Senthilselvan, & Colman, 2013).

Anxiety

There are various types of anxiety, including generalized anxiety disorder (GAD), separation anxiety disorder (SAD), social phobia (SP), and panic disorder. GAD—one of the most common types and the focus of much research cited in this chapter—is diagnosed in children and adolescents by excessive anxiety and worry, difficulty controlling worry, and one (or more) of the following symptoms: (1) restlessness, (2) fatigue, (3) difficulty concentrating, (4) irritability, (5) muscle tension, and (6) sleep disturbances (APA, 2013). Anxiety is more prevalent than depression in childhood and has an earlier age of onset (Cummings, Caporino, & Kendall, 2014). Some of the cognitive features of anxiety include worry, rumination, self-consciousness, and apprehension (Collie, Martin, Nassar, & Roberts, 2018; for related discussion, see Martin, Chapter 16, this volume).

Many researchers have made the distinction between trait anxiety, generally considered a personality characteristic, and state anxiety, an experience of tension or apprehension triggered by a particular moment or experience (Spielberger, Gonzalez-Reigosa, Urrutia, Natalicio, & Natalicio, 2017). Although this distinction is not commonly made in educational research, researchers studying anxiety about school usually measure state anxiety, anxiety that is triggered by a particular class, subject, or task (e.g., Awan, Azher, Anware, & Naz, 2010).

Anxiety and depression are both theoretically and empirically distinct emotional disorders; however, they have a very high rate of comorbidity (Cummings et al., 2014; Seligman & Ollendick, 1998). Youth with depression exhibit comorbid anxiety ranging from 15% to 75%, and youth with anxiety exhibit comorbid depression at a rate ranging from 10% to 15% (Cummings et al., 2014; the reasons for the high rates of comorbidity are beyond the scope of this chapter; see Seligman & Ollendick, 1998; Grills, Seligman, & Ollendick, 2014, for a review of the literature). Anxiety and depression are frequently studied together because of the high rates of comorbidity. However, as we discuss later, they have varied and distinct outcomes for motivation and achievement.

IDEA Criteria for Emotional Disturbance

Depression and anxiety both fall under the category of emotional disturbance (ED) according to the IDEA (U.S. Department of Education, 2004). ED is characterized by five criteria: (1) “inability to learn,” (2) “inability to build or maintain satisfactory relationships with teachers or peers,” (3) “inappropriate types of behavior or feelings,” (4) “pervasive mood of unhappiness [depression],” and (5) “tendency to develop physical symptoms or fears [anxiety]” (Forness & Kavale, 2000, p. 264). The last two criteria can best be described as depression and anxiety and may be the source or cause of the first three criteria. The key distinction for a child qualifying for special education under IDEA with an ED designation is that their emotional symptoms cause an inability to learn. Children with ED often have lower academic achievement than their non-ED counterparts (Rodriguez & Routh, 1989) and experience greater depression and anxiety than their non-ED peers (Cullinan & Sabornie, 2004; Newcomer, Barenbaum, & Pearson, 1995).

According to parent reports in one study, children who will later be classified with ED generally start exhibiting difficulties around 4.6 years old, about the same age as students with other disabilities (Wagner, Kutash, Duchnowski, Epstein, & Sumi, 2005). However, students with ED first receive special education services a statistically significant 1.1 years later than students with other disabilities (Wagner et al., 2005).

Gender Differences in Depression and Anxiety

In general, more boys are classified with ED than are girls. Wagner et al. (2005) found that more than 75% of students classified as ED are boys, which is significantly more than students with other disabilities and the general population. However, although males are more likely to exhibit internalizing behavior problems before adolescence than they do after adolescence, females are more likely to exhibit them after puberty (Kaess et al., 2011). Bean (2012) found that females exhibited more internalizing behaviors (anxiety and depression) than males.

As mentioned above, beginning in childhood, girls generally report more depression than do boys. For example, Siegel, Yancey, Aneshensel, and Schuler (1999) found that adolescent girls reported being more depressed than boys. However, after controlling for body image, these differences disappeared, suggesting that girls’ depression is closely tied to their body image. Other researchers have not replicated these findings. Al-Qaisy (2011) found, in a sample of 200 college-age males and females, that males experienced more depression and females experience more anxiety. Similarly, Cheung (1995) found that the boys in his sample experienced more depression than the girls. And other researchers have found no gender differences in early adolescents’ depression (Fröjd et al., 2008). These researchers did, however, find that a higher GPA was a protective factor against depression for boys, but not for girls. Although the authors do not offer explanations for the differing findings in gender differences in depression, one possible source of the differences could be culture. The Siegel et al. (1999) sample was from the US, Cheung (1995) studied students in Hong Kong, and Fröjd et al. (2008) studied students in Finland.

Racial and Ethnic Differences in Depression and Anxiety

Many studies have found significant differences in depression, anxiety, and ED in different racial and ethnic groups (for related discussion, see Macfarlane, Macfarlane, & Mataiti, Chapter 25, this volume). In Siegel et al.'s (1999) study mentioned above, the authors found that Hispanic adolescents reported being more depressed than the white, African-American, and Asian-American adolescents included in the study. Nevertheless, African-American students comprise a significantly larger proportion of students diagnosed/identified with a variety of EDs (approximately 25%) compared with the general population (Wagner et al., 2005). Skiba, Poloni-Staudinger, Gallini, Simmons, and Feggins-Azziz (2006) found that African-American children were more than two times more likely than other students to be classified as ED. This is still the case today. The U.S. Department of Education (2017) reported that, in 2015, African-American children were two times more likely to be classified as ED than other racial and ethnic groups with disabilities.

There is much discussion about the reasons for the overrepresentation of African-American students in the ED classification. Some (e.g., Skiba et al., 2008) suggest that it is due to a cultural mismatch between the white majority teachers and the African-American minority students; however, Bean's (2012) study suggests the opposite. She compared children's self-report of internalizing behaviors (such as anxiety and depression) with teachers' and mothers' reports in a sample of 126 African-American children, their parents, and teachers. She found significant differences between children's and mothers' reports and between children's and teachers' reports, but not between mothers' and teachers' reports, with children rating themselves higher than their mothers and teachers. The fact that mothers' and teachers' reports of children's internalizing behaviors were similar (and lower than children's reports) indicates that African-American children might in fact exhibit internalizing behavior more than non-African-American children and teachers are not being biased in their reporting as has been commonly thought.

Definitional Problems

When reviewing the research literature, there are challenges in synthesizing findings owing to a lack of uniformity in the definitions of anxiety and depression and how they are measured and operationalized across studies. Some researchers (largely from clinical psychology) use the DSM clinical definitions of anxiety and depression (see above). They use clinical diagnostic measures and differentiate between the various types of anxiety and depression (e.g., GAD, SAD, SP, MDD, etc.). Many researchers studying anxiety in school use nondiagnostic screening measures of anxiety, such as the Beck Anxiety Inventory (e.g., Heberle, Krill, Briggs-Gowan, & Carter, 2015), which are often subject-specific (e.g., foreign language: Awan et al., 2010) or task-specific (e.g., test anxiety: Lowe et al., 2007). As we mentioned above, most researchers do not specify if they are measuring state or trait anxiety; however, when examining the measures, it becomes clear that the authors using clinical and nonclinical measures are attempting to measure trait anxiety, whereas those using task or subject-specific measures are aiming to measure state anxiety. Finally, a relatively small body of literature uses the IDEA criteria, classifying students with anxiety and depression as having an emotional disturbance (ED; Wagner et al., 2005).

Overall, the literature on DSM-based clinical diagnoses of depression and anxiety in children and adolescents is entirely separate from the literature on school-based special needs under IDEA. Although there is some overlap in their diagnostic criteria, it is important to note that researchers examining links of anxiety and depression to motivation and achievement have generally relied on only one of these sets of criteria. It is also crucial to note that students who qualify as having an ED under IDEA may not have a clinical diagnosis for anxiety or depression, and students with a clinical diagnosis may not qualify for special education under IDEA. (Underdiagnosis of students with ED is a pressing concern among special education researchers and teachers [Forness & Kavale, 2000].) Similarly, students who score high on a researcher-developed measure of depression or anxiety, particularly subject-specific or test anxiety, may not be clinically anxious or depressed and might not qualify as ED. These inconsistencies in definitions and operationalization of the constructs have led to confusion in determining how to effectively help children with anxiety and depression. Many researchers use their own measures of anxiety and depression that are neither clinical diagnoses nor necessarily IDEA-qualifying. To determine fully how motivation theories in general and EVT in particular can be applied to research on children with special emotional needs, researchers should be consistent with their definition and operationalization of these terms. The following sections will include examples of studies using different definitions of anxiety and depression. When possible, we will point out the distinctions in definitions and measures.

Relations of Depression and Anxiety to Motivation and Achievement

Depression is almost always associated with negative school, social, and physiological outcomes. Researchers have found that anxiety can sometimes be adaptive if it is not too high and sometimes can become maladaptive (for related discussion, see Pekrun & Loderer, Chapter 18, this volume). Most of these studies use researcher-developed measures of depression and anxiety, which do not necessarily provide clinical diagnoses or IDEA criteria for ED.

School-Related Outcomes among Students with Depression

Many researchers have found that depression has negative consequences for children's and adolescents' academic achievement, socialization, and school retention (e.g., Al-Qaisy, 2011; Quiroga, Janosz, Lyons, & Morin, 2012; Yousefi, Talib, Mansor, Juhari, & Redzuan, 2010); however, the direction of and mechanisms behind these relationships remains unclear. For example, Fröjd et al. (2008) studied relations of students' depression (measured by the Beck Depression Inventory), self-reported GPA, self-perceptions of their concentration, social relationships, school performance, and reading and writing abilities, in a large sample of seventh- through ninth-grade students. They found that students who were more depressed had lower GPAs, more difficulty concentrating, more problems with peers and teachers, and more difficulty in reading and writing. Zychinski and Polo (2012) also found that depression (as measured by the Children's Depression Inventory) negatively predicted fifth- through seventh-grade students' academic achievement (as measured by standardized test scores and GPA). In a second set of analyses (using hierarchical regression), the authors found

that academic self-efficacy and a performance-avoidance goal orientation mediated the relationship between depression and academic achievement, thus adding clarity to the direction and nature of the relationship between achievement and depression (for related discussion, see Bergin & Prewett, Chapter 14, this volume). In addition, Verboom, Sijtsma, Verhulst, Penninx, and Ormel (2014) conducted a longitudinal study of 2,230 children, aged 10–18 years. They also found a negative relationship between achievement and depression and found that the relationship is bidirectional (i.e., they each predict each other); however, this was true only for girls.

Quiroga et al. (2012) examined the relationship between early adolescent depression, grade retention, and school dropout in seventh-grade students. They measured students' depression at three time points during seventh grade using the Inventory to Diagnose Depression. They also obtained data on the students' prior grade retention. They then followed this group for 6 years (1 year past their expected graduation date) to determine how many graduated and how many dropped out. They found that depression in seventh grade rendered students almost three times as likely to drop out of school before they completed high school. The combined effect of depression and grade retention rendered students more than seven times more likely to drop out of school compared with students only with grade retention.

Other researchers also have shown that students with mental health problems attain lower levels of education (Best, Hauser, Gralinski-Bakker, Allen, & Crowell, 2004; Kessler, Foster, Saunders, & Stang, 1995; Vander Stoep et al., 2000). Vander Stoep, Weiss, Kuo, Cheney, and Cohen (2003) analyzed data from the longitudinal Children in Community Study in order to determine what percentage of secondary school drop-outs were attributable to psychiatric disorders. The authors found that 46% of students who fail to complete secondary school do so because of psychiatric disorders, such as depression.

School-Related Outcomes among Students with Anxiety

Researchers studying the relationship between anxiety and academic achievement have found mixed results (Alpert & Haber, 1960; Collie et al., 2018). Some researchers have found that anxiety is positively related to achievement (e.g., DiLalla, Marcus, & Wright-Phillips, 2004; Elmelid et al., 2015); others have found that it is negatively related with achievement (e.g., Awan et al., 2010); and others still have found no relationship (e.g., Collie et al., 2018; DiPerna, Lei, & Reid, 2007).

Research on how test anxiety, generally regarded as a type of state-anxiety, relates to achievement has produced clearer results (Zeidner, 1998). Test anxiety is “a situation-specific disposition to perceive performance-related evaluations as threatening and thus to respond with heightened state anxiety” (Schnell, Ringeisen, Raufelder, & Rohrmann, 2015, p. 91). It is one of the most common stressors for adolescents around the world (Sung, Chao, & Tseng, 2016). Test anxiety is characterized by cognitive (e.g., worry), physiological/emotional (e.g., increased heart rate), and behavioral manifestations (e.g., social withdrawal; Lowe et al., 2007; Roick & Ringeisen, 2017). The worry aspect of test anxiety relates more strongly to performance than does the emotional aspect (Goetz, Preckel, Zeidner, & Schleyer, 2008). Wine (1980) and others (e.g., Sung et al., 2016) propose that worry interferes with students' ability to focus on the test they are taking.

Although test anxiety has generally been associated with poor academic performance, Sung et al. (2016) found differential relationships between anxiety and achievement in low-, moderate-, and high-achieving groups. Students with low and high academic achievement reported the lowest test anxiety, and the students with moderate achievement reported the highest test anxiety. Moreover, they found that the relationship of anxiety to achievement was positive in lower-achieving students and negative in higher-achieving students.

Most researchers have found higher test anxiety in females than in males (Cassady & Johnson, 2002; Sung et al., 2016). However, these studies also found that females perform the same or better than males, indicating that the higher levels of anxiety are not interfering with their cognitive processing but may actually be motivational (Cassady & Johnson, 2002; Chapell et al., 2005; Sung et al., 2016).

Returning to anxiety more generally, researchers have found that it can have adverse social and emotional consequences among students as well. Anxiety has been associated with loneliness, withdrawal, and peer alienation (Coplan, Closson, & Arbeau, 2007; Duchesne, Larose, Vitaro, & Tremblay, 2010; Duchesne, Vitaro, Larose, & Tremblay, 2008). Students with anxiety often struggle with regulating their thoughts, and, thus, their anxious worries and ruminations stay in the forefront of their minds. This becomes problematic in social situations, particularly among students with social anxiety disorder whose worries about their social interactions can be paralyzing and result in antisocial behavior or, more commonly, social withdrawal.

Socioemotional Variables, ED, and Achievement

Although relatively little research has been done specifically on relations of motivation and achievement in students with an ED classification, one study used data from the Special Education Elementary Longitudinal Study and the National Longitudinal Transition Study in order to determine “the complex array of factors that help explain the academic and social obstacles children and youth with ED encounter at school” (Wagner et al., 2005, p. 79). They found that parents of ED children reported that their children had lower social skills than did parents of children with other disabilities, including low self-control and low cooperation. It is important to note that students with ED do not typically have problems with cognitive functioning; even so, their academic performance is significantly lower than that of students in the general population. Wagner et al. (2005) found that 61.2% of children with ED scored in the bottom quartile for reading, compared with 25% for the general population. Their math scores were slightly better but still significantly lower than the scores in the general population. We discuss below some work looking at how children who have low expectations for success in a subject but still value it highly may be more at risk for depression.

Depression, Anxiety, and Motivation

There are relatively few studies of relations among depression, anxiety, and motivation. Cheung (1995) studied these relations in a large sample of fifth- through eighth-grade

students; the motivation-related belief he assessed was students' expectations for what grades they would get. He corroborated other findings that negative life events such as divorce or death or illness of a parent predict depression. However, he also found that the interaction of life events and achievement expectation predicted depression, suggesting that achievement expectation is an important moderator in the relationship between life events and depression. More specifically, students with high achievement expectations were less likely to be depressed, suggesting that positive expectations are a protective factor.

Cole et al. (1999) measured third- and sixth-graders' over- and underestimation of their academic competence, depression, and anxiety, as well as their teachers' estimations of their academic competence, every 6 months for 3 years. They found that boys were more likely to overestimate their academic abilities, whereas girls were more likely to underestimate them. For both boys and girls, depression and anxiety were negatively associated with academic overestimation. Moreover, the gender differences in over- and underestimation were eliminated after controlling for students' anxiety and depression. These findings suggest that girls' underestimation of their academic abilities is related to both.

Recently, Parhiala et al. (2018) studied the relations of school motivation and emotional well-being (part of which was a subscale measuring internalizing behaviors associated with depression and anxiety). They used latent profile analysis to examine these relations and found five profiles. Children in profiles with low emotional well-being had poor academic performance, but *only* when accompanied by low school motivation.

Depression, Anxiety, and SEVT

As discussed in greater detail below, there are clear theoretical connections between depression, anxiety, emotional disturbance, and key constructs included in SEVT. For example, Eccles and colleagues (e.g., Eccles-Parsons et al., 1983; Wigfield et al., 2016) proposed that goals are central influences on individuals' expectancies for success and subjective task values (for related discussion, see Bergin & Prewett, Chapter 14, this volume). Many researchers have found that, if an individual highly values a goal (e.g., becoming a doctor), but is unable to attain it, they are more likely to experience depression than those who attain that goal (e.g., see Street, 2002). Similarly, if an individual views an unattainable goal as central to their identity, they will likely suffer from low attainment value. Failing to obtain the goal also would negatively impact individuals' expectancies for success, even as they continue to have high utility or attainment value for the goal. They may also have high intrinsic value, but we feel that high intrinsic value and low expectancy would not necessarily result in anxiety or depression. On the other hand, individuals may have low expectancies for success *and* low utility, attainment, or intrinsic value. This combination of motivational factors is unlikely to be a cause of depression, but could be a symptom of it. SEVT researchers include "affective memories" as an important predictor of individuals' ability beliefs, goals, and value; they focus on anxiety when discussing these affective reactions.

IMPACT OF PARENT SOCIALIZATION PRACTICES AND BELIEFS ON CHILDREN'S EXPECTANCIES, VALUES, ANXIETY, AND DEPRESSION

As discussed earlier, in SEVT Eccles and colleagues proposed that parents' beliefs about and behavior with their children have strong influences on their developing motivational beliefs and values, and many other developmental outcomes (see Eccles, 1993; Eccles, Wigfield, & Schiefele, 1998, for full discussion of the parent socialization aspect of the model). They and others have examined how parents' beliefs about their children and ways in which they interact with them impact children's developing expectancies and values, and (in a few studies) their anxiety and depression (see Eccles, 2006; Grolnick, Friendly, & Bellas, 2009; Pahl, Barrett, & Gullo, 2012; Pomerantz & Grolnick, 2017; Simpkins, 2015; Wigfield et al., 2015 for reviews). Owing to space limitations we focus here primarily on particular parent socialization beliefs and practices discussed by Eccles and colleagues in SEVT, but also mention some other parenting practices that have received much attention in the literature, especially autonomy support as discussed by self-determination theorists (Deci & Ryan, 1985; Ryan & Deci, 2016).

Eccles-Parsons et al. (1983; see also Eccles, 1993, 2006; Wigfield et al., 2015) propose that children's expectancies, values, ability beliefs, and goals are directly predicted by their parents' beliefs about their abilities and values, as well as indirectly related through children's perceptions of parents' beliefs. Importantly, both Parsons, Adler, and Kaczala (1982) and Jodl, Michael, Malanchuk, Eccles, and Sameroff (2001) found that the relations of parents' beliefs about their children's abilities to children's own ability beliefs and expectancies remained significant when children's achievement was taken into account. Thus, when parents believe their children are competent in a subject area, children are more likely to believe they are as well. Of course, this also means that, when parents think their children lack ability in a certain subject area, children's own ability beliefs will be lower. Indeed, parents' doubts about their children's ability, as well as certain behaviors toward them, likely relate to children's later experiences of depression and anxiety. We return to this point below.

Along with their beliefs, different parental behaviors with their children can either positively or negatively impact children's developing expectancies, values, anxiety, and depression, depending on their type or quality. We discuss some of these next.

Quality or Type of Parental Involvement

Grolnick et al. (2009) and Wigfield et al. (2015) discussed that the quality of parental involvement varies across different dimensions. A complete review of the research on these dimensions of involvement is beyond the scope of this chapter; we focus here on two frequently studied ones—control versus autonomy support and positive or negative affective reactions (including criticism)—that can impact children's developing expectancies and values and, potentially, their depression and anxiety.

Parental Autonomy Support versus Control

Parents' provision of autonomy support, as distinct from being controlling, is a key aspect of Deci and Ryan's (Deci & Ryan, 1985; Ryan & Deci, 2016) self-determination

theory (for related discussion, see, in this volume, Strnadová, Chapter 4; Wehmeyer & Shogren, Chapter 12); Eccles and colleagues also include it in the socialization part of SEVT. When parents provide autonomy support or support their children's own attempts at doing their homework, other school activities, and activities outside of school, children can develop a sense of personal control over their activities. Furthermore, when these children are successful in these activities, they develop positive expectancies for school and come to value school (see Pomerantz & Grolnick, 2017; Ryan & Deci, 2016, for detailed discussion and review of work showing how parents' autonomy support relates positively to their children's motivation and achievement). On the other hand, excessive parental control gives children the message that they are not capable of doing the work on their own, and also can create both dependencies and resentment in children, perhaps leading them to devalue the activities their parents are trying so hard to get them to do. One form of excessive parental control is over-involvement in their children's activities (including their schoolwork). Such over-involvement has been shown to contribute to the development of children's anxiety (Creswell, Murray, Stacey, & Cooper, 2011; Murray, Creswell, & Cooper, 2009; Wei & Kendall, 2014), which, as discussed earlier, relates negatively to children's ability beliefs, expectancies for success, and task values (see also Meece et al., 1990).

Research has shown that parents' autonomy support, along with being nurturing and receptive to their children, are behaviors that can protect children from developing anxiety or depression (Bayer, Sanson, & Hemphill, 2006). For instance, Majdandžić, Möller, de Vente, Bögels, and van Den Boom (2014) and Majdandžić et al. (2018) studied challenging parenting behavior (CPB), an autonomy-supportive parenting practice that involves lovingly encouraging children to push beyond their perceived limits. They, as well as Lazarus et al. (2016), found that, overall, CPB predicted fewer anxiety symptoms and anxiety disorders in preschool-aged children; however, there were differences by parent. Majdandžić et al. (2014) found that fathers' CPB predicted less social anxiety in 4-year-olds, whereas mothers' CPB predicted greater social anxiety. The authors suggested that mothers' use of CPB may be perceived as antithetical to a mother's caring, nurturing role and is thus confusing to the child, resulting in higher levels of social anxiety. Majdandžić et al. (2018) found a negative association between both mothers' and fathers' use of CPB and children's anxiety. Similarly, Lazarus et al. (2016) found that both parents' use of CPB decreased anxiety in their children; however, only mothers' use of CPB predicted both anxiety symptoms and clinical diagnosis; fathers' use of CPB was predictive of symptoms only. The authors explain these differences by suggesting that fathers' use of CPB alone is not a strong enough predictor of diagnosable anxiety. Furthermore, they explain that theirs is the first study to use a clinical diagnosis of anxiety in relationship to CPB, whereas previous studies have used observational and parent reports (Lazarus et al., 2016).

Relatively less "familial control" can also be a protective factor against the development of depression and anxiety. Chorpita, Brown, and Barlow (2016) studied how mothers' and fathers' familial control strategies (measured as the extent to which parents exert much control—or the extent to which they support their children's autonomy) related to their school-aged (6–15-year-old) children's locus of control, negative affect (child's self-reported feelings of depression and anxiety), and clinical symptoms of them. They found that children's feelings of greater control (less familial control and greater internal locus of control) predicted less negative affect and fewer clinical symptoms of depression and anxiety. As discussed above, early socialization

influences (such as family) impact the development of children's expectancies and values. When parents help their children develop a sense of autonomy and an internal locus of control, then children have a stronger sense that they are responsible for their outcomes, thus reinforcing stronger expectations of success.

Parental Affect and Criticism

In SEVT, Eccles and colleagues (e.g., Eccles, 2006; Eccles-Parsons et al., 1983; Wigfield et al., 2016) propose that the impact of parents' beliefs, affect, and behavior toward their children are filtered through children's perceptions of them, which in turn impacts children's developing competence beliefs and values, affect, and subjective task values. In a study that provides support for these proposed links, Pomerantz, Wang, and Ng (2005) showed that mothers' negative affect expressed when working with their 8–12-year-old children on homework negatively impacted their children's motivation and emotional functioning 6 months later. Interviews with the mothers showed that they reported much more positive than negative affect. However, they expressed more negative affect on days that their children seemed to need more help with homework and stated that their children seemed more "helpless" on those days; in this context, being helpless meant that children did not appear to think they could do their homework on their own. Taking this to a broader level, Harter (1990) reported that children's self-esteem (or self-worth, in her terms) correlates moderately strongly with their perceptions that parents and peers hold them in high regard. Importantly, she distinguished level of perceived support from its conditionality. Her research indicates that adolescents who believe their parents' love and support is conditional on their performance in school or in other endeavors are more likely to engage in suicidal ideation, something that should be of great concern and is a diagnostic characteristic of depression.

Turning to how parental affect relates to the development of children's depression and anxiety, Hudson, Dodd, Lyneham, and Bovopoulos (2011) conducted a longitudinal study looking at relations of parenting practices of mothers to the development of anxiety in their children; the study began when participating children were 4 years old. Mothers provided information on their children's anxiety, and the authors used the DSM-IV anxiety disorders interview to assess mothers' anxiety. They also included observational measures of children's behavioral inhibition (a potential risk factor for later anxiety), maternal involvement, and maternal negativity toward the child. Hudson et al. found that children's behavioral inhibition, children's anxiety, maternal anxiety, and maternal over-involvement measured when children were age 4 predicted children's anxiety at age 6, specifically social phobia and GAD; however, after controlling for baseline anxiety, only maternal anxiety predicted child anxiety at age 6.

With respect to parental criticism, we noted earlier that, although most young children begin school optimistic about their abilities and value learning, some preschool children already have more negative reactions when they do tasks poorly and receive criticism about their performance. In a study mentioned earlier, Heyman et al. (1992) used a hypothetical scenario to study preschool children's reactions to receiving criticism from their teacher for a drawing they had made that contained a mistake (e.g., one of the children in the picture had no feet). In the scenario, teachers told the children

they were disappointed in them for turning in a drawing with this mistake. Heyman et al. found that some children downgraded their ratings of the quality of their picture, had difficulty saying how they might improve it, expressed negative affect, believed they were not good at drawing, and—most troubling—stated they were bad people as a result of their performance. Further, about half of the children who downgraded their evaluations of their drawings thought their parents would criticize them when they found out about their teachers' evaluations. In discussing their findings, Heyman et al. suggested that early criticism from parents and (later) teachers likely is a strong influence on children's reactions to early challenges and failures, potentially starting children on a path toward later learned helplessness. To date, few studies have addressed this directly; however, Heyman et al.'s results can be interpreted as providing support for the links in the EVT model between parents' behaviors toward their children, children's perceptions of their parents' behaviors, and children's own beliefs and values.

Parents' Depression and Anxiety and Their Children's Depression and Anxiety

Researchers have shown that parents' own depression and anxiety impact their children's anxiety and depression through multiple pathways (see Downey & Coyne, 1990, and Beilock, Schaeffer, & Rozek, 2017, for reviews). Although depression and anxiety are moderately heritable and may be genetically passed from parents to children (Levinson, 2006), other socialization factors play a prominent role as well, particularly in trait-level anxiety in academic areas. Maloney, Ramirez, Gunderson, Levine, and Beilock (2015) studied how parents who themselves were math anxious affected their first- and second-graders' math achievement and math performance. Interestingly, math anxious parents impacted both child outcomes, but only when they worked frequently with their children on their math homework. Maloney et al. speculated that their results were due to math anxious parents expressing negative attitudes toward math while working with their children, being rigid in the kinds of math problem-solving strategies they suggested, and/or getting frustrated with their children. The authors noted that it is not just frequency of parent involvement (as is often emphasized by teachers and others in the school setting), but the affective and cognitive quality of the involvement.

Various stressors in parents' lives can impact the development of their children's depression and anxiety. Pahl et al. (2012) measured mothers' and fathers' depression, anxiety, and parenting stress as well as their 4–6-year-old children's anxiety and behavioral inhibition. The parenting stress measure included stressors such as death of a loved one, spousal conflict, challenges with their child, and low socioeconomic status, among others. The authors combined parents' anxiety and depression to form a negative affect variable for each parent. They found that the strongest predictors of child anxiety were mothers' parenting stress and the child's behavioral inhibition. Mothers' and fathers' negative affect indirectly predicted child anxiety through behavioral inhibition. Again, as posited in the EVT model, children's interpretations and understandings of their parents' beliefs and behaviors are what impact their motivational beliefs and values, and (for some children) the children's depression and anxiety.

Influences of Family Poverty and Neighborhood Safety

In SEVT, Eccles and her colleagues include environmental factors such as neighborhood safety and poverty (often encountered together) as important influences on children's beliefs, values, choices, and achievement (Eccles, 1993; Eccles-Parsons et al., 1983; Wigfield et al., 2015). These characteristics also predict the development of children's depression and anxiety. Najman et al. (2010) studied the relations, over time, of family poverty levels to the development of anxiety and depression in a large sample of Australian children. Family poverty level was measured five times, beginning when participating mothers were pregnant, and child anxiety and depression scores were obtained when they were 14 and 21 years old. Results indicated that experiencing poverty at age 14 was the strongest predictor of later anxiety and depression. Similarly, Bean (2012) found that neighborhood safety was negatively correlated with the number of hours children with ED spend in special education (as opposed to the regular classroom).

In SEVT, parents' socializing practices, of course, are not the only ones children experience; their experiences in school impact their expectancies, values, anxiety, and depression. We turn to that topic next.

EXPERIENCES IN SCHOOL AND CHILDREN'S DEVELOPING EXPECTANCIES, VALUES, ANXIETY, AND DEPRESSION

Our discussion of schooling's impact on students' developing expectancies and values has to be constrained owing to space limitations; see Roeser, Urda, and Stephens (2009) for extended discussion of schooling's impact on students' motivation and achievement. We focus here on how teacher-student relations, teacher expectancies for their students, the kinds of evaluations children receive in school, and ability grouping practices can influence children's developing expectancies and values, and (potentially) anxiety and depression.

Teacher-Student Relations

The research on teacher-student relations shows clearly that, when teachers support students emotionally and instrumentally, students have higher expectations for success and clearer positive social and academic goals, value school more, and are more willing to engage in school activities (see Wentzel, 2016 for review; for related discussion, see, in this volume, Gillies, Chapter 22; Wehmeyer & Shogren, Chapter 12). These relations emerge even when children's relations with peers and parents are taken into account. Teachers' relations with students are crucial to students' early adjustment in school (Birch & Ladd, 1996), and the importance of such relations continues into middle school, and beyond. In one highly cited study, Goodenow (1993) reported that middle school students' perceptions of support from teachers and their sense of belongingness in their classrooms related strongly to their perceived valuing of the schoolwork in which they were engaged. Such relationships may be particularly important for children who do not have positive relations with their parents (Wentzel, 2009, 2016).

A number of researchers have shown that depressed and anxious students' perceptions that they receive teacher support and/or that their teachers create a positive classroom "climate" can foster their emotional adjustment in school. For instance, Murray and Greenberg (2006), in a study of sixth-graders with ED, found that, when the students felt that their relations with teachers were positive, they were less anxious. Kuperminic, Leadbeater, and Blatt (2001) found that sixth- and seventh-grade students' perceptions that their classroom environments were positive moderated the effects of self-criticism on later internalizing problems. Finally, LaRusso, Romer, and Selman (2008) found, in a nationally representative sample of high school students, that when teachers create classroom climates that students perceive as respectful, students are less likely to become depressed.

One aspect of teacher–student relations that has been considered from the perspective of EVT is teachers' expectations for students' success in school (Eccles & Wigfield, 1995; see Jussim, Robustelli, & Cain, 2009, for a full review of the teacher expectancy literature). Jussim et al.'s review shows that teachers' expectations are, for the most part, accurate in the sense of how strongly they relate to students' achievement. However, they also discuss how these expectations can act as self-fulfilling prophecies: When teachers expect students to do well, they can end up doing better, and, when they expect students to do poorly, they indeed can do so. Further, Weinstein and her colleagues (e.g., Weinstein, Marshall, Sharp, & Botkin, 1987) have shown that even first-grade children are aware of teachers' expectancies for different students, and how teachers differentially treat members of the class based on their high and low expectancies for students. As with the work on parental influences on children's developing expectancies and values, and perhaps depression and anxiety, the impact of teacher expectancies on children occurs through their perceptions of these expectations, as was proposed in the EVT model.

Evaluation and Grouping in School

Teacher expectancies also affect their recommendations for which ability group children get placed in for different subjects. Once they enter school, children begin to receive evaluative information of different types and engage in social comparison with peers; both evaluation and social comparison can strongly influence the development of their competence beliefs (for related discussion, see Tracey et al., Chapter 24, this volume)—and, potentially, depression and anxiety. Schools are organized in an age-stratified structure, where children spend most of their time with same-age peers. This gives children ample opportunities to compare themselves with these peers on a variety of things, such as how they are doing in different subjects, how they are doing socially, and so on. Social comparison is a prime source of information about one's ability (Ruble, 1983), and, when children begin to understand that they are doing less well than others, their ability beliefs and expectancies can decrease markedly (Wigfield et al., 2015). These decreases may set the stage for the development of both depression and anxiety (Zeidner & Schleyer, 1998).

After children enter elementary school, they begin to experience much more evaluation than they did either at home or in preschool; this information includes grades, teacher comments, tests, and other kinds of evaluation. These evaluations increase in

frequency as children move through school. Children's grades and teachers' praise and criticism of them have a strong impact on their developing expectancies and values (e.g., Eccles, 2006; Parsons et al., 1982), as well as their general self-esteem and overall adjustment (Harter, 1990).

Children's grades, test scores, and other evaluations have increasingly important consequences for them, both for their current schooling experiences and opportunities (e.g., whether they are placed in honors courses, regular-level courses, or remedial courses; the kinds of recognition they get, such as the honor roll) and also for their longer-term futures (Eccles, 2006; Wigfield et al., 2015). Adolescents' grades and test scores, of course, are major determinants of whether or not they get into college, as well as the type of college to which they are accepted. Children doing poorly in school will begin to doubt their competence for different academic activities and, particularly for those who continue to value school, are increasingly at risk for developing anxiety or depression (Harter, 1990). Some students doing poorly begin to disidentify from school as a way to maintain their self-esteem (Osborne, 1997; for related discussion, see Martin, Chapter 16, this volume). Although this strategy may protect their self-esteem in the short term, given the importance of school success, credentials from school, and other markers of school achievement for future educational and occupational opportunities, disidentification with school ultimately can have many negative consequences for children and adolescents.

Teachers' evaluations have another important consequence for students: assignment to ability groups within or between classrooms. In the US, ability grouping begins as early as kindergarten, usually with assignments to low, middle, and high groups in both reading and math within a given classroom. In middle and high school, between-class grouping, or tracking, becomes prevalent, where students take classes with other students at their same overall level of ability. Other countries use nationwide tracking systems. In Germany, students are separated into three different types of school, based on their performance in school and via testing at the end of fourth grade: *Gymnasium*, the academic track; *Realschule*, the technical track; and *Hauptschule*, the vocational track (Trautwein, Lüdtke, Marsh, Köller, & Baumert, 2006). Although there is increasing flexibility in aspects of the German system, it still is firmly in place in many areas. Singapore has a national tracking system in which students are grouped into three ability groups (high, middle, and low) within the same school (Liem, Marsh, Martin, McInerney, & Yeung, 2013).

The overall rationale for ability grouping is that students will learn better when grouped with others who perform at similar levels (Oakes, 1992; Slavin, 1990). In addition, advocates of ability grouping argue that lower-ability students may suffer when they are in class with high-ability students because they will not believe they can keep up with them (Tieso, 2003). High-ability students may feel held back by having to wait on the lower-ability students. A complete review of the large literature on ability grouping is beyond the scope of this chapter; Oakes and Slavin did the major reviews of its effects on student achievement, self-esteem, and competence beliefs in the 1980s and 1990s. Both researchers concluded that ability grouping had some benefits for high-achieving children, but primarily deleterious effects on children assigned to the low groups, both with respect to their future achievement and psychological well-being. They thus argued strongly against continuing the use of ability grouping. Despite this evidence, many schools continue to use ability grouping. There is some

more recent evidence that flexible grouping practices can benefit students at different levels of ability (Tieso, 2003).

Extant studies on the long-term impact of ability grouping on students' outcomes reveal somewhat different results that depend in part on the age of the children included in the study. McCoach, O'Connell, and Levitt (2006) studied the impact of within-class grouping on growth in kindergarten children's reading comprehension and found that children in classes where such grouping was used achieved greater growth in comprehension over the course of the school year. Alexander, Dauber, and Entwisle (1993) found that differences in first-grade reading group placement and teacher–student interactions predicted students' subsequent motivation and achievement, even after controlling for initial differences in reading competence; thus, children placed in low-ability groups early often continued to do less well and may come to have lower motivation than children in the higher groups. Fuligni, Eccles, and Barber (1995) studied the long-term consequences of ability group placement in math in seventh grade. They found no positive and some negative consequences for students assigned to the low-ability classrooms, and some benefits for students in both the middle- and high-ability classrooms. An additional challenge for lower-ability students is that it is uncommon in many schools for students to be moved into a different ability group; the initial assignment thus can have cascading effects for students' experiences in the classes to which they are assigned, as well as limit their opportunities to take more advanced classes.

One of the most fascinating findings regarding how tracking/ability grouping impacts students' ability beliefs (and, by extension, their expectancies for success) is the big-fish-little-pond effect (BFLPE; Liem et al., 2013; Marsh, 1987; Marsh et al., 2008; for related discussion, see Tracey et al., Chapter 24, this volume). Marsh and his colleagues, and others, have found, in a wide variety of settings, that students performing equally well in higher- or lower-ability tracked groups or schools vary in their ability self-concepts: those in the higher tracks have *lower* self-concepts. In explaining these results, Marsh and his colleagues posit that academic self-concepts are determined by both individuals' own achievement and the average achievement of the school that they attend; they have shown that both together predict academic self-concept more than either alone.

Researchers have found support for the BFLPE in many different countries around the world, and, although there are variables that moderate the effect, the moderation effects are small (Marsh et al., 2008). Liem et al. (2013) built on existing work on the BFLPE by studying the Singaporean policy of creating three “streams” of students in a given school. They found support for the BFLPE in their study, but, interestingly, the effects of school stream were stronger than those of overall school achievement. Importantly, Marsh and O'Mara (2008) showed that the BFLPE lasted several years after high school graduation, such that the students in more selective schools and programs continued to have lower academic self-concepts than students achieving equally well but from less selective schools. In a study of Israeli students in gifted and talented programs, Zeidner and Schleyer (1998) found the BFLPE. They further showed that school program predicted students' test anxiety: Students in the gifted programs reported significantly more worry and emotionality than did students in mixed ability classes. These findings have intriguing implications with respect to the “cost” of attending highly selective schools or gifted and talented programs within a school.

To our knowledge, very little research has explicitly been conducted on the BFLPE in depressed and/or anxious students. As mentioned above, a small but significant body of research has focused on the BFLPE and test anxiety in both gifted and non-gifted student populations (e.g., Goetz et al., 2008; Zeidner & Schleyer, 1998). Less research has focused on the BFLPE and depression; however, various researchers have found a negative relationship between self-concept and depression (e.g., Berg & Klinger, 2009; Cole, 1990; Fathi-Ashtiani, Ejei, Khodapanahi, & Tarkhorani, 2007).

It is important to keep in mind that the BFLPE occurs for students performing equally well in the selective and “mixed” program or school. More broadly, if children in the lower ability tracks, either within a given school or across different schools, compare themselves with students in the higher tracks or schools, they likely begin to doubt their academic competencies. As these doubts grow, children’s self-esteem can decrease, as well as their overall well-being (see Marsh, Tracey, & Craven, 2006, for a study of the BFLPE in students with mild intellectual disabilities; for related discussion, see Tracey et al., Chapter 24, this volume). Further, having all the children or adolescents who struggle with learning in one track can lead to behavior problems and disengagement (Oakes, Gamoran, & Page, 1992). Considering that many students with emotional special needs are taken out of the regular classroom for all or part of the day and grouped with other students with special needs, these problems could be exacerbated. It is helpful to these students to have higher achieving role models in class with them.

Another critical concern about ability grouping is that certain groups of children are more likely to be placed in the lower groups than are others; these assignments may in part be due to teacher expectations for students who are members of these groups. For instance, teachers have lower expectancies for African-American children and children from lower SES backgrounds (Jussim et al., 2009); these students are disproportionately represented in lower-ability groups. This problem is magnified by the point made above that, once children are assigned to a certain group, they infrequently are reassigned to other groups; it is quite difficult to move up the ability grouping ladder. To our knowledge, there are no studies of whether anxious or depressed students are disproportionately assigned to lower-ability groups. Given that students with emotional and behavioral disorders struggle in school and achieve less well than other students, it seems possible that they would be more likely to be placed in lower groups.

What might the consequences of placement in different ability groups be in relation to depression and anxiety among children and adolescents? We conjecture that children placed in the high group but who are struggling to keep up with the pace of learning in that group may be at risk of becoming anxious, depressed, or both. A major reason for this is that students compare themselves more with classmates they perceive as more similar to themselves, which in this case means the other children in the high-ability group or groups. They may begin to doubt their competency as they observe others in their group mastering material more quickly and with seeming ease, with these doubts increasing across the school years. An important question for placement of these children (in schools where ability grouping still is used) is whether the benefits of being in the high group outweighs the potential effects of anxiety some of the children in this group may experience; children or adolescents who become anxious or depressed trying to keep up with others in the high group may be better off in the middle groups.

Children placed in the low-ability groups may not become anxious about that, but perhaps may be at greater risk for depression. This would be particularly true for

children and adolescents who think the reason they are in the lower group is because they lack intelligence, and their intelligence or abilities will not improve through increased effort. Over time, these children’s beliefs that they lack competence could put them at risk of depression (Masten et al., 2005). Or, these children may be the ones most likely to disidentify with school and, ultimately, drop out (see Osborne, 1997; Roderick & Camburn, 1999).

As discussed above, the quality of teacher–student relations can mitigate the risk of some of these effects (e.g., Kuperminic et al., 2001; LaRusso, Romer, & Selman, 2008). However, it can be challenging for teachers to develop and maintain positive, caring relations with middle and high school students because of the sheer number of students that teachers teach every day. Because students with ED present more challenges to teachers, in terms of both their personal characteristics and their struggles with achievement, it may be especially challenging for teachers to maintain positive relationships with these students. Of course, these are the students who often most need high-quality relations with teachers to help them cope with, or perhaps reduce, the effects of their emotional disturbances on their academic achievement and other characteristics.

IMPLICATIONS FOR EDUCATIONAL PRACTICE

There are many implications for educational practice based in the work reviewed in this chapter. In this section, we focus primarily on school-based interventions alleviating different-aged students’ anxiety and depression, including (where applicable) as relevant to factors and processes under SEVT. Although these interventions, by and large, have been successful, they are relatively few in number. This may be because, as Schoenfeld and Janney (2008) discussed concerning children’s anxiety, schools do not focus much on anxiety diagnoses or on programs to help anxious children, despite the evidence reviewed here and elsewhere that anxious children and adolescents achieve less well in school than they could if their anxiety were reduced. Rather, schools focus more on children with externalizing problems, perhaps because those problems are more easily observable and also because children having those problems are much more likely to disrupt classrooms. Schoenfeld and Janney’s points likely also apply to school-based interventions on reducing child and adolescent depression. We also should note that, although there have been a variety of interventions that have increased students’ expectancies for success and valuing of achievement (see Harackiewicz, Canning, Tibbetts, Priniski, & Hyde, 2016, and Rosenzweig & Wigfield, 2016, for review), none of these interventions have focused directly on reducing anxiety and depression. In addition, interventions designed to reduce anxiety and depression have not been based in SEVT and so have not focused directly on enhancing children and adolescents’ expectancies and values. As we will see, however, the cognitive-behavioral interventions focused on both anxiety and depression attempt to change children’s thinking about themselves and their potential achievement outcomes. Thus, from the perspective of SEVT, such interventions impact children’s interpretations of their experiences—in this case, achievement outcomes. Further, in the SEVT model, their interpretations directly influence their competence beliefs and goals and affective memories. These then impact children’s developing expectancies and values.

Depression Intervention Programs

Maag and Swearer (2005) discuss and review cognitive-behavioral interventions (CBIs) designed to reduce children's and adolescents' depression. As the name implies, CBIs focus both on depressed students' thinking and their behavior. Maag and Swearer begin by discussing how teachers and other school staff can play an important role in initial identification of students suffering (or possibly suffering) from depression. They also make the important point that, because depression is a serious mental health problem, diagnoses of depression should ultimately be done by trained clinicians, and any school-based intervention designed to reduce it must be delivered (or closely informed and monitored) by highly trained professionals. We next discuss two effective types of CBI program.

Attribution retraining programs are one type of program focused on modifying children's understanding of and thinking about why the outcomes they receive or obtain occur (see also Forsterling, 1985; Perry & Hamm, 2017; for related discussion, see Martin, Chapter 16, this volume). Attributions are individuals' explanations for various outcomes that occur in their lives, such as good or poor school performance, acceptance or rejection by peers, and so on. Weiner (1979, 1985) classified these attributions into different categories and discussed how some are adaptive in the sense of explaining outcomes positively, and others are maladaptive. Weiner (see also Dweck, 1975) proposed that the most maladaptive attribution for poor performance is that one lacks the ability to succeed; this is because Weiner classified ability as an internal, stable, and uncontrollable cause. When individuals attribute failure to lack of ability they will give up, try to withdraw from the situation, and otherwise disengage because they do not believe further effort will improve their outcomes. Eccles and her colleagues (Eccles, 2009; Eccles-Parsons et al., 1983; Wigfield et al., 2016) included attributions in their SEVT model, stating that the kinds of attribution one makes directly influence subsequent ability beliefs, and then expectancies for success, among other things.

Attribution retraining involves teaching individuals who believe their failure is due to lack of ability to attribute it to lack of effort and good strategy use instead, because both of these are modifiable things that the individual can control (for related discussion, see Pekrun & Loderer, Chapter 18, this volume). These programs have been successful in changing students' attributions, reducing depression, and also improving their performance (Forsterling, 1985; Perry & Hamm, 2017). Perry and Hamm provide a recent review of a variety of attribution retraining studies they and their colleagues, and others, have done. Many of these studies used state-of-the-art randomized control trial designs, and the treatments focused on changing individuals' attributions that they failed owing to lack of ability (uncontrollable, stable) to controllable causes, such as effort and strategy use. The interventions were effective in changing both students' attributions and also their school achievement, with effect sizes ranging from medium to large. With respect to expectancies and values, changing children's failure attributions to something they can control (such as effort) likely increases their expectancies for success on subsequent tasks. To date, no one has studied if these programs have an impact on students' valuing of achievement.

A second type of program designed to alleviate depression is a cognitive restructuring program; Maag and Swearer (2005) define this as an intervention designed to change depressed individuals' negative self-statements (e.g., I just am not a good

person) and “irrational” beliefs such as absolutist thinking (e.g., I will never amount to anything), or their catastrophizing a situation into something much more serious than it really is. This type of program focuses on changing individuals’ competence beliefs and so it aligns well with key attributes of SEVT such as expectancies and self-concepts. Both of these types of program (i.e., attribution retraining and cognitive restructuring) have been effective at reducing children’s and adolescents’ depression; two example studies are presented next. It is important to note that all of the studies reviewed by Maag and Swearer were conducted in hospital or other clinical settings, rather than schools.

Stark, Reynolds, and Kaslow (1987) implemented two interventions to alleviate children’s depression. One was behaviorally focused and the other more cognitively based. The cognitive intervention focused on changing children’s attributions and also taught children how to better self-monitor and evaluate themselves in positive ways. From the SEVT perspective, the cognitive intervention focused on children’s interpretations of their experiences and the impact they have on subsequent beliefs, values, and outcomes. Participants were 29 elementary school-aged children diagnosed as depressed. The researchers implemented the treatment in small groups of children. They measured a variety of outcomes, from children’s depression and anxiety to the child behavior checklist (completed by their mothers), and found that both interventions produced improvements on various measures of depression at post-test and 8-week follow-up. Gaynor and Lawrence (2002) worked with ten depressed adolescents aged 13–18, teaching them self-monitoring and problem-solving skills, along with changing their thinking about how to interpret poor outcomes when they occur. Results showed that adolescents’ depression, as measured by Beck’s Depression Inventory and the Hamilton Depression Rating scale, was lower at post-test and 3-month follow-up.

Along with the focus on attribution retraining and other cognitive interventions to reduce depression, it is possible that interventions focused on increasing depressed adolescents’ sense that the work they are doing in school has meaning for them and is purposeful can also be effective, given that when individuals are depressed they often feel a lack of meaning or purpose in their lives. A variety of intervention researchers basing their work in SEVT have focused on enhancing students’ sense of the relevance of what they are doing in school for their own lives (see Albrecht & Karabenick, 2017; Harackiewicz & Priniski, 2016; Rosenzweig & Wigfield, 2016; Wigfield et al., 2017, for review). These intervention studies have enhanced participants’ competence beliefs, valuing of achievement, and performance; however, none of the studies to date have specifically addressed whether these kinds of intervention are effective for depressed or anxious children and adolescents.

Anxiety Intervention Programs

Researchers have developed interventions to deal with many different kinds of anxiety (see Beilock et al., 2017; King, Heyne, & Ollendick, 2005; Zeidner, 1998, for review). Some of the interventions reviewed by King et al. can be conducted in schools, but many are carried out by therapists working with individual children. In the school setting, educators and policymakers have been most concerned about test anxiety, and many programs have been developed to reduce test anxiety (Denny, 1980; Hembree,

1988; Wigfield & Eccles, 1989; Zeidner, 1998). As with the programs reviewed by King et al., most test anxiety interventions are designed to be implemented with individual children or adolescents, rather than being conducted with groups in the school setting. Zeidner provides a comprehensive review of many of these programs and organized them under two broad categories: programs that deal with the emotional/physiological aspect of anxiety, and programs that deal with the cognitive or worry aspect of anxiety—the latter being more aligned with the focus on perceptions and beliefs that is such an important part of SEVT. One example of an emotion-focused program is relaxation training, which involves learning deep breathing techniques, how to relax tense muscles, or learning (through conditioning) a cue word that signals to the individual to relax. Another is systematic desensitization (SD). Zeidner states that SD is the most popular of the emotion-focused programs. In SD, the participant first gets into a relaxed state and then visualizes a set of increasingly anxiety-provoking test-taking scenes. The participant works through these systematically, only going to the next, more stressful scene after being able to stay relaxed while visualizing the previous one. Hembree's meta-analysis of the effectiveness of relaxation training and SD showed that both reduce test anxiety, with SD having stronger effect sizes. However, neither relaxation training nor SD led to improved test performance or grades.

Anxiety intervention programs linked to the second broad category noted by Zeidner (1998) focus on the worry aspect of anxiety by attempting to change the negative, self-deprecating thoughts of anxious individuals and replacing them with more positive, task-focused thoughts, and also on helping the anxious individual focus on the task at hand, rather than irrelevant thoughts (e.g., see Denny, 1980; Meichenbaum & Butler, 1980; Wine, 1980). Indeed, it is these that align with SEVT interventions that seek to promote children's valuing of the subject they are studying and beliefs about their ability to do so (see Harackiewicz & Priniski, 2016; Rosenzweig & Wigfield, 2016). Some of these programs focus solely on changing individuals' thinking, whereas others change both their thinking and behavior (cognitive behavior therapy [CBT]; Meichenbaum, 1993). CBT programs implemented in clinical settings currently are the most frequently used programs that address the worry aspect of anxiety. They contain a potpourri of techniques including relaxation techniques, coping skills in the form of positive self-statements, self-reinforcements, and learning problem-solving skills to use when encountering difficulties. Both these types of program have been successful in lowering individuals' anxiety and (importantly) also improving their academic performance (Hembree, 1988; King et al., 2005; Zeidner, 1998). However, Schoenfeld and Janney's (2008) review of 11 school-based anxiety intervention programs (all of which used CBT techniques) showed that 9 of the 11 reduced participants' anxiety but did not have an impact on their school performance. They concluded that, until such programs increase students' achievement, they likely will not be widely implemented in schools.

In the conclusion of their article, King et al. (2005) make the important observation that we do not have a clear understanding of which aspects of the anxiety reduction treatments are most effective, or *how* they work. According to SEVT, it may be that the interventions promote more positive competence beliefs and values as a result of participants' anxiety being reduced. Thus, they suggest that researchers should assess more closely the cognitive processes of individuals in therapy, to understand better how their thinking is changing, or how they better focus their attention, and so on. As

noted earlier, from an SEVT perspective, one indirect effect of these programs could be increasing students' expectancies for success, which could impact their performance and also improve their affect while doing academic tasks in and out of school. King et al. also stated that there is very little information available on the “dosage” of different treatments, how similar or different they are across programs, and what the optimum treatment dosage might be. Further, they noted that many of the successful interventions are multifaceted, and so we do not know if there are particular parts of the intervention that are most effective, or if the sum of the intervention components is greater than the individual parts. Mayer, Lochman, and Van Acker (2005) made two additional points that are crucial for all kinds of school-based intervention. First, they stated that school personnel need to buy into the programs as things they believe are worth doing and to which they can commit time. Second, they noted that it is crucial for the developers of school-based interventions to take into account specific characteristics of the school and its population. They argue that doing so would make programs more effective, but stated that few programs do this.

To conclude this section, although results presented here regarding interventions focused on reducing depression and anxiety are encouraging, we go back to Schoenfeld and Janney's (2008) point that neither of these EDs receive enough attention in schools, even though they can be quite debilitating to students' academic performance and overall well-being. In addition to interventions, some of the school factors discussed earlier likely relate to some students becoming more anxious and depressed, or remaining emotionally better-adjusted in school. Positive teacher–student relations are one obvious preventive factor with respect to both anxiety and depression. Conversely, teachers who are highly critical, are not supportive (emotionally or otherwise), and who lower students' competence beliefs and expectancies of success may increase the likelihood that some children in their classes will become anxious, depressed, or both, particularly in middle and high school. This likelihood may be amplified for students who receive much criticism, little emotional support, and negative expectations from their parents. For some students, perceiving that their teacher or parent has low expectations for them may lead to negative self-appraisals that are implicated in anxiety and depression; these linkages have not been studied, and are an important direction for future research.

FUTURE DIRECTIONS

We have provided suggestions for future research throughout the chapter and so, in this final section, we highlight what we consider to be the most important issues researchers should address concerning how children's developing expectancies and values impact the development of anxiety and depression. As we noted at the outset of the chapter, most researchers examining the development of anxiety and depression have not based their work in SEVT. However, we believe SEVT can provide a relevant theoretical framework to guide research to assist understanding of the development of each, particularly given that one of the central beliefs of SEVT—individuals' expectancies for success—relate strongly and negatively to depression and also that, in SEVT, Eccles and colleagues (Eccles-Parsons et al., 1983; Wigfield et al., 2016) include anxiety and other kinds of negative affect as direct predictors of children's subjective task values and indirect predictors of their expectancies.

A necessary first step before looking more closely at how the development of children's expectancies and values relate to the development of depression and anxiety is to compare and then clarify the different definitions of depression and anxiety and the measures of them, in order to arrive at consensus on both definition and measurement of these central ED constructs. Doing so would facilitate researchers' ability to compare findings across studies and make better progress in understanding the development of depression and anxiety. Then, researchers interested in the development of children's expectancies and values, and the factors that influence them, should further examine how their expectancies and values in different subject areas relate to the development of their depression and anxiety. Such work could and should look at both the developmental trajectories and interrelations among these constructs, using analysis strategies such as growth mixture modeling (see Musu-Gillette et al., 2015, for an example of applying these analytic strategies to understand the development of expectancies and values). Researchers also should employ person-centered analyses (such as latent profile analysis) to examine profiles of children's and adolescents' expectancies, values, anxiety, and depression in relation to their achievement, to determine which kinds of meaningful profiles exist (see Conley, 2012, for an example of this kind of work). Such work should be done within and across different groups in different cultures.

Finally, we believe researchers need to begin to examine processes and mechanisms behind the observed relations of expectancies, values, depression, and anxiety in two ways. First we need to look more fully at mechanisms that explain the development of depression and anxiety, such as particular parenting practices (e.g., excessive criticism and control) and their beliefs about their children (e.g., believing their children are not very capable), various aspects of school and classroom environments (e.g., excessive evaluation, immutable ability grouping, etc.), as well as how the quality of teacher-student relationships relates to children's depression and anxiety. In a similar vein, we need work on the psychological and other mechanisms that reduce anxiety and depression, enhance academic outcomes, and underpin prevention programs to stop the development of anxiety and depression before they start. The low uptake of interventions in schools is often because declines in emotional disorders (e.g., anxiety) are not matched by improvements in academic outcomes; it is, therefore, critical to identify factors and processes that can successfully achieve both.

CONCLUSION

To conclude, we suggest that SEVT is a useful framework to help us better understand the development of depression and anxiety among children and young people. For some children, low expectancies for success can be a precursor to the development of anxiety and depression, particularly if they continue to value school. At the same time, for some children, poor valuing may undergird a sense of purposelessness that is typical of depressive mood and symptoms. In both cases, SEVT provides a lens through which to better understand these special needs students. We are encouraged that researchers and clinicians have developed successful interventions for reducing children's and adolescents' depression and anxiety, but find it troubling that (as Schoenfeld & Janney, 2008, discussed) these two EDs are less likely to be diagnosed and treated in school than other ones, such as externalizing problems. We also are encouraged that prevention programs for both have been developed (Stice, Marti,

Shaw, & Jaconis, 2009) and believe that their broader implementation will be a particularly good way to forestall the development of these emotional disorders. We look forward to following the next decade of research on the issues we discussed and the role of SEVT in guiding and facilitating this research.

REFERENCES

- Albrecht, J. R., & Karabenick, S. A. (2017). Relevance for learning and motivation in education. *The Journal of Experimental Education*, 86, 1–10. doi:10.1080/00220973.2017.1380593
- Alexander, K. L., Dauber, S. L., & Entwisle, D. R. (1993). First-grade classroom behavior: Its short- and long-term consequences for school performance. *Child Development*, 64, 801–803. doi:10.2307/1131219
- Al-Mosaiwi, M., & Johnstone, T. (2018). In an absolute state: Elevated use of absolutist words is a marker specific to anxiety, depression, and suicidal ideation. *Clinical Psychological Science*, 6, 529–542. doi:10.1177/2167702617747074
- Alpert, R., & Haber, R. N. (1960). Anxiety in academic achievement situations. *The Journal of Abnormal and Social Psychology*, 61, 207–215. doi:10.1037/h0045464
- Al-Qaisy, L. (2011). The relation of depression and anxiety in academic achievement among group of university students. *International Journal of Psychology and Counseling*, 3, 96–100.
- American Psychiatric Association [APA]. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.
- Archambault, I., Eccles, J. S., & Vida, M. N. (2010). Ability self-concepts and subjective value in literacy: Joint trajectories from grades 1–12. *Journal of Educational Psychology*, 102, 804–816. doi:10.1037/a0021075
- Awan, R. N., Azher, M., Anwar, M. N., & Naz, A. (2010). An investigation of foreign language classroom anxiety and its relationship with students' achievement. *Journal of College Teaching & Learning*, 7, 33–40. doi:10.19030/tlc.v7i11.249
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84, 191–215.
- Battle, A., & Wigfield, A. (2003). College women's value orientations toward family, career, and graduate school. *Journal of Vocational Behavior*, 62, 56–75. doi:10.1016/S0001-8791(02)00037-4
- Bayer, J. K., Sanson, A. V., & Hemphill, S. A. (2006). Parent influences on early childhood internalizing difficulties. *Journal of Applied Developmental Psychology*, 27, 542–559. doi:10.1016/j.appdev.2006.08.002
- Bean, K. (2012). Differential ratings of and maternal impact on anxiety and depression among African American children in special education. *Children and Youth Services Review*, 34, 1868–1875. doi:10.1016/j.childyouth.2012.05.024
- Beck, A. T. (2002). Cognitive models of depression. *Clinical Advances in Cognitive Psychotherapy: Theory and Application*, 14, 29–61.
- Beilock, S. L., Schaeffer, M. W., & Rozek, C. S. (2017). Understanding and addressing performance anxiety. In A. J. Elliot, C. S. Dweck, & D. S. Yeager (Eds.), *Handbook of competence and motivation* (2nd ed., pp. 155–172). New York: Guilford.
- Berg, D. H., & Klinger, D. A. (2009). Gender differences in the relationship between academic self-concept and self-reported depressed mood in school children. *Sex Roles*, 61, 501–509. doi:10.1007/s11199-009-9652-2
- Best, K. M., Hauser, S. T., Gralinski-Bakker, J. H., Allen, J. P., & Crowell, J. (2004). Adolescent psychiatric hospitalization and mortality, distress levels, and educational attainment. *Archives of Pediatrics & Adolescent Medicine*, 158, 749–752. doi:10.1001/archpedi.158.8.749
- Birch, S. H., & Ladd, G. W. (1996). Interpersonal relationships in the school environment and children's early school adjustment: The role of teachers and peers. In J. Juvonen & K. R. Wentzel (Eds.), *Cambridge studies in social and emotional development. Social motivation: Understanding children's school adjustment* (pp. 199–225). New York: Cambridge University Press. doi:10.1017/CBO9780511571190.011
- Birmaher, B., Ryan, N. D., Williamson, D. E., Brent, D. A., Kaufman, J., Dahl, R. E., ... Nelson, B. (1996). Childhood and adolescent depression: A review of the past 10 years. Part I. *Psychiatry*, 35, 1427–1439.
- Bong, M., Cho, C., Ahn, H. S., & Kim, H. J. (2012). Comparison of self-beliefs for predicting student motivation and achievement. *Journal of Educational Research*, 105, 336–352. doi:10.1080/00220671.2011.627401
- Cassady, J. C., & Johnson, R. E. (2002). Cognitive test anxiety and academic performance. *Contemporary Educational Psychology*, 27, 279–295. doi:10.1006/ceps.2001.1094

- Chapell, M. S., Blanding, B. Z., Silverstein, M. E., Takahashi, M., Newman, B., Gubi, A., & McCann, N. (2005). Test anxiety and academic performance in undergraduate and graduate students. *Journal of Educational Psychology*, 97, 268–274. doi:10.1037/0022-0663.97.2.268
- Cheung, S. K. (1995). Life events, classroom environment, achievement expectation, and depression among early adolescents. *Social Behavior and Personality*, 23, 83–92. doi:10.2224/sbp.1995.23.1.83
- Chorpita, B. F., Brown, T. A., & Barlow, D. H. (2016). Perceived control as a mediator of family environment in etiological models of childhood anxiety—republished article. *Behavior Therapy*, 47, 622–632. doi:10.1016/j.beth.2016.08.008
- Cole, D. A. (1990). Relation of social and academic competence to depressive symptoms in childhood. *Journal of Abnormal Psychology*, 99, 422–429. doi:10.1037/0021-843X.99.4.422
- Cole, D. A., Martin, J. M., Peeke, L. A., Seroczynski, A. D., & Fier, J. (1999). Children's over- and underestimation of academic competence: A longitudinal study of gender differences, depression, and anxiety. *Child Development*, 70, 459–473. doi:10.1111/1467-8624.00033
- Collie, R. J., Martin, A. J., Nassar, N., & Roberts, C. L. (2018). Social and emotional behavioral profiles in kindergarten: A population-based latent profile analysis of links to socio-educational characteristics and later achievement. *Journal of Educational Psychology*. Advance online publication. doi:10.1037/edu0000262
- Conley, A. M. (2012). Patterns of motivation beliefs: Combining achievement goal and expectancy-value perspectives. *Journal of Educational Psychology*, 104, 32–47. doi:10.1037/a0026042
- Coplan, R. J., Closson, L. M., & Arbeau, K. A. (2007). Gender differences in the behavioral associates of loneliness and social dissatisfaction in kindergarten. *Child Psychology and Psychiatry*, 48, 988–995. doi:10.1111/j.1469-7610.2007.01804.x
- Creswell, C., Murray, L., Stacey, J., & Cooper, P. (2011). Parenting and child anxiety. *Anxiety Disorders in Children and Adolescents*, 2, 299–322. doi:10.1017/CBO9780511994920.015
- Cullinan, D., & Sabornie, E. J. (2004). Characteristics of emotional disturbance in middle and high school students. *Journal of Emotional and Behavioral Disorders*, 12, 157–167. doi:10.1177/10634266040120030301
- Cummings, C. M., Caporino, N. E., & Kendall, P. C. (2014). Comorbidity of anxiety and depression in children and adolescents: 20 years after. *Psychological Bulletin*, 140, 816–845. doi:10.1037/a0034733
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press. doi:10.1007/978-1-4899-2271-7
- Denny, D. R. (1980). Self-control approaches to the treatment of test anxiety. In I. G. Sarason (Ed.), *Test anxiety: Theory, research, and applications* (pp. 111–128). Hillsdale, NJ: Lawrence Erlbaum.
- DiLalla, L. F., Marcus, J. L., & Wright-Phillips, M. V. (2004). Longitudinal effects of preschool behavioral style on early adolescent school performance. *Journal of School Psychology*, 42, 385–401. doi:10.1016/j.jsp.2004.05.002
- DiPerna, J. C., Lei, P.-W., & Reid, E. E. (2007). Kindergarten predictors of mathematical growth in the primary grades: An investigation using the early childhood longitudinal study-kindergarten cohort. *Journal of Educational Psychology*, 99, 369–379. doi:10.1037/0022-0663.99.2.369
- Downey, G., & Coyne, J. C. (1990). Children of depressed parents: An integrative review. *Psychological Bulletin*, 108, 50–76.
- Duchesne, S., Larose, S., Vitaro, F., & Tremblay, R. E. (2010). Trajectories of anxiety in a population sample of children: Clarifying the role of children's behavioral characteristics and maternal parenting. *Development and Psychopathology*, 22, 361–373. doi:10.1017/S0954579410000118
- Duchesne, S., Vitaro, F., Larose, S., & Tremblay, R. E. (2008). Trajectories of anxiety during elementary-school years and the prediction of high school noncompletion. *Journal of Youth and Adolescence*, 37, 1134–1146. doi:10.1007/s10964-007-9224-0
- Durik, A. M., Vida, M., & Eccles, J. S. (2006). Task values and ability beliefs as predictors of high school literacy choices: A developmental analysis. *Journal of Educational Psychology*, 98, 382–393. doi:10.1037/0022-0663.98.2.382
- Dweck, C. S. (1975). The role of expectations and attributions in the alleviation of learned helplessness. *Journal of Personality and Social Psychology*, 31, 674–685. doi:10.1037/h0077149
- Eccles, J. S. (1993). School and family effects on the ontogeny of children's interests, self-perceptions, and activity choice. In J. Jacobs (Ed.), *Nebraska symposium on motivation, 1992: Developmental perspectives on motivation* (pp. 145–208). Lincoln: University of Nebraska Press.
- Eccles, J. S. (2005). Subjective task values and the Eccles et al. model of achievement related choices. In A. J. Elliott & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 105–121). New York: Guilford Press.

- Eccles, J. S. (2006). Families, schools, and developing achievement-related motivations and engagement. In J. E. Grusec & P. D. Hastings (Eds.), *Handbook of socialization theory and research* (pp. 665–691). New York: Guilford Press.
- Eccles, J. S. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educational Psychologist*, 44, 78–89. doi:10.1080/00461520902832368
- Eccles, J. S., & Wigfield, A. (1995). In the mind of the achiever: The structure of adolescents' academic achievement related-beliefs and self-perceptions. *Personality and Social Psychology Bulletin*, 21, 215–225. doi:10.1177/0146167295213003
- Eccles, J. S., & Wigfield, A. (in press). From expectancy-value theory to situated expectancy value theory: A developmental, social cognitive, and sociocultural perspective on motivation. *Contemporary Educational Psychology*.
- Eccles, J. S., Wigfield, A., & Schiefele, U. (1998). Motivation to succeed. In W. Damon (Series Ed.) & N. Eisenberg (Vol. Ed.), *Handbook of child psychology: Vol. 3. social, emotional, and personality development* (5th ed., pp. 1017–1095). New York: Wiley.
- Eccles-Parsons, J. S., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motivation* (pp. 75–146). San Francisco, CA: W. H. Freeman.
- Elmelid, A., Stickley, A., Lindblad, F., Schwab-Stone, M., Henrich, C. C., & Ruchkin, V. (2015). Depressive symptoms, anxiety and academic motivation in youth: Do schools and families make a difference? *Journal of Adolescence*, 45, 174–182. doi:10.1016/j.adolescence.2015.08.003
- Englund, M. M., & Siebenbruner, J. (2012). Developmental pathways linking externalizing symptoms, internalizing symptoms, and academic competence to adolescent substance use. *Journal of Adolescence*, 35, 1123–1140. doi:10.1016/j.adolescence.2012.03.004
- Fathi-Ashtiani, A., Ejei, J., Khodapanahi, M. K., & Tarkhorani, H. (2007). Relationship between self-concept, self-esteem, anxiety, depression and academic achievement in adolescents. *Journal of Applied Sciences*, 7, 995–1000. doi:10.3923/jas.2007.995.1000
- Flake, J. K., Barron, K. E., Hulleman, C., McCoach, D. B., & Welsh, M. E. (2015). Measuring cost: The forgotten component of expectancy-value theory. *Contemporary Educational Psychology*, 41, 232–244. doi:10.1016/j.cedpsych.2015.03.002
- Forness, S. R., & Kavale, K. A. (2000). Emotional or behavioral disorders: Background and current status of the E/BD terminology and definition. *Behavioral Disorders*, 25, 264–269. doi:10.1177/019874290002500304
- Forsterling, F. (1985). Attributional retraining: A review. *Psychological Bulletin*, 98, 495–512. doi:10.1037/0033-2909.98.3.495
- Fröjd, S. A., Nissinen, E. S., Pelkonen, M. U. I., Marttunen, M. J., Koivisto, A., & Kaltiala-Heino, R. (2008). Depression and school performance in middle adolescent boys and girls. *Journal of Adolescence*, 31, 485–498. doi:10.1016/j.adolescence.2007.08.006
- Fuligni, A. J., Eccles, J. S., & Barber, B. L. (1995). The long-term effects of seventh-grade ability grouping in mathematics. *The Journal of Early Adolescence*, 15, 58–89.
- Gaspard, H., Häfner, I., Parrisius, C., Trautwein, U., & Nagengast, B. (2017). Assessing task values in five subjects during secondary school: Measurement structure and mean level differences across grade level, gender, and academic subject. *Contemporary Educational Psychology*, 48, 67–84. doi:10.1016/j.cedpsych.2016.09.003
- Gaynor, S., & Lawrence, P. (2002). Complementing CBT for depressed adolescents with learning through in vivo experience (live): Conceptual analysis, treatment description, and feasibility study. *Behavioural and Cognitive Psychotherapy*, 30, 79–101. doi:10.1017/S135246580200108X
- Goetz, T., Preckel, F., Zeidner, M., & Schleyer, E. (2008). Big fish in big ponds: A multilevel analysis of test anxiety and achievement in special gifted classes. *Anxiety, Stress & Coping*, 21, 185–198. doi:10.1080/10615800701628827
- Goodenow, C. (1993). Classroom belonging among early adolescent students: Relationships to motivation and achievement. *Journal of Early Adolescence*, 13, 21–43. doi:10.1177/0272431693013001002
- Grills, A.E., Seligman, L., & Ollendick, T. (2014). Anxiety disorders in children and adolescents. In P.M.G. Emmelkamp & T. Ehring (Eds.), *The Wiley handbook of anxiety disorders* (pp. 424–456). Chichester, UK: Wiley.
- Grolnick, W. S., Friendly, R. W., & Bellas, V. M. (2009). Parenting and children's motivation at school. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 279–300). New York: Routledge. doi:10.1002/da.20241

- Grover, R. L., Ginsburg, G. S., & Ialongo, N. (2007). Psychosocial outcomes of anxious first graders: A seven-year follow-up. *Depression and Anxiety*, 24, 410–420. doi:10.1002/da.20241
- Harackiewicz, J. M., Canning, E. A., Tibbetts, Y., Priniski, S. J., & Hyde, J. S. (2016). Closing achievement gaps with a utility-value intervention: Disentangling race and social class. *Journal of Personality and Social Psychology*, 111, 745–765. doi:10.1037/pspp0000075
- Harter, S. (1990). Causes, correlates and the functional role of global self-worth: A life-span perspective. In J. Kolligian & R. Sternberg (Eds.), *Perceptions of competence and incompetence across the life-span* (pp. 67–98). New Haven, CT: Yale University Press.
- Heberle, A. E., Krill, S. C., Briggs-Gowan, M. J., & Carter, A. S. (2015). Predicting externalizing and internalizing behavior in kindergarten: Examining the buffering role of early social support. *Journal of Clinical Child & Adolescent Psychology*, 44, 640–654. doi:10.1080/15374416.2014.886254
- Hembree, R. (1988). Correlates, causes, effects, and treatments of test anxiety. *Review of Educational Research*, 58, 47–77. doi:10.3102/00346543058001047
- Heyman, G. D., Dweck, C. S., & Cain, K. M. (1992). Young children's vulnerability to self-blame and helplessness: Relationship to beliefs about goodness. *Child Development*, 63, 401–415. doi:10.2307/1131488
- Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist*, 41, 111–127. doi:10.1207/s15326985ep4102_4
- Hudson, J. L., Dodd, H. F., Lyneham, H. J., & Bovopoulos, N. (2011). Temperament and family environment in the development of anxiety disorder: Two-year follow-up. *Journal of the American Academy of Child & Adolescent Psychiatry*, 50, 1255–1264. doi:10.1016/j.jaac.2011.09.009
- Jacobs, J., Lanza, S., Osgood, D. W., Eccles, J. S., & Wigfield, A. (2002). Ontogeny of children's self-beliefs: Gender and domain differences across grades one through 12. *Child Development*, 73, 509–527. doi:10.1111/1467-8624.00421
- Jodl, K. M., Michael, A., Malanchuk, O., Eccles, J. S., & Sameroff, A. (2001). Parents' role in shaping early adolescents' occupational aspirations. *Child Development*, 72, 1247–1265. doi:10.1111/1467-8624.00345
- Jussim, L., Robustelli, S. L., & Cain, T. R. (2009). Teacher expectations as self-fulfilling prophecies. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 381–410). New York, NY: Routledge.
- Kaess, M., Parzer, P., Haffner, J., Steen, R., Roos, J., Klett, M., ... Resch, F. (2011). Explaining gender differences in non-fatal suicidal behavior among adolescents: A population-based study. *BMC Public Health*, 11, 597. doi:10.1186/1471-2458-11-597
- Kessler, R. C., Avenevoli, S., & Merikangas, K. R. (2001). Mood disorders in children and adolescents: An epidemiologic perspective. *Biological Psychiatry*, 49, 1002–1014. doi:10.1016/S0006-3223(01)01129-5
- Kessler, R. C., Foster, C. L., Saunders, W. B., & Stang, P. E. (1995). Social consequences of psychiatric disorders, I: Education attainment. *The American Journal of Psychiatry*, 152, 1026–1032. doi:10.1176/ajp.152.7.1026
- King, N. J., Heyne, D., & Ollendick, T. H. (2005). Cognitive-behavioral treatments for anxiety and phobic disorders in children and adolescents: A review. *Behavioral Disorders*, 30, 241–257. doi:10.1177/019874290503000304
- Kirkpatrick, K. M., Chang, Y., Lee, Y. J., Tas, Y., & Anderman, E. M. (2013). The role of perceived social cost of math and science learning in academic expectations and intentions. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.
- Kuperminic, G. P., Leadbeater, B. J., & Blatt, S. J. (2001). School social climate and individual differences in vulnerability to psychopathology among middle school students. *Journal of School Psychology*, 39, 141–159. doi:10.1016/S0022-4405(01)00059-0
- LaRusso, M. D., Romer, D., & Selman, R. L. (2008). Teachers as builders of respectful school climates: Implications for adolescent drug use norms and depressive symptoms in high school. *Journal of Youth and Adolescence*, 37, 386–398. doi:10.1007/s10964-007-9212-4
- Lazarus, R. S., Dodd, H. F., Majdandžić, M., de Vente, W., Morris, T., Byrow, Y., & Hudson, J. L. (2016). The relationship between challenging parenting behaviour and childhood anxiety disorders. *Journal of Affective Disorders*, 190, 784–791. doi:10.1016/j.jad.2015.11.032
- Levinson, D. F. (2006). The genetics of depression: A review. *Biological Psychiatry*, 60, 8492. doi:10.1016/j.biopsych.2005.08.024
- Liem, G., Marsh, H. W., Martin, A. J., McInerney, D. M., & Yeung, A. S. (2013). The big-fish-little-pond effect and a national policy of within school ability streaming: Alternative frames of reference. *American Educational Research Journal*, 50, 326–370. doi:10.3102/0002831212464511
- Lowe, P. A., Lee, S. W., Witteborg, K. M., Prichard, K. W., Luhr, M. E., Cullinan, C. M., ... Janik, M. (2007). The test anxiety inventory for children and adolescents (TAICA): Examination of the psychometric properties

- of a new multidimensional measure of test anxiety among elementary and secondary school students. *Journal of Psychoeducational Assessment*, 26, 215–230. doi:10.1177/0734282907303760
- Maag, J. W., & Swearer, S. M. (2005). Cognitive-behavioral interventions for depression: Review and implications for school personnel. *Behavioral Disorders*, 30, 259–276. doi:10.1177/019874290503000305
- Majdandžić, M., Lazarus, R. S., Oort, F. J., van der Sluis, C., Dodd, H. F., Morris, T. M., ... Bögels, S. M. (2018). The structure of challenging parenting behavior and associations with anxiety in Dutch and Australian children. *Journal of Clinical Child & Adolescent Psychology*, 47, 282–295. doi:10.1080/15374416.2017.1381915
- Majdandžić, M., Möller, E. L., de Vente, W., Bögels, S. M., & van Den Boom, D. C. (2014). Fathers' challenging parenting behavior prevents social anxiety development in their 4-year-old children: A longitudinal observational study. *Journal of Abnormal Child Psychology*, 42, 301–310. doi:10.1007/s10802-013-9774-4
- Maloney, E. A., Ramirez, G., Gunderson, E. A., Levine, S. C., & Beilock, S. L. (2015). Intergenerational effects of parents' math anxiety on children's math achievement and anxiety. *Psychological Science*, 26, 1480–1488. doi:10.1177/0956797615592630
- Marsh, H. W. (1987). The big-fish-little-pond effect on academic self-concept. *Journal of Educational Psychology*, 79, 280–295. doi:10.1037/0022-0663.79.3.280
- Marsh, H. W., & O'Mara, A. (2008). Reciprocal effects between academic self-concept, self-esteem, achievement, and attainment over seven adolescent years: Unidimensional and multidimensional perspectives of self-concept. *Personality and Social Psychology Bulletin*, 34, 524–552. doi:10.1177/0146167207312313
- Marsh, H. W., Tracey, D. K., & Craven, R. G. (2006). Multidimensional self-concept structure for preadolescents with mild intellectual disabilities: A hybrid multigroup-MIMC approach to factorial invariance and latent mean differences. *Educational and Psychological Measurement*, 66, 795–818. doi:10.1177/0013164405285910
- Marsh, H. W., Seaton, M., Trautwein, U., Lüdtke, O., Hau, K. T., O'Mara, A. J., & Craven, R. G. (2008). The big-fish-little-pond-effect stands up to critical scrutiny: Implications for theory, methodology, and future research. *Educational Psychology Review*, 20, 319–350.
- Masten, A. S., Roisman, G. I., Long, J. D., Burt, K. B., Obradović, J., Riley, J. R., ... Tellegen, A. (2005). Developmental cascades: Linking academic achievement and externalizing and internalizing symptoms over 20 years. *Developmental Psychology*, 41, 733–746. doi:10.1037/0012-1649.41.5.733
- Mayer, M., Lochman, J., & Van Acker, R. (2005). Introduction to the special issue: Cognitive-behavioral interventions with students with EBD. *Behavioral Disorders*, 30, 197–212. doi:10.1177/019874290503000306
- McCoach, D. B., O'Connell, A. A., & Levitt, H. (2006). Ability grouping across kindergarten using an early childhood longitudinal study. *The Journal of Educational Research*, 99, 339–346. doi:10.3200/JOER.99.6.339-346
- Meece, J. L., Wigfield, A., & Eccles, J. S. (1990). Predictors of math anxiety and its consequences for young adolescents' course enrollment intentions and performances in mathematics. *Journal of Educational Psychology*, 82, 60–70. doi:10.1037/0022-0663.82.1.60
- Meichenbaum, D. (1993). Changing conceptions of cognitive behavior modification: Retrospect and prospect. *Journal of Consulting and Clinical Psychology*, 61, 202–204. doi:10.1037/0022-006X.61.2.202
- Meichenbaum, D., & Butler, L. (1980). Cognitive ethology. In K. R. Blankstein, P. Pliner, & J. Polivy (Eds.), *Assessment and modification of emotional behavior. Advances in the study of communication and affect* (Vol. 6, pp. 187–208, pp. 187–208). Boston: Springer. doi:10.1007/978-1-4684-3782-9_7
- Moilanen, K. L., Shaw, D. S., & Maxwell, K. L. (2010). Developmental cascades: Externalizing, internalizing, and academic competence from middle childhood to early adolescence. *Development and Psychopathology*, 22, 635–653. doi:10.1017/S0954579410000337
- Murray, C., & Greenberg, M. T. (2006). Examining the importance of social relationships and social contexts in the lives of children with high-incidence disabilities. *The Journal of Special Education*, 39, 220–233. doi:10.1177/00224669060390040301
- Murray, L., Creswell, C., & Cooper, P. J. (2009). The development of anxiety disorders in childhood: An integrative review. *Psychological Medicine*, 39, 1413–1423. doi:10.1017/S0033291709005157
- Musu-Gillette, L. E., Wigfield, A., Harring, J., & Eccles, J. S. (2015). Trajectories of change in student's self-concepts of ability and values in math and college major choice. *Educational Research and Evaluation*, 21, 343–370. doi:10.1080/13803611.2015.1057161
- Naicker, K., Galambos, N. L., Zeng, Y., Senthilselvan, A., & Colman, I. (2013). Social, demographic, and health outcomes in the 10 years following adolescent depression. *Journal of Adolescent Health*, 52, 533–538. doi:10.1016/j.jadohealth.2012.12.016

- Najman, J. M., Hayatbakhsh, M. R., Clavarino, A., Bor, W., O'Callaghan, M. J., & Williams, G. M. (2010). Family poverty over the early life course and recurrent adolescent and young adult anxiety and depression: A longitudinal study. *American Journal of Public Health, 100*, 1719–1723. doi:10.2105/AJPH.2009.180943
- Nelson, J. M., & Harwood, H. (2011). Learning disabilities and anxiety: A meta-analysis. *Journal of Learning Disabilities, 44*, 3–17. doi:10.1177/0022219409359939
- Newcomer, P. L., Barenbaum, E., & Pearson, N. (1995). Depression and anxiety in children and adolescents with learning disabilities, conduct disorders, and no disabilities. *Journal of Emotional and Behavioral Disorders, 3*, 27–39. doi:10.1177/106342669500300104
- Oakes, J. (1992). Can tracking research inform practice? Technical, normative, and political considerations. *Educational Researcher, 21*, 12–21.
- Oakes, J., Gamoran, A., & Page, R. N. (1992). Curriculum differentiation: Opportunities, outcomes, and meanings. In P. Jackson (Ed.), *Handbook of research on curriculum* (pp. 570–608). New York: Macmillan.
- Osborne, J. W. (1997). Race and academic disidentification. *Journal of Educational Psychology, 89*, 728–735. doi:10.1037/0022-0663.89.4.728
- Pahl, K. M., Barrett, P. M., & Gullo, M. J. (2012). Examining potential risk factors for anxiety in early childhood. *Journal of Anxiety Disorders, 26*, 311–320. doi:10.1016/j.janxdis.2011.12.013
- Parhiala, P., Torppa, M., Vasalmapi, K., Eklund, K., Poikkeus, A., & Aro, T. (2018). Profiles of school motivation and emotional well-being among adolescents: Association with math and reading performance. *Learning and Individual Differences, 61*, 196–204. doi:10.1016/j.lindif.2017.12.003
- Parsons, J. E., Adler, T. F., & Kaczala, C. M. (1982). Socialization of achievement attitudes and beliefs: Parental influences. *Child Development, 53*, 310–321. doi:10.2307/1128973
- Patterson, G. R., & Capaldi, D. M. (1990). A mediational model for boys' depressed mood. In J. Rolf, A. Masten, D. Cicchetti, K. Nüchterlein, & S. Weintraub (Eds.), *Risk and protective factors in the development of psychopathology* (pp. 141–163). Cambridge: Cambridge University Press.
- Perez, T., Cromley, J. G., & Kaplan, A. (2014). The role of identity development, values, and costs in college STEM retention. *Journal of Educational Psychology, 106*, 315–329. doi:10.1037/a0034027
- Perry, R. P., & Hamm, J. M. (2017). The attribution perspective on competence and motivation: Theory and treatment interventions. In A. J. Elliot, C. S. Dweck, & D. S. Yeager (Eds.), *Handbook of competence and motivation* (2nd ed., pp. 61–84). New York: Guilford Press.
- Pomerantz, E. M., & Grolnick, W. S. (2017). The role of parenting in children's motivation and competence: What underlies facilitative parenting? In A. J. Elliot, C. S. Dweck, & D. S. Yeager (Eds.), *Handbook of competence and motivation* (2nd ed., pp. 566–585). New York: Guilford Press.
- Pomerantz, E. M., Wang, Q., & Ng, F. F. (2005). Mothers' affect in the homework context: The importance of staying positive. *Developmental Psychology, 41*, 414–427. doi:10.1037/0012-1649.41.2.414
- Quiroga, C. V., Janosz, M., Lyons, J. S., & Morin, A. J. (2012). Grade retention and seventh-grade depression symptoms in the course of school dropout among high-risk adolescents. *Psychology, 3*, 749. doi:10.4236/psych.2012.329113
- Roderick, M., & Camburn, E. (1999). Risk and recovery from course failure in the early years of high school. *American Educational Research Journal, 36*, 303–344. doi:10.3102/00028312036002303
- Rodriguez, C. M., & Routh, D. K. (1989). Depression, anxiety, and attributional style in learning-disabled and non-learning-disabled children. *Journal of Clinical Child Psychology, 18*, 299–304. doi:10.1207/s15374424jccp1804_2
- Roeser, R. W., Urdu, T. C., & Stephens, J. M. (2009). School as a context of student motivation and achievement. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 381–410). New York: Routledge.
- Roick, J., & Ringeisen, T. (2017). Self-efficacy, test anxiety, and academic success: A longitudinal validation. *International Journal of Educational Research, 83*, 84–93. doi:10.1016/j.ijer.2016.12.006
- Rosenzweig, E. Q., & Wigfield, A. (2016). STEM motivation interventions for adolescents: A promising start, but further to go. *Educational Psychologist, 51*, 146–163. doi:10.1080/00461520.2016.1154792
- Rosenzweig, E. Q., & Wigfield, A. (2017). What if reading is easy but unimportant? How students' patterns of affirming and undermining motivation for reading information texts predict different reading outcomes. *Contemporary Educational Psychology, 48*, 1133–1148. doi:10.1016/j.cedpsych.2016.09.002
- Ruble, D. (1983). The development of social comparison processes and their role in achievement-related self-socialization. In E. T. Higgins, D. N. Ruble, & W. W. Hartup (Eds.), *Social cognition and social development: A sociocultural perspective* (pp. 134–157). New York: Cambridge University Press.

- Ryan, R. M., & Deci, E. L. (2009). Promoting self-determined school engagement: Motivation, learning, and well being in school. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 171–196). New York: Routledge.
- Ryan, R. M., & Deci, E. L. (2016). Facilitating and hindering motivation, learning, and well-being in schools: Research and observations from self-determination theory. In K. R. Wentzel & D. B. Miele (Eds.), *Handbook of motivation at school* (2nd ed., pp. 96–119). Mahwah, NJ: Erlbaum.
- Safavian, N., Conley, A., & Karabenick, S. (2013). Examining mathematics cost value among middle school youth. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.
- Schiefele, U. (2009). Situational and individual interest. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 197–223). New York: Routledge.
- Schnell, K., Ringeisen, T., Raufelder, D., & Rohrmann, S. (2015). The impact of adolescents' self-efficacy and self-regulated goal attainment processes on school performance—do gender and test anxiety matter? *Learning and Individual Differences*, 38, 90–98. doi:10.1016/j.lindif.2014.12.008
- Schoenfeld, N. A., & Janney, D. M. (2008). Identification and treatment of anxiety in students with emotional or behavioral disorders: A review of the literature. *Education and Treatment of Children*, 31, 583–610. doi:10.1353/etc.0.0034
- Seligman, L. D., & Ollendick, T. H. (1998). Comorbidity of anxiety and depression in children and adolescents: An integrative review. *Clinical Child and Family Psychology Review*, 1, 125–144. doi:10.1023/A:1021887712873
- Siegel, J. M., Yancey, A. K., Aneshensel, C. S., & Schuler, R. (1999). Body image, perceived pubertal timing, and adolescent mental health. *Journal of Adolescent Health*, 25, 155–165. doi:10.1016/S1054-139X(98)00160-8
- Simpkins, S. D. (2015). The role of parents in the ontogeny of achievement-related motivation and behavioral choices. *Monographs of the Society for the Study of Child Development*, 80, 1–151.
- Simpkins, S. D., Davis-Kean, P. E., & Eccles, J. S. (2006). Math and science motivation: A longitudinal examination of the links between choices and beliefs. *Developmental Psychology*, 42, 70–83. doi:10.1037/0012-1649.42.1.70
- Skiba, R. J., Poloni-Staudinger, L., Gallini, S., Simmons, A. B., & Feggins-Azziz, R. (2006). Disparate access: The disproportionality of African American students with disabilities across educational environments. *Exceptional Children*, 72, 411–424. doi:10.1177/001440290607200402
- Skiba, R. J., Simmons, A. B., Ritter, S., Gibb, A. C., Rausch, M. K., Cuadrado, J., & Chung, C. (2008). Achieving equity in special education: History, status, and current challenges. *Exceptional Children*, 74, 264–288. doi:10.1177/001440290807400301
- Slavin, R. E. (1990). Achievement effects of ability grouping in secondary schools: A best-evidence synthesis. *Review of Educational Research*, 60, 471–499. doi:10.3102/00346543060003471
- Spielberger, C. D., Gonzalez-Reigosa, F., Martinez-Urrutia, A., Natalicio, L. F., & Natalicio, D. S. (2017). The state-trait anxiety inventory. *Revista Interamericana de Psicología/Interamerican Journal of Psychology*, 5, 146–158. doi:10.30849/rip/ijp.v5i3%20&%204.620
- Stark, K. D., Reynolds, W. M., & Kaslow, N. J. (1987). A comparison of the relative efficacy of a self-control therapy and a problem-solving therapy for depression in children. *Journal of Abnormal Child Psychology*, 15, 91–113. doi:10.1007/BF00916468
- Stice, E., Marti, C. N., Shaw, H., & Jaconis, M. (2009). An 8-year longitudinal study of the natural history of threshold, subthreshold, and partial eating disorders from a community sample of adolescents. *Journal of Abnormal Psychology*, 118, 587–597. doi:10.1037/a0016481
- Street, H. (2002). Exploring relationships between goal setting, goal pursuit and depression: A review. *Australian Psychologist*, 37, 95–103. doi:10.1080/00050060210001706736
- Sung, Y., Chao, T., & Tseng, F. (2016). Reexamining the relationship between test anxiety and learning achievement: An individual-differences perspective. *Contemporary Educational Psychology*, 46, 241–252. doi:10.1016/j.cedpsych.2016.07.001
- Thapar, A., Collishaw, S., Pine, D. S., & Thapar, A. K. (2012). Depression in adolescence. *The Lancet*, 379, 1056–1067. doi:10.1016/S0140-6736(11)60871-4
- Tieso, C. L. (2003). Ability grouping is not just tracking anymore. *Roeper Review*, 26, 29–36. doi:10.1080/02783190309554236
- Trautwein, U., Lüdtke, O., Marsh, H. W., Köller, O., & Baumert, J. (2006). Tracking, grading, and student motivation: Using group composition and status to predict self-concept and interest in ninth grade mathematics. *Journal of Educational Psychology*, 98, 788–806. doi:10.1037/0022-0663.98.4.788

- Trautwein, U., Nagengast, B., Nagy, G., Jonkmann, K., Marsh, H. W., & Ludtke, O. (2012). Probing for the multiplicative term in modern expectancy-value theory: A latent interaction modeling study. *Journal of Educational Psychology*, 104, 763–777. doi:10.1037/a0027470
- U.S. Department of Education. (2004). Individuals with Disabilities Education Act, 20 U.S.C. § 1400.
- United States Department of Education. (2017). *Thirty-ninth Annual Report to Congress on the implementation of the Individuals with Disabilities Education Act*. Retrieved March 5, 2018, from www2.ed.gov/about/reports/annual/osep/2017/parts-b-c/39th-arc-for-idea.pdf
- Vander Stoep, A., Beresford, S. A., Weiss, N. S., McKnight, B., Cauce, A. M., & Cohen, P. (2000). Community-based study of the transition to adulthood for adolescents with psychiatric disorder. *American Journal of Epidemiology*, 152, 352–362. doi:10.1093/aje/152.4.352
- Vander Stoep, A., Weiss, N. S., Kuo, E. S., Cheney, D., & Cohen, P. (2003). What proportion of failure to complete secondary school in the US population is attributable to adolescent psychiatric disorder? *The Journal of Behavioral Health Services & Research*, 30, 119–124. doi:10.1007/BF02287817
- Verboom, C. E., Sijtsma, J. J., Verhulst, F. C., Penninx, B. W. J. H., & Ormel, J. (2014). Longitudinal associations between depressive problems, academic performance, and social functioning in adolescent boys and girls. *Developmental Psychology*, 50, 247–257. doi:10.1037/a0032547
- Wagner, M., Kutash, K., Duchnowski, A. J., Epstein, M. H., & Sumi, W. C. (2005). The children and youth we serve: A national picture of the characteristics of students with emotional disturbances receiving special education. *Journal of Emotional and Behavioral Disorders*, 13, 79–96. doi:10.1177/10634266050130020201
- Weeks, M., Ploubidis, G. B., Cairney, J., Wild, C. T., Naicker, K., & Colman, I. (2016). Developmental pathways linking childhood and adolescent internalizing, externalizing, academic competence, and adolescent depression. *Journal of Adolescence*, 51, 30–40. doi:10.1016/j.adolescence.2016.05.009
- Wei, C., & Kendall, P. C. (2014). Parental involvement: Contribution to childhood anxiety and its treatment. *Clinical Child and Family Psychology Review*, 17, 319–339. doi:10.1007/s10567-014-0170-6
- Weiner, B. (1979). A theory of motivation for some classroom experiences. *Journal of Educational Psychology*, 71, 3–25. doi:10.1037/0022-0663.71.1.3
- Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review*, 92, 548–573. doi:10.1037/0033-295X.92.4.548
- Weinstein, R. S., Marshall, H. H., Sharp, L., & Botkin, M. (1987). Pygmalion and the student: Age and classroom differences in children's awareness of teacher expectations. *Child Development*, 58, 1079–1093. doi:10.2307/1130548
- Wentzel, K. R. (2009). Students' relationships with teachers as motivational contexts. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 301–322). New York: Routledge. doi:10.4324/9780203879498
- Wentzel, K. R. (2016). Teacher–student relationships. In K. R. Wentzel & D. Miele (Eds.), *Handbook of motivation at school* (2nd ed., pp. 301–322). New York: Routledge.
- Wigfield, A., & Eccles, J. S. (1989). Test anxiety in elementary and secondary school students. *Educational Psychologist*, 24, 159–183. doi:10.1207/s15326985ep2402_3
- Wigfield, A., & Eccles, J. (1992). The development of achievement task values: A theoretical analysis. *Developmental Review*, 12, 265–310. doi:10.1016/0273-2297(92)90011-P
- Wigfield, A., Eccles, J. S., Fredericks, J., Roeser, R., Schiefele, U., & Simpkins, S. (2015). Development of achievement motivation and engagement. In R. Lerner (Series Ed.), C. Garcia Coll, & M. Lamb (Eds.), *Handbook of child psychology*, 7th ed., Vol. 3, *Social and emotional development* (pp. 657–700). New York: Wiley. doi:10.1002/9781118963418.childpsy316
- Wigfield, A., Eccles, J. S., Yoon, K. S., Harold, R. D., Arbretton, A., Freedman-Doan, C., & Blumenfeld, P. C. (1997). Changes in children's competence beliefs and subjective task values across the elementary school years: A three-year study. *Journal of Educational Psychology*, 89, 451–469. doi:10.1037/0022-0663.89.3.451
- Wigfield, A., Rosenzweig, E., & Eccles, J. (2017). Achievement values. In A. J. Elliot, C. S. Dweck, & D. S. Yeager (Eds.), *Handbook of competence and motivation: Theory and application* (2nd ed., pp. 116–134). New York: Guilford Press.
- Wigfield, A., Tonks, S. M., & Klauda, S. L. (2016). Expectancy-value theory. In K. R. Wentzel & D. B. Miele (Eds.), *Handbook of motivation at school* (2nd ed., pp. 55–74). New York: Routledge.
- Wine, J. D. (1980). Cognitive-attentional theory of test anxiety. In I. G. Sarason (Ed.), *Test anxiety: Research, theory, and application* (pp. 349–385). Hillsdale, NJ: Erlbaum.

- Yousefi, F., Talib, M. A., Mansor, M. B., Juhari, R. B., & Redzuan, M. (2010). The relationship between test-anxiety and academic achievement among Iranian adolescents. *Asian Social Science*, 6, 100–105. doi:10.5539/ass.v6n5p100
- Zeidner, M. (1998). *Test anxiety: The state of the art*. New York: Plenum Press.
- Zeidner, M., & Schleyer, E. J. (1998). The big-fish-little-pond effect for academic self-concept, test anxiety, and school grades in gifted children. *Contemporary Educational Psychology*, 24, 305–329. doi:10.1006/ceps.1998.0985
- Zychinski, K. E., & Polo, A. J. (2012). Academic achievement and depressive symptoms in low-income Latino youth. *Journal of Child and Family Studies*, 21, 565–577. doi:10.1007/s10826-011-9509-5

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CONTROL-VALUE THEORY AND STUDENTS WITH SPECIAL NEEDS

Achievement Emotion Disorders and Their Links to Behavioral Disorders and Academic Difficulties

Reinhard Pekrun and Kristina Loderer

From the time students begin formal education and through the postsecondary years, they are faced with challenging demands and transitions that can be difficult to manage emotionally. When entering school, students become members of a larger group of peers, which prompts social comparison along both social and achievement-related dimensions. Unfavorable outcomes of comparison can be further reinforced once formal testing for achievement is introduced, especially if testing involves grading on a curve within classrooms. Later, students are confronted with transitions into secondary school that can involve more challenging task demands, stricter teachers, and ever-changing groups of classmates. After graduating from high school, transitions into postsecondary education (such as college and university) can again feature novel learning tasks, difficult course content, and frequent failure, as well as increased financial demands and unstable social networks that may hinder students' academic and social development.

As a result, emotional disorders have become among the most frequently occurring psychological problems that students face (for related discussion, see, in this volume, Cassady & Thomas, Chapter 3; Wigfield & Ponnock, Chapter 17). Students frequently experience negative emotions including excessive anxiety, shame, guilt, hopelessness, and boredom (Pekrun, Goetz, Titz, & Perry, 2002). These emotional problems can be momentary reactions that remain below diagnostic thresholds for clinical disorders, but they can also exceed these thresholds and persist over long periods of time. Worldwide, 10–20% of children and adolescents experience mental disorders, including emotion-related disorders such as depressive and anxiety disorders (World Health Organization [WHO], 2018a). Among adolescents, anxiety disorders are the most common class of psychological disorders, affecting up to one-third of individuals in this

age group (Essau, Lewinsohn, Lim, Moon-ho, & Rohde, 2018; Merikangas, Nakamura, & Kessler, 2009). For achievement-related emotions, estimates are even higher: up to 40% of students are reported to experience excessive test anxiety (Bögels et al., 2010).

Emotional disorders do not only undermine students' psychological health. They can also derail their learning, academic performance, educational careers, and prospects for future occupational trajectories, and can strain physical health. For example, in higher education, emotional problems are prime reasons why nearly 30% of young adults enrolled in U.S. colleges drop out within the first year (Barefoot, 2004; Feldman, 2005; Tinto, 2010), and fewer than 60% complete their degrees within 6 years in 4-year institutions (Snyder & Dillow, 2013). The far-reaching consequences of emotional experiences are also likely reflected in the numbers of attempted and committed suicides among college students each year (Westefeld et al., 2005).

In this chapter, we focus on emotional disorders related to students' learning and achievement. Pekrun's (2006, 2018a, 2019) control-value theory of achievement emotions (CVT) will be used as a conceptual framework. The theory integrates propositions from previous accounts of achievement emotions, including attributional theories (Graham & Taylor, 2014; for related discussion, see Martin, Chapter 16, this volume), models of stress-related achievement emotions (e.g., Folkman & Lazarus, 1985), expectancy-value approaches to emotions (Pekrun, 1992a; Turner & Schallert, 2001; for related discussion, see Wigfield & Ponnock, Chapter 17, this volume), and theories of test anxiety (see Zeidner, 1998, 2014). CVT also seeks to expand existing theories by considering not only emotions related to success and failure outcomes of achievement activities, such as pride and shame, but also emotions related to these activities themselves, such as enjoyment and boredom during learning.

We first define achievement emotion and discuss related emotional and behavioral disorders, as well as mental health. Next, we outline how CVT helps explain the determinants of these emotions. This section focuses on appraisals and appraisal bias as factors causing achievement emotion disorders. We then discuss implications for the role of gender and social antecedents in the etiology of these disorders, as well as effects of emotional disorders on students' learning, performance, and behavioral problems. Finally, we consider how CVT explains ways to regulate achievement emotions and to manage related disorders using psychotherapy, treatment interventions, and appropriate educational practices. In the concluding section, we outline directions for future research.

ACHIEVEMENT EMOTIONS AND RELATED DISORDERS

Definition of Achievement Emotion

Achievement emotions are defined as emotions that relate to achievement activities (e.g., studying) or achievement outcomes (success and failure; see Table 18.1). As such, it is possible to distinguish between outcome-related and activity-related achievement emotions. In the three-dimensional emotion taxonomy that is part of CVT (Pekrun, 2006), the differentiation of activity versus outcome emotions pertains to the *object focus* of achievement emotions. In addition, as emotions more generally, achievement emotions can be grouped according to their *valence* and to the degree of *activation* implied (Table 18.1). In terms of valence, positive emotions can be distinguished from

Table 18.1 A Three-Dimensional Taxonomy of Achievement Emotions

Object Focus	Positive ^a		Negative ^b	
	Activating	Deactivating	Activating	Deactivating
<i>Activity</i>	Enjoyment	Relaxation	Anger Frustration	Boredom
<i>Outcome / prospective</i>	Hope Joy ^c	Relief ^c	Anxiety	Hopelessness
<i>Outcome / retrospective</i>	Joy Pride Gratitude	Contentment Relief	Shame Anger	Sadness Disappointment

^aPositive = pleasant emotion. ^bNegative = unpleasant emotion. ^cAnticipatory joy/relief.

negative emotions, such as enjoyment (pleasant) versus anxiety (unpleasant). In terms of activation, physiologically activating emotions can be distinguished from deactivating emotions, such as excitement (activating) versus contentment (deactivating).

Many emotions in academic settings are seen as achievement emotions, as they relate to activities and outcomes that are typically judged according to competence-based standards of quality. However, not all of the emotions triggered in academic settings are achievement emotions. For example, topic emotions related to the contents of learning materials, epistemic emotions such as surprise, curiosity, and confusion, as well as social emotions frequently occur in these same settings. Achievement emotions can overlap with other categories of emotion, as in social achievement emotions such as admiration, envy, or contempt related to the success and failure of others.

Related Emotional Disorders

There are two types of emotional disorder that involve achievement emotions. First, achievement emotions themselves can constitute disorders if they are excessive, persistent, and maladaptive in terms of causing psychological distress and impairing students' academic and social functioning. To denote these disorders, we propose to call them *achievement emotion disorders*. The most frequently considered variants involve excessive negative emotions, such as excessive test anxiety. However, a lack of positive emotion can also be problematic. Second, excessive and maladaptive achievement emotions can be components of *general emotional disorders*, such as depressive episodes and generalized anxiety disorder.

Achievement Emotion Disorders

These disorders can be focused on one specific, discrete achievement emotion, such as excessive anxiety before and during tests (for related discussion, see, in this volume, Cassady & Thomas, Chapter 3; Wigfield & Ponnock, Chapter 17). Alternatively, they can comprise a broader range of maladaptive discrete emotions, such as test anxiety combined with shame and hopelessness. Between-person correlations among these three negative emotions typically range from $r = .60$ to $r = .90$ (e.g., Pekrun, Goetz, Frenzel,

Barchfeld, & Perry, 2011), and combinations of these emotions are frequent. However, among the many disorders of achievement emotions that occur in students, none is explicitly listed in current psychiatric classifications. In the ICD-10 (i.e., *International Classification of Diseases*; WHO, 1993), exam anxiety was considered, but even this emotion is no longer listed in the ICD-11 (WHO, 2018b), nor is it listed in the DSM-5 (*Diagnostic and Statistical Manual of Mental Disorders Version 5*; American Psychiatric Association [APA], 2013). In the DSM-5, performance anxiety is considered, but only in terms of fear of public performance, which is seen as a variant of social anxiety disorder (APA, 2013, p. 203). Among the emotion problems not considered in these systems, excessive boredom may be especially important. Students have been found to experience boredom for 32–58% of classroom instruction time (Larson & Richards, 1991; Nett, Goetz, & Hall, 2011). Boredom can be very intense, disrupt students' learning, motivate them to disengage from school, and thus derail their functioning in educational contexts and beyond (Pekrun, Goetz, Daniels, Stupnisky, & Perry, 2010).

Although not mentioned in the ICD-11 and the DSM-5, test and exam anxiety, and achievement anxiety more generally, would be classified as specific phobias using these systems. Specific phobias are defined as “marked fear or anxiety about a specific object or situation” (APA, 2013, p. 197), with the object or situation “almost always” provoking immediate fear or anxiety; the phobic situation being actively avoided or endured with intense fear or anxiety; the intensity of the emotion being out of proportion relative to the danger; the symptoms persisting over time; and fear, anxiety, or avoidance causing significant distress or impairment in important areas of functioning. Several types of achievement-related anxiety can fulfill these criteria. This is not only true for test and exam anxiety; other variants include anxiety related to specific subject domains, generalized achievement anxiety, and school phobia.

Research has found that emotions tend to generalize across school subjects in the early school years but differentiate as students mature. In late secondary school, emotions such as enjoyment, anxiety, and boredom often show zero correlations across dissimilar school subjects, such as math versus languages (Goetz, Frenzel, Pekrun, Hall, & Lüdtke, 2007). Zero correlations imply that achievement emotion disorders can be specific to a particular subject in some students, but can generalize across subjects in other students. A well-researched domain-specific emotion disorder is excessive math anxiety, which involves not only fear of tests in mathematics but also fear of various situations that involve doing math in daily life (inside and out of school). *Math anxiety* can not only impair students' learning and achievement in mathematics (Chang & Beilock, 2016; Pekrun, Lichtenfeld, Marsh, Murayama, & Goetz, 2017), but also undermine their educational careers more generally, given the importance of the subject (for related discussion, see, in this volume, Jordan, Barbieri, Dyson, & Devlin, Chapter 19; Morsanyi, Chapter 21). Compared with math anxiety, *verbal anxiety* (i.e., fear and anxiety related to languages) has been researched less but may also be common and equally problematic (Horwitz, 2001; for related discussion, see, in this volume, Dockrell & Lindsay, Chapter 6; Hall, Capin, Vaughn, & Cannon, Chapter 7).

Achievement anxiety can prompt *school phobia*. We define school phobia as excessive fear of and anxiety about attending school that persists and leads to motivation to avoid school. Although more precise evidence is lacking, school refusal and absenteeism are likely due to school phobia in many cases (other possible reasons include hopelessness, boredom, pressure from peers to withdraw from school, and

sociocultural contexts that alienate students from education; for related discussion, see Macfarlane, Macfarlane, & Mataiti, Chapter 25, this volume). Depending on definition, age group, and country, estimates of the prevalence of school refusal range from 1% to a high 28% (Baker & Bishop, 2015; Blagg, 1987; also see Kearney, Eisen, & Silverman, 1995). Outcomes include poor academic achievement as well as risk of unemployment and subsequent negative developments related to unemployment, such as relationship problems and mental health difficulties.

General Emotional Disorders

Excessive negative achievement emotions and a lack of positive achievement emotions can be components of depressive disorders and generalized anxiety disorder (for related discussion, see, in this volume, Cassady & Thomas, Chapter 3; Wigfield & Ponnock, Chapter 17). Using the DSM-5 classification, relevant depressive disorders include *major depressive disorder*, *persistent depressive disorder*, *other specified depressive disorder*, and *unspecified depressive disorder*. As defined in the DSM-5, major depressive disorder is characterized by symptoms persisting for 2 weeks or longer, including (among others) depressed mood most of the day and nearly every day; diminished interest in all or most activities; fatigue or loss of energy; feelings of worthlessness or guilt; diminished ability to think or concentrate; and recurrent thoughts of death. The 12-month prevalence of major depressive disorder in the US is estimated to be 7%, with higher percentages in late adolescence and young adulthood (APA, 2013). Persistent depressive disorder is defined by a similar set of symptoms, but persisting for at least 2 years. “Other specified depressive disorder” and “unspecified depressive disorder” differ from major depression and persistent depressive disorder in terms of a reduced number of symptoms or reduced length. Although systematic evidence is lacking, given that educational activities comprise a major part of students’ daily activities, depressed mood and depressive cognition are likely to also include achievement-related thoughts and emotions such as worries about failure, hopelessness, shame, and guilt. As such, achievement emotions can constitute a major part of the depressive disorders students experience.

The same holds true for the role of achievement emotions in students’ *generalized anxiety disorder* (GAD). As defined in the DSM-5, GAD is characterized by excessive anxiety and worry occurring on most days over at least 6 months; difficulties in controlling the worry; as well as symptoms such as restlessness, difficulties concentrating, and sleep disturbance, among others. Estimates for the 12-month prevalence of GAD range from 0.4% to 3.5% (APA, 2013). It is likely that achievement-related worries comprise part of GAD in students, given the importance of achievement in their life. GAD can comprise combinations of various more circumscribed types of anxiety such as achievement anxiety, social anxiety, and physical anxiety.

Related Behavioral Disorders

Negative achievement emotions can contribute to various dysfunctional behaviors. In terms of the DSM-5 classification, relevant disorders may include adjustment disorders; sedative, hypnotic, or anxiolytic drug use disorders; gambling disorder; internet gaming disorder; and suicidal behavior disorder. *Adjustment disorders* comprise distress reactions to stressful events that are out of proportion to the severity or

intensity of the stressor (excluding death, physical injury, and sexual violation that are subsumed under the categories of acute stress disorder and post-traumatic stress disorder). In the achievement domain, examples are excessive feelings of shame, guilt, hopelessness, and resignation after failure and negative feedback.

Sedative, hypnotic, or anxiolytic drug use disorders consist of using these drugs over a longer period of time, craving or strong desire to use them, and failure to fulfill major role obligations (e.g., poor work performance) due to drug use, among other possible symptoms. Excessive anxiety at school can motivate use of these drugs. The 12-month prevalence is estimated to be 0.4% among 12–17-year-olds (APA, 2013), but this estimate is based on diagnosed cases and is likely to be an underestimation of the frequency of excessive use of these drugs among students. *Gambling disorder* and *internet gaming disorder* involve excessive gambling or internet gaming that leads to clinically significant impairment or distress. For these behaviors, as well, wanting to escape from the challenge of academic tasks can be a prime motivator (for the link between academic problems and these behaviors, see Ferguson, Coulson, & Barnett, 2011; Foster et al., 2015). In the DSM-5, *suicidal behavior disorder* is defined by having made an attempt to commit suicide during the past 24 months. Although systematic evidence is lacking, it seems likely that excessive negative emotions related to academic failure (such as hopelessness) can contribute to students' suicidal ideation and attempts to commit suicide.

Emotional Well-Being and Mental Health

It is important to note that the absence of disorders and mental illness does not mean presence of emotional well-being and mental health. Reduced emotional well-being (“languishing”), even when beneath the threshold for a mental disorder, is an important outcome as it is associated with increased distress and impaired productivity. In contrast, elevated emotional well-being (“flourishing”) predicts better productivity, psychosocial functioning, and health (Keyes, 2007). As such, it is an important task for education to prevent or reduce emotion problems at school, even if they do not meet the threshold for being considered disorders. Furthermore, it is also important to help students develop adaptive emotions such as enjoyment of learning, hope for success, gratitude for support by others, and compassion for classmates that contribute to their emotional well-being and mental health. Preventing mental illness and improving mental well-being are key parallel strategic priorities for young people (Mehta, Croudace, & Davies, 2015; Royal College of Psychiatrists, 2010), and preventing achievement emotion disorders and improving achievement-related emotional well-being should be considered key parallel priorities for education.

APPRAISAL ANTECEDENTS AND APPRAISAL BIAS

Achievement emotions and related disorders can be influenced by numerous factors, including genetic dispositions, situational perceptions, cognitive appraisals, medication and neurohormonal processes, physiological feedback from autonomic nervous system activity, and sensory feedback from facial, gestural, and postural expression (Barrett, Lewis, & Haviland-Jones, 2016). Among these factors, appraisals of situational demands and personal competencies likely play a major role. Specifically, CVT proposes that *perceived control* and *perceived values* are most important (Figure 18.1).

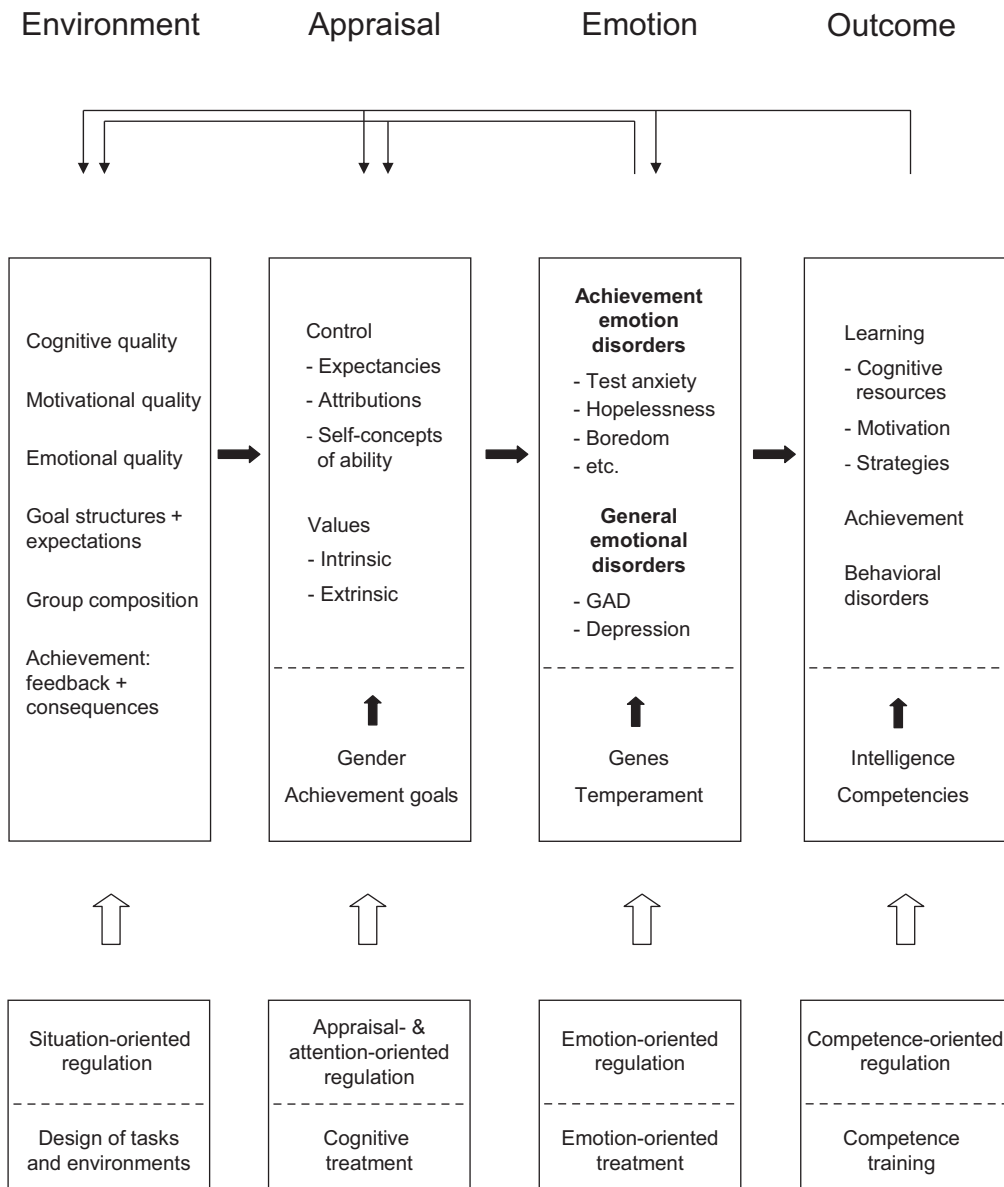


Figure 18.1 Control-Value Theory: Basic Propositions and Implications for Disorders. GAD = Generalized Anxiety Disorder

Succinctly stated, the theory posits that achievement emotions are induced when the individual feels in control of, or out of control of, achievement activities and outcomes that are subjectively important. By implication, biases in these appraisals are likely to contribute to related disorders.

Perceived control pertains to the perceived controllability of achievement-related actions and outcomes, as implied by causal expectations (self-efficacy expectations and outcome expectancies), causal attributions of achievement, and competence appraisals

(e.g., self-concepts of ability). Perceived value relates to the subjective importance of these activities and outcomes. Value can pertain to characteristics of achievement activities themselves (intrinsic values), to the value of resulting success or failure (achievement value), or to their instrumental value for obtaining further outcomes (utility value; Wigfield & Eccles, 2000).

By considering expectancies and values, CVT shares assumptions with expectancy-value theories of motivation (e.g., Heckhausen, 1991; Pekrun, 1993; Wigfield & Eccles, 2000; for related discussion, see Wigfield & Ponnock, Chapter 17, this volume). By considering perceived control and value, CVT also shares assumptions with other appraisal theories of emotion. Specifically, the constructs of perceived control and value integrate several dimensions from traditional approaches to appraisals (perceived control: power, control, agency; perceived value: goal relevance, goal congruency, intrinsic pleasantness, normative significance; Scherer, Schorr, & Johnstone, 2001; for related discussion, see Bergin & Prewett, Chapter 14, this volume).

Control, Value, and Achievement Emotions

Outcome Emotions

Different control and value appraisals are assumed to instigate different achievement emotions (Table 18.1). *Prospective joy* and *hopelessness* are expected to be triggered when there is high perceived control (joy) or a complete lack of control (hopelessness), respectively. For example, students who believe they have prepared well for an exam may feel joyous about the prospect of receiving a good grade. Conversely, students who believe they are incapable of mastering the exam may experience hopelessness. *Hope* and *anxiety* are instigated when there is uncertainty about control, the attentional focus being on anticipated success in the case of hope, and on anticipated failure in the case of anxiety. A student who is unsure about being able to master an important exam may hope for success, fear failure, or both.

Retrospective joy and *sadness* are considered control-independent emotions that immediately follow perceived success and failure, further appraisals being unnecessary. In contrast, *disappointment* and *relief* depend on appraisals of the match between expectations and the actual outcome. Disappointment is aroused when anticipated success does not occur, and relief when anticipated failure does not occur. Finally, *pride*, *shame*, *gratitude*, and *anger* are thought to be induced by causal attributions of success and failure to oneself or others, respectively. For example, a sports student who wins an important race will feel pride provided that they attribute the victory to their own ability or effort. Conversely, losing an important race can induce shame if attributed to lack of ability or effort.

Furthermore, the theory posits that these outcome emotions also depend on the subjective importance of the outcome, implying that they are a joint function of perceived control and value. For instance, students should feel worried if they judge themselves incapable of mastering the learning material (low controllability) in an important course (high value). In contrast, if they feel that they are able to learn the material (high controllability), or are indifferent about the course (low value), their anxiety should be low.

Activity Emotions

The theory proposes that *enjoyment* of achievement activities depends on a combination of positive competence appraisals and positive appraisals of the intrinsic value of the action (e.g., studying) and its reference object (e.g., learning material). For example, students are expected to enjoy learning if they feel competent to meet task demands and value the learning material. When they feel incompetent or are disinterested in the material, studying is not enjoyable. *Anger* and *frustration* are aroused when the intrinsic value of the activity is negative (e.g., when working on a difficult project is perceived as taking too much effort). Finally, *boredom* is experienced when the activity lacks any intrinsic incentive value.

Empirical Evidence

Empirical studies confirm that perceived control over achievement relates positively to students' enjoyment, hope, and pride, and negatively to their anger, anxiety, shame, hopelessness, and boredom (see Pekrun & Perry, 2014). Furthermore, research has shown that the perceived value of achievement relates positively to both positive and negative achievement emotions except boredom, indicating that the importance of success and failure amplifies these emotions. For boredom, negative links with value have been found, corroborating that boredom is instigated when value is lacking (e.g., Pekrun et al., 2010). Finally, studies have confirmed that control and value interact in the arousal of achievement emotions, with positive emotions being especially pronounced when both control and value are high, and negative emotions when value is high but control is lacking (e.g., Goetz, Frenzel, Stoecker, & Hall, 2010; Lauerman, Eccles, & Pekrun, 2017; Putwain et al., 2018).

Appraisal Bias and Achievement Emotion Disorders

From the propositions of CVT outlined above, it follows that excessively high or low appraisals can generate momentary excessive emotions. For example, feeling completely out of control over performance on an exam can prompt hopelessness related to this exam. Single instances like this, however, are not sufficient to constitute an emotional disorder. As outlined earlier, emotional disorders are defined by persistence over time. As such, it is persistent excessive appraisals (i.e., enduring beliefs) that will generate emotional disorders related to achievement.

A useful term to denote excessive appraisals is *appraisal bias* (Mehu & Scherer, 2015; Scherer & Brosch, 2009). Similar to the definition of emotional disorders, appraisal bias is defined as appraisals being out of proportion relative to the event to which they relate. For example, if academic success is so important to some students that they would consider themselves worthless if they failed an exam, then this appraisal would be considered excessive and biased.

An alternative term proposed by A. Ellis (1962) is *irrational beliefs*. Biased appraisals can be irrational in terms of misrepresenting reality (e.g., over- or underestimating the likelihood of an event). We prefer using the term appraisal bias because not all appraisals can be judged using criteria of rationality. Specifically, whereas perceptions of control can misrepresent the factual amount of controllability of an event, appraisals

of value are inherently subjective and cannot be judged in terms of rationality. Nevertheless, they can be out of proportion relative to an event, at least in terms of being inconsistent with socioculturally defined norms of how to judge its importance.

According to the propositions of CVT, three specific appraisal biases may be most important in the etiology of achievement emotion disorders and related behavioral disorders: lack of control, lack of value, and excessive negative value.

Lack of Control

Perceived control can be excessively low relative to the actual controllability of achievement. Persistent appraisals of such a lack of control can cause excessive anxiety, shame, and hopelessness related to achievement. By contributing to these emotions, lack of control can also generate school phobia. Furthermore, low control has been found to prompt boredom. Traditionally, boredom was assumed to be characteristic of gifted students who suffer from a lack of challenge at school (“The bored and disinterested gifted child”; Sisk, 1988). However, although overly high control may play a role in the genesis of boredom disorder, lack of control has been found to be more typical for boredom in the general student population (Pekrun et al., 2010). If students feel out of control over understanding the materials of a lesson, then those materials are meaningless to them, and they may feel bored.

Lack of control can involve various different types of expectations, attributions, and underlying perceptions of competence. Control is perceived to be lacking if the student expects they cannot successfully manage their learning (e.g., in terms of not being able to persist in making an effort), or if they believe they will fail regardless of the amount of learning invested. In other words, control is lacking when *self-efficacy expectations* or *action-outcome expectations* are too low. Lack of control is also implied by *attributions of failure* to uncontrollable, stable causes that cannot be changed from the student’s perspective. A prime example is attributions to lack of ability that is deemed not to be malleable. Persistent maladaptive attributions have been called dysfunctional *attributional styles* (Metalsky, Abramson, Seligman, Semmel, & Peterson, 1982; for related discussion, see Martin, Chapter 16, this volume).

Low *self-concept of ability* (Marsh & Shavelson, 1985) contributes to these dysfunctional expectations and attributions. If students believe they lack ability, expectations to succeed will be low, and failure will be attributed to lack of ability (for related discussion, see Tracey, Merom, Morin, & Maïano, Chapter 24, this volume). The belief that it is not possible to change one’s abilities can also play an important role. As related to intelligence, this belief has been called *entity conception of intelligence* by C. Dweck, which stands in contrast to the belief that intelligence is malleable (*incremental conception*, or “growth mindset”; see Yeager & Dweck, 2012). Believing that abilities cannot be changed can contribute to low self-concept of ability and low expectations to succeed.

Lack of Value

According to CVT, the quality and intensity of emotional experiences are also determined by value appraisals. When value is lacking, most emotions are diminished. When positive value is lacking, positive emotions are reduced, which compromises psychological well-being and mental health. Instead, lack of positive value can trigger

boredom. However, this will only be the case if negative value is lacking as well—as noted, boredom is prompted if an achievement activity lacks any kind of incentive value. As such, low value bias is a primary origin for achievement-related boredom disorder (for related discussion, see Wigfield & Ponnock, Chapter 17, this volume).

Excessive Negative Value

Value is thought to amplify all achievement emotions except boredom. By implication, excessively high value of achievement can contribute to excessive negative emotions such as anxiety, shame, guilt, and hopelessness related to achievement. More specifically, it is the negative value (i.e., importance) of failure that is expected to exacerbate these failure-related emotions. However, value of success and value of failure are closely related—not attaining success can be seen as failure. As such, valuing achievement generally is a double-edged sword, as it can drive both positive and negative emotions.

This is different with the intrinsic value of achievement activities. Positive intrinsic value is expected to promote positive emotions. In contrast, excessive negative intrinsic value can contribute to excessive anger and frustration during studying, which can prompt avoidance, similar to anxiety. An example for negative intrinsic value is the feeling of exhaustion due to too much effort. Although empirical evidence is largely lacking, it seems likely that a negative intrinsic value bias can contribute to anger-related emotional disorder.

Although lack of control bias, lack of value bias, and excessive negative value bias may be most important, other biases could also play a role in the etiology of achievement emotion disorders. For example, excessively high perceived control (overconfidence) has been found to possibly impair rather than promote students' learning (de Bruin, Kok, Lobbestael, & de Grip, 2017). It could be that excessive perceived control triggers positive emotions (e.g., pride, joy) that are out of proportion relative to students' current state of attainment, thus contributing to manic or hypomanic episodes and leading them to reduce effort that would be needed to actually achieve. However, as related evidence is lacking, this possibility remains speculative.

THE INFLUENCE OF GENDER AND SOCIAL ENVIRONMENTS

To the extent that cognitive appraisals are proximal determinants of achievement emotions and related disorders, more distal individual antecedents, such as goals, beliefs, cognitive abilities, or gender should affect these emotions by first influencing appraisals (Figure 18.1; Pekrun, 2006). Similarly, social environments and the broader sociocultural context should influence these emotions through shaping the emotion-arousing appraisals (for related discussion, see, in this volume, Macfarlane et al., Chapter 25; Tracey et al., Chapter 24). As such, CVT implies that distal individual antecedents and social environments should influence students' emotions and emotional disorders by affecting their control and value appraisals.

Distal Individual Antecedents: The Case of Gender

The prevalence of emotional disorders differs between genders across the life span, suggesting that gender constitutes a risk factor for the development of these disorders.

In adolescence and young adulthood, all types of anxiety disorders, as well as unipolar major depressive disorder, occur up to twice as frequently in females as compared with males (APA, 2013; Merikangas et al., 2009; WHO, 2018c). In education, the findings consistently show that average scores for test anxiety are higher for female than for male students (Hembree, 1988; Zeidner, 1998). Similarly, in the 2015 assessments of the Programme for International Student Achievement (PISA), schoolwork-related anxiety was significantly higher for girls in all of the 55 countries that participated in the assessment of this variable (Organisation for Economic Co-operation and Development [OECD], 2017).

Female students also report higher levels of negative emotions in mathematics, such as math anxiety, shame, and hopelessness, compared with boys (Frenzel, Pekrun, & Goetz, 2007). In the 2012 cycle of PISA, which focused on mathematics, average math anxiety was significantly higher for females in 56 of the 65 participating countries (OECD, 2013). Female students also report lower positive emotions in this domain, such as enjoyment of math (Frenzel et al., 2007). This is consistent with the gender differences in students' performance in mathematics—on average, girls receive lower test scores in mathematics than boys (OECD, 2016). In contrast, girls may enjoy language-related activities more than boys do. For example, reading for enjoyment was reported more frequently by girls in 64 out of 65 countries participating in the PISA 2009 assessments (OECD, 2010).

Why are girls more anxious about math than boys, and why do they enjoy math less? CVT offers an answer. Girls and boys not only differ in their math emotions, they also differ in their control and value appraisals in mathematics. Specifically, even if average performance is similar, female students report lower perceived control and competence in mathematics, likely owing to socially shared gender stereotypes about math-related competencies and the lack of female role models in math. This difference in perceived control provides an explanation for the differences in emotions (Frenzel et al., 2007). Female students' doubts about their competence contribute to their reduced psychological well-being in this domain and to their lower interest in the science, technology, engineering, and mathematics (STEM) subjects and related career decisions, which partly explains the underrepresentation of females in many STEM-related occupations that involve mathematics as a major component.

Social Environments

Similar to the role of individual antecedents such as gender, the impact of social environments is also thought to be mediated by individual control and value appraisals. Variables in the environment that affect these appraisals should influence the resulting emotions and disorders as well. According to CVT, the following groups of factors may be relevant for a broad variety of achievement emotions and disorders (Figure 18.1).

Cognitive Quality

The cognitive quality of classroom instruction and social environments as defined by their structure, clarity, and potential for cognitive stimulation likely has a positive influence on students' perceived control and the perceived value of academic tasks, thus positively influencing their achievement emotions. Conversely, lack of structure

and clarity can contribute to lack of control and resulting anxiety, confusion, shame, and hopelessness. In addition, the level of demands and difficulty of tasks are critically important. Task difficulty impacts the likelihood of successful performance, thus influencing perceived control over task performance and all of the emotions that depend on control. For example, if the very first questions on an exam are too difficult and cannot be answered, perceived control can decrease to the extent that a student starts to panic or even resigns and does not complete the exam.

Furthermore, the match between demands and competences can influence perceived task value, thus also influencing emotions. If demands slightly exceed current competencies, the task can be perceived as an enjoyable challenge. In contrast, if the demands are too high (over-challenge) or too low (under-challenge), the incentive value of a task may be reduced to the extent that boredom is experienced (Csikszentmihalyi, 1975; Pekrun et al., 2010). As such, a school environment that constantly overtaxes a student can contribute to both anxiety disorders (by decreasing control) and excessive boredom (by decreasing value).

Motivational Quality

Teachers, parents, and peers deliver messages about the controllability and value of academic tasks, thus influencing the genesis of emotional disorders. For example, perceived control can be influenced by attributing a student's achievement to specific causes. Telling students that their failures are due to lack of ability can reduce students' sense of control and prompt shame and anxiety; in contrast, attributing failure to lack of effort or study strategies helps students to uphold positive expectations and experience hope. Similarly, perceived value can be influenced by explaining the relevance of learning materials (Harackiewicz, Tibbetts, Canning, & Hyde, 2014). However, increasing perceived importance can boost not only positive emotions but negative emotions as well—as noted, greater value amplifies all types of emotion except for boredom. Specifically, reminding students of the importance of successful performance on tests and exams is a double-edged sword—"fear appeals" can exacerbate students' anxiety (Putwain, Remedios, & Symes, 2015; for related discussion, see Martin, Chapter 16, this volume).

Emotional Quality

Emotions can be directly transmitted to others by means of nonverbal communication. Displays of emotion conveyed by facial, gestural, and postural expression provide information about an individual's emotional state. These signals can be automatically mimicked by others so that the others experience the same emotion. Such "emotional contagion" (Hatfield, Cacioppo, & Rapson, 1994) likely plays a major role in daily classroom interaction, with emotions being transmitted from teachers to students, from students to teachers, and among classmates. As such, through emotional contagion, teachers can directly influence the mood in the class, provided that they display rather than suppress their emotions. In fact, a few studies suggest that teachers' enjoyment can strongly facilitate students' enjoyment of class, and that this process is mediated through teachers' displayed enthusiasm for teaching (Frenzel, Becker-Kurz, Pekrun, Goetz, & Lüdtke, 2018; Frenzel, Goetz, Lüdtke,

Pekrun, & Sutton, 2009). In addition, emotional transmission can involve observational learning: Watching others enjoy solving a problem shows that problem-solving can be enjoyable, which can facilitate students' adoption of positive value appraisals (Bruder, Fischer, & Manstead, 2014). It is likely that negative emotions, such as anxiety and anger, can be transmitted in similar ways. Emotional contagion and adoption of appraisals may be primary mechanisms explaining how female teachers can transmit their fear of math to their students (Beilock, Gunderson, Ramirez, & Levine, 2010).

Similarly, emotions in the family can likely be transmitted through these same mechanisms. Parents' or siblings' negative emotions related to school, or to achievement more generally, can be adopted by students through contagion and adoption of maladaptive appraisals. In fact, especially with younger children, parents may have more emotional power over their children than teachers and classmates, owing to children's attachment to caregivers and to the overall amount of time spent at home relative to school (for related discussion, see Panlilio & Corr, Chapter 9, this volume). As such, it seems likely that parents transmit their achievement appraisals, their anxieties, or their boredom not only through genetic transmission, but also through daily interaction with their children (see, e.g., Elliot & Thrash, 2004).

Goal Structures and Social Expectations

Different standards for evaluating achievement imply different goal structures in the classroom (Johnson & Johnson, 1974; Murayama & Elliot, 2009; Roseth, Johnson, & Johnson, 2008; for related discussion, see Bergin & Prewett, Chapter 14, this volume). In *individualistic goal structures* (alternatively called mastery goal structures), achievement is based on absolute (task mastery) or individual (individual improvement over time) standards. In these structures, the achievement of any individual student is defined independently from the achievement of other students. In contrast, *competitive goal structures* (alternatively called performance goal structures) are based on normative standards, which define a student's achievement relative to the achievement of other students. Based on such a definition, individual achievement is logically dependent on the achievement of others. Not everybody can succeed in terms of outperforming others, and the (normative) success of some students comes at the cost of failure for others. Finally, in *cooperative goal structures*, individual achievement is a positive function of the achievement of others—the better the contributions of each student, the better the achievement of the whole group.

These goal structures define opportunities for experiencing success and perceiving control, thus influencing students' emotions. Specifically, competitive goal structures imply, as noted, that some individuals have to experience failure, thus inducing negative emotions such as anxiety and hopelessness in these individuals (Pekrun, Elliot, & Maier, 2006). Similarly, the demands implied by an important other's unrealistic expectancies for achievement can lead to negative emotions resulting from reduced subjective control. For example, if parents hold overly high aspirations for their children's academic success, they can reduce children's sense of control to meet their parents' expectations, which can prompt anxiety and ultimately prevent the very attainment that parents had hoped for in the first place (Murayama, Pekrun, Suzuki, Marsh, & Lichtenfeld, 2016).

Composition of Student Groups

The ability level of the classroom determines the likelihood of performing well relative to one's classmates. All else being equal, chances for performing well relative to others are reduced when in a high-achieving class, thus students' perceived control and competence tend to be reduced as well. In contrast, being in a low-achieving class offers more chances to be successful, enabling a sense of competence (Marsh, 1987, calls this the "big-fish-little-pond effect"—all other things being equal, it may be preferable to be a "big fish" in a "little pond" rather than a relatively small fish in a big pond of high achievers; for related discussion, see Tracey et al., Chapter 24, this volume). Owing to these effects on perceived control, positive emotions such as enjoyment can be reduced, and negative emotions such as anxiety exacerbated, when a student is in a high-achieving class. Other things being equal, individual students' anxiety has, in fact, been found to be higher in high-ability classrooms than in low-ability classrooms (Pekrun, Murayama, Marsh, Goetz, & Frenzel, 2019; Preckel, Zeidner, Goetz, & Schleyer, 2008).

The negative effects of membership in a high-achieving classroom pose a conundrum for educators. Placing students in high-ability classes provides them with peers who are role models for cognitive development and can provide cognitive stimulation. However, these possible benefits need to be weighed against the psychosocial costs of such a placement, including the risk for a reduction in self-confidence, decrease in positive emotions, and increase in negative emotions. Furthermore, it may be that the expected benefits for learning do not even occur. When controlling for measurement error, the effects of class-average achievement on individual achievement can be negative as well (Dicke et al., 2018), implying that being in a high-achieving class neither benefits students' emotions nor their cognitive learning.

Furthermore, negative effects of being among higher-achieving students also jeopardize the educational benefits of inclusion of students with special needs. Including these students has been defined as a high-priority goal of educational policy (United Nations Organization, 2006) and is practiced across countries today. However, students with special needs who are low achievers may be at the bottom of the achievement hierarchies within regular classrooms, which is likely to undermine their self-confidence and exacerbate emotional disorders, relative to being among other low-achieving students in special education institutions (Szumski & Karwowski, 2015; Tracey et al., Chapter 24, this volume).

Feedback and Consequences of Achievement

Success can strengthen perceived control, and cumulative failure undermines control. In environments involving frequent assessments, performance feedback is likely of primary importance for the arousal of achievement emotions and genesis of related disorders. In addition, the consequences of success and failure are important, as they affect the instrumental value of achievement. Positive outcome emotions (e.g., hope for success) can be increased if success produces beneficial long-term outcomes (e.g., future career opportunities), provided sufficient contingency between one's own efforts, success, and these outcomes. Negative consequences of failure (e.g., unemployment), on the other hand, may increase achievement-related anxiety and hopelessness (Pekrun, 1992a).

As such, failure in academic exams can prompt strong and persistent distress responses. Especially for exams that define future opportunities, such as final university exams, it is difficult to judge whether such distress responses are “out of proportion to the severity or intensity of the stressor,” as required for diagnosing them as adjustment disorder (APA, 2013). Given the functions of academic exams in defining future prospects across domains (education, occupation, lifetime income, social status, health, etc.), it seems difficult to exaggerate their importance.

Mental-health-oriented policy should consider ways to redefine testing and exams rather than primarily considering exam-related adjustment problems as an individual disorder. Specifically, high-stakes testing bearing important consequences for students is likely to amplify their test emotions and to exacerbate related emotional disorders if failure cannot be avoided (Seegol, Carlson, Goforth, von der Embse, & Barterian, 2013), suggesting that policymakers and practitioners should refrain from implementing high-stakes testing wherever possible. This may also be true if the goal is to reduce negative emotions and burnout in teachers. Variants of testing that involve high stakes for teachers may fulfill principles of accountability but can exacerbate their negative achievement emotions, jeopardize their mental health, and contribute to teacher attrition (see Wiliam, 2010).

EFFECTS ON LEARNING, ACHIEVEMENT, AND BEHAVIORAL DISORDERS

Research has shown that emotions can profoundly influence a broad range of cognitive and behavioral processes (Barrett et al., 2016; Clore & Huntsinger, 2007). As such, achievement emotions and related emotional disorders can influence students’ academic learning and performance, as well as their behavior more generally.

Learning and Achievement

For students’ academic achievement, effects of emotions on attention, motivation, self-regulation, and use of learning strategies may be most important, as depicted in the cognitive-motivational model of emotion effects that is part of CVT (Pekrun, 1992b, 2006). *Activating positive emotions* such as enjoyment of learning focus students’ attention on learning, promote their motivation to learn, and facilitate use of deep learning strategies. As such, these emotions are thought to have positive effects on students’ achievement. In contrast, positive emotions that do not relate to learning, such as an adolescent’s first romantic emotions, can draw attention away, reduce academic effort, and lower overall performance. Similarly, *deactivating positive emotions*, such as relief and relaxation, may not always have positive effects on achievement.

Activating negative emotions such as anxiety or anger distract attention and reduce interest, intrinsic motivation, and deep learning, but they can strengthen extrinsic motivation to avoid failure. For example, if a student is afraid of failing an impending exam, they may be highly motivated to invest effort in order not to fail. As such, the effects of these emotions on learning outcomes can be variable. *Deactivating negative emotion* such as hopelessness and boredom, on the other hand, generally undermine attention, motivation, and strategy use, suggesting that they uniformly impair achievement. If students are bored by a lecture, their mind starts wandering, they cannot focus their attention on the lecture anymore, and their motivation to continue is undermined. Then, when they are tested on the contents, their memory of the material will remain poor.

Links between emotions and achievement outcomes have been most researched for students' test anxiety (Hembree, 1988; Zeidner, 1998, 2014; for related discussion, see, in this volume, Cassidy & Thomas, Chapter 3; Wigfield & Ponnock, Chapter 17), but recent studies have also addressed emotions other than anxiety. Across studies, positive emotions such as enjoyment of learning, hope, and pride typically correlated positively with students' grades and test scores at school. For negative emotions such as anxiety, anger, shame, hopelessness, and boredom, correlations were negative (Pekrun & Stephens, 2012). Furthermore, there is also longitudinal evidence demonstrating that students' emotions impact their achievement over the school years, with positive emotions promoting achievement and negative emotions undermining achievement (Meece, Wigfield, & Eccles, 1990; Pekrun, 1992a; Pekrun et al., 2017; Steinmayr, Crede1, McElvany, & Wirthwein, 2016).

Nonacademic Behavior and Behavioral Disorders

Students can cope with negative emotions and emotional disorders in adaptive or maladaptive ways. Two problematic variants are using drugs to fight negative emotion, and avoiding academic work and instead engaging in alternative, nonacademic behaviors. Both types of behavior involve emotion-focused rather than problem-focused coping. From an emotion regulation perspective (see below), drug use is a response-oriented type of regulation as it involves an attempt to suppress the emotional response through physiological pathways. Alternative behaviors, such as disengaging from school and engaging in internet gaming, involve situation selection in terms of avoiding school and switching to another context. Both variants of coping with negative achievement emotions are employed frequently by students. They can constitute DSM-diagnosed behavioral disorders if they persist over a longer period of time and lead to failure to fulfill academic obligations, as noted earlier (APA, 2013; for related discussion, in this volume, see Hue, Chapter 10; O'Donnell & Reschly, Chapter 23).

Drug use can involve any drugs that are suited to reduce activating negative emotions such as anxiety, or deactivating negative emotions such as boredom. Relevant drugs can include sedative and anxiolytic drugs, as noted earlier, but also other substances such as alcohol, nicotine, caffeine, and amphetamines. Alternative non-academic behaviors can include any kinds of action that make it possible to avoid dealing with academic tasks. This can be excessive engagement in behaviors that are usually seen as developmentally adaptive, such as sports; behaviors that are discussed controversially from a developmental perspective, such as extensive internet gaming; and behaviors that are clearly maladaptive, such as school absenteeism and delinquent behavior.

Furthermore, excessive negative achievement emotions can prompt students to engage in suicidal ideation and attempts to commit suicide. Suicidal behavior disorder shows a high comorbidity with depressive episodes and anxiety disorders (APA, 2013). Among adolescents and young adults, suicide is the second leading cause of death in Western countries, and the rates of suicide are increasing (e.g., in the US; National Institute of Mental Health, 2018).

RECIPROCAL CAUSATION, EMOTION REGULATION, AND INTERVENTION

Reciprocal Causation

Emotions influence students' learning, achievement, and nonacademic behavior, but achievement and behavioral outcomes are expected to reciprocally influence appraisals, emotions, and the environment (Pekrun, 2006; see Figure 18.1). As such, emotions, their antecedents, and their effects are linked by reciprocal causation over time. Reciprocal causation can involve a number of feedback loops, including the following two that may be especially important. First, emotions impact students' achievement, and achievement affects the development of their emotions. As outlined earlier, positive emotions typically promote achievement, and resulting success contributes to positive emotions. Negative emotions can undermine learning, and resulting failure exacerbates negative emotions. Second, learning environments shape students' appraisals and emotions, but these emotions reciprocally affect students' environments and the behavior of teachers, classmates, and parents. For example, teachers' and students' emotions during classroom instruction are likely linked in reciprocal ways, emotional contagion and social appraisals being mechanisms producing these links (Frenzel et al., 2018).

Reciprocal causation can take different forms and can extend over fractions of seconds (e.g., in linkages between appraisals and emotions), days, weeks, months, or years. Two important types of feedback loop are positive and negative loops. To explain, CVT adopts usage of the terms "positive" loop and "negative" loop from general systems theory (see Pekrun, 2006). As such, "positive" does not mean that a feedback loop has positive consequences, and "negative" does not imply negative consequences. Instead, these terms have an algebraic meaning. Positive feedback loops imply that the effect of variable A on variable B has the same sign as the effect of B on A; negative feedback loops imply that the two effects bear opposite signs. Depending on the variables involved, the outcomes of both types of loop can be either beneficial or detrimental.

Positive feedback loops likely are commonplace (e.g., in reciprocal linkages between different students' anxiety or between teachers' and students' enjoyment, as cited earlier). Positive feedback loops imply that individual risk factors, such as poor learning behavior and achievement, and emotional disorders can reinforce each other over time (vicious cycles of academic failure and negative emotions). Similarly, risky social environments involving reduced chances to succeed, on the one hand, and students' lack of control and negative emotions, on the other, can reinforce each other. For example, parental pressure for achievement can increase a student's anxiety, and the student's avoidance behavior and poor achievement can motivate parents to exert more pressure.

However, negative feedback loops are no less important and can be leveraged to alleviate negative emotions. For example, failure on an exam can induce anxiety in a student, but anxiety can motivate the student to successfully avoid failure in the next exam. Similarly, anxiety can motivate a student to seek support from teachers and parents, and support can help the student to reduce anxiety.

Reciprocal causation has implications for the regulation of achievement emotions, for the treatment of excessively negative emotions, and for the design of “emotionally sound” (Astleitner, 2000) learning environments. Specifically, as emotions, their antecedents, and their effects can be reciprocally linked over time, emotions can be regulated and changed by addressing any of the elements involved in these cyclic feedback processes.

Emotion Regulation

Emotion regulation is defined as intentional attempts to influence one’s emotions (Gross, 2015; Jacobs & Gross, 2014). Typically, individuals try to upregulate their positive emotions and downregulate their negative emotions, which can improve their hedonic balance. Alternatively, it is possible to downregulate positive or upregulate negative emotions in the service of higher-order goals, such as suppressing one’s pride about an A on an exam when other students failed (counter-hedonic emotion regulation; Gross, 2015). CVT implies that students can use situation-, appraisal-, emotion-, and competence-oriented strategies to regulate their emotions (Figure 18.1; Harley, Pekrun, Taxer, & Gross, 2019). These four groups of strategies are broadly consistent with J. Gross’s (2015) process model of emotion regulation. However, they expand upon Gross’s conception by considering competence-oriented regulation as a separate category that is especially relevant for regulating emotions in the achievement domain.

Situation-Oriented Regulation

Students can select and modify situations to regulate their emotions (*situation selection* and *situation modification* in Gross’s model). An example is selecting a course or school track that matches a student’s interests and competencies, thus facilitating enjoyment and reducing anxiety. Once a situation is selected, it is still possible to modify its features to regulate emotions. For example, students can ask teachers for support when they encounter difficulties or modify tasks to make them less boring (Sansone, Weir, Harpster, & Morgan, 1992). Depending on students’ age and the format of classroom instruction, competencies and opportunities to select and modify academic tasks and environments may be limited. However, situation selection and modification can be used by teachers and parents, and students can prompt such regulation by asking them for help.

Appraisal-Oriented Regulation

This type of regulation addresses the cognitive processes that mediate between situational events and emotional responses, including changing appraisals (*reappraisal*), as well as changing the attention to the events that prompt these appraisals (*attention deployment*; Gross, 2015). According to CVT, three types of reappraisal are especially important to reduce appraisal bias and negative emotions: increasing perceived control, increasing positive intrinsic value, and reducing excessive negative value of achievement activities and failure.

As for attention deployment, an important feature of emotional disorders, such as phobias and GAD, is sustained and enhanced attention on negative events, such as focusing on past and future failures in test anxiety. Such *attentional biases* are often implicit and unknown to the individual (Mogg & Bradley, 2005). As such, one way to regulate negative achievement emotions is to make attentional biases accessible to conscious reflection in order to reduce them.

Emotion-Oriented Regulation

Emotions can be regulated by influencing the psychological, physiological, and behavioral responses that are part of emotion. Response modulation occurs late in the emotion episode, after response tendencies have been initiated. For example, students who experience tension and bodily symptoms when taking an important test may try to tone down the physiological aspects of anxiety (e.g., increased heart rate, trembling hands) and its psychological symptoms (e.g., worry, feelings of uncertainty) by taking anxiolytic drugs, smoking cigarettes, and drinking alcohol, or by practicing relaxation techniques.

Expressive suppression is a response-focused strategy that aims to prevent the emotional response from being observed. Suppression can decrease expressive behavior, but can come at the cost of increasing rather than decreasing physiological arousal (Gross & Thompson, 2007). Furthermore, explicit suppression may require continuous monitoring, which taxes cognitive resources (Baumeister & Eppes, 2005) and reduces the resources available for performing academic tasks. Rather than hiding emotions, students may express them verbally or nonverbally. The advantage of emotion expression is that attention is called to what one feels, which may contribute to modifying the situation. For example, students may show disappointment when they are unable to solve a problem, which can prompt support by teachers or classmates.

Competence-Oriented Regulation

Research has shown that the best predictor of academic performance is students' existing competencies in a given subject domain. As outlined earlier, successful performance drives positive achievement emotions, whereas cumulative failure contributes to the development of negative emotions. By implication, building one's competencies is an important strategy to reduce negative achievement emotions and related disorders (for related discussion, in this volume, see Schunk & DiBenedetto, Chapter 11; Wigfield & Ponnock, Chapter 17). Relevant competencies include subject-matter knowledge as well as metacognitive knowledge about organizing one's learning in terms of effectively using available resources (e.g., time, personal energy), using cognitive learning strategies, and using metacognitive strategies to adequately monitor and evaluate one's progress (for related discussion, see Perry, Mazabel, & Yee, Chapter 13, this volume). Competence-oriented regulation plays a role in all situations that demand skillful action, but may be especially important for achievement activities and related achievement emotions.

Regulating before the full-fledged emotional response has developed can be more effective than regulating the emotion after it has already been prompted. As such, situation-, appraisal-, and competence-oriented regulation can be more beneficial than

emotion-oriented regulation. However, it would be misleading to generally classify some strategies as adaptive and others as maladaptive. For example, although some emotion-oriented strategies, such as taking drugs, come at high costs for performance and health when used over months or years, they may be beneficial in the short term (e.g., to dampen extreme panic right before an important exam). As such, it is important to be able to flexibly use a repertoire of different strategies in ways that are adapted to situational demands. Abilities to flexibly use emotion regulation strategies are part of students' emotional competences (or "emotional intelligence"; Matthews, Zeidner, & Roberts, 2002).

INTERVENTION AND EDUCATIONAL PRACTICES

Achievement emotion disorders and related behavioral disorders can be prevented or reduced using psychotherapy, classroom interventions, and appropriate educational practices. Psychotherapy differs from classroom intervention and practices by addressing existing disorders. Classroom treatment interventions differ from educational practices more generally by explicitly targeting students' emotions, whereas educational practices typically have a broader focus. However, principles of intervention can be used to enrich educational practices, suggesting that this distinction is less clear.

Psychotherapy

Therapy for achievement emotions is warranted when students experience excessive negative emotions or a severe lack of positive emotions. To date, the evidence on available options is largely limited to therapy for students' test anxiety. This evidence shows that individual achievement anxiety is treatable; in fact, some of the treatments for test anxiety are among the most successful psychological therapies available (Hembree, 1988). Similar to the various individual strategies to regulate emotions described earlier, different test anxiety treatments focus on different manifestations and antecedents of this emotion, including affective-physiological symptoms (emotion-oriented therapy); cognitive appraisals and appraisal biases (cognitive therapy); and competence deficits caused by a lack of strategies for learning and problem-solving (skills training, competence development; Zeidner, 1998). Multimodal therapies integrate different procedures to address different symptoms and antecedents of anxiety within one treatment. Cognitive and multimodal therapies have proven especially effective at both reducing achievement anxiety and enhancing academic performance (Zeidner, 1998). This is consistent with CVT's proposition that maladaptive control-value appraisals are prime drivers of achievement emotion disorders, which implies that psychotherapy should target these appraisals.

Classroom Intervention

Researchers have started to use motivational interventions in the classroom to help students change their emotions. From the perspective of CVT, interventions that target perceived control bias, lack of value bias, and negative value bias may be especially promising. Specifically, there is evidence that *attributional retraining* can not only increase students' motivation and academic performance, but also change their

achievement emotions (for related discussion, see Martin, Chapter 16, this volume). Attributional retraining aims to increase perceived control over achievement by scaffolding students to change their attributions. For example, students are instructed to switch from attributing failure to uncontrollable lack of ability to considering controllable factors such as lack of effort or learning strategies. Studies have shown that attributional retraining can reduce negative achievement emotions such as test anxiety and increase positive emotions such as hope and pride (for a summary, see Perry, Chipperfield, Hladkyj, Pekrun, & Hamm, 2014). It is to be expected that other interventions targeting perceived control, such as *growth mindset intervention* (Yeager & Dweck, 2012), can be similarly beneficial.

Utility value intervention targets lack of value (Harackiewicz et al., 2014). As noted earlier, utility value pertains to the extrinsic value of achievement activities as defined by their instrumental usefulness to attain further outcomes, such as the competencies needed to deal with math in daily life or prospects for future career opportunities (for related discussion, see Wigfield & Ponnock, Chapter 17, this volume). One typical method is asking students to generate ideas and write essays on how the contents in a given domain, such as math or science, could be useful for their current or future lives (see also Kaplan, Sinai, & Flum, 2014). The existing evidence demonstrates that utility value intervention can increase students' motivation and academic performance. It seems likely that this intervention can also affect their emotions. However, CVT proposes that increasing the perceived importance of achievement activities can not only promote positive emotions but also amplify negative emotions such as fear of failure. To the extent that this is the case in a given group of students, it may be useful to use principles of utility intervention to increase intrinsic value rather than instrumental value.

Lack of control, lack of value, excessive negative value, and the emotions associated with these three appraisal biases can be combined, but can also occur separately. As such, the three biases define different groups of students at risk for achievement emotion disorders. By implication, each single control-related or value-related intervention can help some, but not all, students at risk. For classroom intervention aiming to address a broader range of emotional problems, a multimodal combination of the principles of these interventions could be useful (e.g., *control value intervention*, Pekrun, 2018b; see also Harackiewicz & Priniski, 2018).

Educational Practices

Educators can change their daily classroom practices, and policymakers can change the structure of educational institutions, to reduce emotional disorders in students and promote their mental health. CVT implies that this can be achieved by targeting the environmental factors listed earlier (see section on the role of social environments and Pekrun, 2014). As such, teachers can help students by increasing the cognitive, motivational, and emotional quality of classroom instruction and exams through providing clearly structured materials and clear explanations; matching task demands to students' competencies; conveying information that academic activities are intrinsically valuable; refraining from using fear appeals that exacerbate negative value and anxiety; displaying their enthusiasm about subject matter and teaching their class; and better regulating their own anger and anxiety.

In terms of goal structures and expectations, teachers can focus on using mastery standards to evaluate achievement; implementing mastery and cooperative goal structures in the classroom; and adapting their expectations to students' proximal zone of development, rather than boosting competitive social comparison and conveying aspirations that are too high to be met by students (for related discussion, see Bergin & Prewett, Chapter 14, this volume). In terms of placing students in schools and classes and composing student groups, policymakers, teachers, and parents should attend to the potentially detrimental consequences of including low achievers in high-achieving groups, and of practices of tracking and streaming more generally. Finally, an important message conveyed by CVT is that policymakers and administrators should refrain from overinflating the importance of achievement. Specifically, they should refrain from making students' career opportunities contingent upon current performance. High-stakes testing can increase students' extrinsic motivation, but is likely to jeopardize their intrinsic motivation, undermine their enjoyment, and intensify their anxiety, thus putting them at risk for developing emotional disorders.

DIRECTIONS FOR FUTURE RESEARCH

As outlined in this chapter, CVT is a useful tool for explaining students' emotional problems at school and designing interventions targeting these problems. However, for many of the theory's propositions and related emotional disorders, researchers have only just begun to collect empirical evidence. Whereas cumulative findings are available for excessive test anxiety, achievement emotion disorders other than anxiety have not yet received the attention they deserve. By implication, whereas it is possible to derive evidence-based recommendations for practice for test anxiety, recommendations for many other emotional problems still remain speculative. To facilitate evidence-based practice and make it possible to better inform educational policymakers, administrators, teachers, and parents, the following directions for future research on achievement emotion disorders may be especially important.

Prevalence

Although it is clear that substantial numbers of students suffer from excessive test anxiety across age groups and cultural contexts, the prevalence of other achievement emotion disorders is less clear owing to lack of research. Correlations between achievement emotions in the general student population suggest that there are three groups of emotions that show high correlations within groups and only moderate correlations between groups: positive emotions; mixed-control negative emotions including anger, frustration, and boredom; and low-control negative emotions such as anxiety, shame, and hopelessness (e.g., Pekrun et al., 2011). These findings suggest that emotions from these three groups are distinct. However, it remains unclear if they also are distinct at the tails of the score distributions (excessively low positive emotion, excessively high negative emotion). It could be that achievement emotion disorders are typically generalized across emotions (generalized achievement emotion disorder), or that they are distinct, which would make it necessary to distinguish between different disorders.

As with psychiatric classifications of emotional disorders more generally, the problem of categorization is aggravated by the fact that distributions of emotion

parameters such as frequency or intensity typically are continuous. Dichotomizing or trichotomizing these distributions into categories, such as mild, moderate, and severe depressive episodes, involves decisions that are conceptually arbitrary, are difficult to justify empirically, and jeopardize the reliability of diagnoses (see also Scherer & Mehu, 2015). As such, a dimensional perspective on achievement emotion disorders, and emotional disorders more generally, may be more fruitful than categorical conceptions as used in current systems such as the ICD-11 and the DSM-5.

Comorbidity and Role for General Emotional Disorders

It is a task for future research to clarify how frequently achievement emotion disorders co-occur with other disorders (see also Bögels et al., 2010; for related discussion, see, in this volume, Bergin & Prewett, Chapter 14; Hall et al., Chapter 7; Schunk & DiBenedetto, Chapter 11; Swanson, Chapter 2). In addition, it is important to examine the role of achievement emotions in general emotional disorders, such as depressive episodes and GAD (for related discussion, in this volume, see Cassady & Thomas, Chapter 3; Wigfield & Ponnock, Chapter 17). As argued earlier, given that achievement situations typically represent a major part of students' daily life, it seems likely that related emotions are critically important components of these disorders. Combinations of achievement emotion disorders with other disorders may depend on age and developmental stage, making it important to conduct longitudinal, developmental studies. For example, achievement anxiety may be characterized as one type of social-evaluative anxiety early in children's development. Later, values of success and failure can become internalized and disconnected from their social origins, implying that achievement anxiety can show distinct developmental trajectories that differ from the development of a student's social anxiety.

Individual Antecedents

As outlined earlier, the existing findings support the proposal that control and value appraisals are proximal antecedents of achievement emotions. However, evidence specifically targeting excessive emotions and their link with appraisal biases is largely lacking. Furthermore, similar to the difficulties of distinguishing normal versus abnormal emotion, it remains unclear whether it would be useful to define cutoff values separating normal-range from biased appraisals, and how such cutoff values could be defined. In addition, research is needed to clarify the role of appraisals within the broader spectrum of individual antecedents, including physiological processes and genetic dispositions. For achievement anxiety, as well as anxiety more generally, there may be substantial heritability (Zeidner, 2007). However, this may be different with other achievement emotions. Research should investigate the role of genetic and epigenetic transmission of achievement emotion disorders, as well as the joint and interactive action of genetic dispositions and socially transmitted appraisals.

Social Antecedents

Research has started to investigate the links between classroom instruction and students' achievement emotions. However, with few exceptions (e.g., Frenzel et al., 2018), most of the available studies have used cross-sectional designs and failed to account

for the multilevel nature of classroom data. Furthermore, the focus typically has been on the influence of teachers. We need more evidence on the role of parents and peers for the development of achievement emotion disorders. As outlined earlier, emotions are contagious; to what extent is this also true for excessive emotions, and how do parents', classmates', and students' emotional disorders co-develop over time? To answer these questions, advanced analytical methodology such as doubly-latent multilevel modeling and social network analysis will be needed (e.g., Borgatti, Mehra, Brass, & Labianca, 2009; Marsh et al., 2009; Pekrun et al., 2019).

Cultural Context and Relative Universality

CVT proposes that trigger events and objects of achievement emotions, as well as process parameters such as frequency, intensity, and decay rates, can differ across individuals, genders, academic domains, and cultures (for related discussion, see, in this volume, Graham & Harris, Chapter 20; Jordan et al., Chapter 19; Macfarlane et al., Chapter 25; Morsanyi, Chapter 21; Tricot, Vandenbroucke, & Sweller, Chapter 15). However, the functional relations of these emotions with their outcomes and antecedents are thought to be universal (as per the *relative universality* hypothesis of achievement emotions; see Pekrun, 2009, 2018a). As such, the symptoms of achievement emotion disorders are likely to vary across cultures, similar to the cultural contingency of other emotional disorders (APA, 2013). In contrast, their links with outcomes and origins should follow universal principles.

Relative universality has been examined for achievement emotions in the broader student population. For example, findings from the OECD's PISA suggest that average levels of achievement anxiety vary substantially across countries, whereas the link between anxiety and students' performance is universally negative across countries. For example, in the PISA 2012 assessment, students' anxiety and achievement in math correlated negatively in all of the 64 participating countries, and all of these correlations but one were significant (OECD, 2013). Similarly, in the PISA 2015 assessment, students' schoolwork-related anxiety showed negative correlations with their science performance in 52 of 55 countries participating in the assessment of anxiety (OECD, 2016). However, this evidence pertains to the whole range of emotion and performance scores in the general student population. Future research should investigate if principles of relative universality also hold for the excessive emotions implied by achievement emotion disorders.

Intervention and Educational Practices

We need more research examining ways to design and implement classroom interventions that are suited to prevent or reduce achievement emotion disorders, and to generally help students develop adaptive and reduce maladaptive emotions. To make a start, it could be useful to investigate the possible benefits of existing motivational interventions targeting students' lack of control or lack of value, such as attributional retraining, growth mindset intervention, and utility value intervention, as discussed earlier. Research is also needed to investigate possible negative emotional side effects of these interventions, such as increasing students' anxiety as a result of increasing perceived value. Furthermore, it could be fruitful to examine if existing social-emotional learning (SEL) programs (Durlak, Domitrovich, Weissberg, & Gullotta, 2016), which

target students' general competencies to understand and regulate emotions, are suited to reduce achievement emotion disorders. Alternatively, if a more focused approach is needed, principles of SEL programs could be adapted to specifically target the regulation of achievement emotions.

We also need research investigating how changing daily classroom practices can help to reduce emotional disorders. This includes practices that are fully under teachers' control, but also rules that are defined by educational policy and educational institutions, such as how to compose student groups and how to evaluate students' achievement. For example, research using the PISA data suggests that low-achieving students' levels of self-confidence can be reduced in education systems using course-by-course tracking within schools, relative to systems using within- and between-school streaming that separates low from high achievers (Chmielewski, Dumont, & Trautwein, 2013; but see also Parker, Marsh, Jerrim, Guo, & Dicke, 2018). Research is needed to find out if these effects translate into reduced levels of emotional well-being, and how appropriately composing student groups could help with reducing the prevalence of achievement emotion disorders.

In both intervention studies and research on classroom practices, it will be important to distinguish between different risk groups of students and investigate the relative benefits for these groups, such as *lack-of-control students* experiencing hopelessness and resignation, *lack-of-value students* suffering from boredom, and *excessive-negative-value students* whose mental health is derailed by persistent achievement anxiety. In order to translate the findings into practice, and to scale up benefits to national and international levels, knowledge about emotions and related interventions also needs to be included in teacher education programs.

CONCLUSION

Emotional disorders are among the most prevalent mental health problems in childhood, adolescence, and young adulthood. As discussed in this chapter, this is true not only for depressive episodes and general anxiety disorders, but also for achievement-related emotional problems. When these problems meet criteria for disorders in terms of intensity, persistence, and impairment of mental health and daily functioning, we propose calling them achievement emotion disorders. Examples are excessive achievement anxiety, shame, boredom, and hopelessness, as well as lack of enjoyment. Despite their frequency and importance for students' well-being and development, these disorders are disregarded in current psychiatric classifications such as the ICD-11 and the DSM-5.

Apart from biologically grounded individual dispositions, biases of individual appraisals of achievement activities, success, and failure likely are major determinants of achievement emotion disorders. These biases may pertain to perceived lack of control, lack of value, or excessive negative value. Social factors that contribute to these biases are risk factors as well, such as achievement standards and social reactions suggesting that a failure makes a student a worthless person. Achievement emotion disorders, in turn, contribute to students' general emotional disorders, behavioral disorders, and academic difficulties. Treatment of achievement emotion disorders in terms of individual psychotherapy and classroom interventions should focus on reducing appraisal biases as well as individual and social risk factors prompting such biases, and prevention should focus on designing educational environments in ways

that help students develop healthy appraisals. Researchers need to develop suitable interventions and design principles, and policymakers, administrators, and practitioners need to implement them in educational practice and teacher education. Through combining such efforts invested by researchers and educators, it should be possible to help students move through their educational careers with confidence and enjoyment, rather than anxiety, boredom, or hopelessness.

REFERENCES

- American Psychiatric Association (APA). (2013). *Diagnostic and statistical manual of mental disorders version 5*. Washington, DC: Author.
- Astleitner, H. (2000). Designing emotionally sound instruction: The FEASP-approach. *Instructional Science*, 28, 169–198. doi:10.1023/A:1003893915778
- Baker, M., & Bishop, F. L. (2015). Out of school: A phenomenological exploration of extended non-attendance. *Educational Psychology in Practice*, 31, 354–368. doi:10.1080/02667363.2015.1065473
- Barefoot, B. O. (2004). Higher education's revolving door: Confronting the problem of student drop-out in U.S. colleges and universities. *Open Learning*, 19, 9–18. doi:10.1080/0268051042000177818
- Barrett, F. L., Lewis, M., & Haviland-Jones, J. M. (Eds.). (2016). *Handbook of emotions* (4th ed.). New York: Guilford Press.
- Baumeister, R. F., & Eppes, F. (2005). *The cultural animal, human nature, meaning, and social life*. Oxford, UK: Oxford University Press.
- Beilock, S. L., Gunderson, E. A., Ramirez, G., & Levine, S. C. (2010). Female teachers' math anxiety affects girls' math achievement. *Proceedings of the National Academy of Sciences*, 107, 1860–1863. doi:10.1073/pnas.0910967107
- Blagg, N. (1987). *School phobia and its treatment*. London, UK: Routledge.
- Bögels, S. M., Alden, L., Beidel, D. C., Clark, L. A., Pine, D. S., & Stein, M. B. (2010). Social anxiety disorder: Questions and answers for the DSM-V. *Depression and Anxiety*, 27, 168–189. doi:10.1002/da.20670
- Borgatti, S. P., Mehra, A., Brass, D. J., & Labianca, G. (2009). Network analysis in the social sciences. *Science*, 323(5916), 892–895. doi:10.1126/science.1165821
- Bruder, M., Fischer, A., & Manstead, A. S. (2014). Social appraisal as a cause of collective emotions. In C. von Scheve & M. Salmela (Eds.), *Collective emotions: Perspectives from psychology, philosophy, and sociology* (pp. 141–155). Oxford, UK: Oxford University Press.
- Chang, H., & Beilock, S. L. (2016). The math anxiety-math performance link and its relation to individual and environmental factors: A review of current behavioral and psychophysiological research. *Current Opinion in Behavioral Science*, 10, 33–38. doi:10.1016/j.cobeha.2016.04.011
- Chmielewski, A. K., Dumont, H., & Trautwein, U. (2013). Tracking effects depend on tracking type: An international comparison of students' mathematics self-concept. *American Educational Research Journal*, 50, 925–957. doi:10.3102/0002831213489843
- Clore, G. L., & Huntsinger, J. R. (2007). How emotions inform judgment and regulate thought. *Trends in Cognitive Sciences*, 11, 393–399. doi:10.1016/j.tics.2007.08.005
- Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety*. San Francisco, CA: Jossey-Bass.
- de Bruin, A. B. H., Kok, E. M., Lobbestael, J., & de Grip, A. (2017). The impact of an online tool for monitoring and regulating learning at university: Overconfidence, learning strategy, and personality. *Metacognition and Learning*, 12, 21–43. doi:10.1007/s11409-016-9159-5
- Dicke, T., Marsh, H. W., Parker, P. D., Pekrun, R., Guo, J., & Televantou, I. (2018). Effects of school-average achievement on individual self-concept and achievement: Unmasking phantom effects masquerading as true compositional effects. *Journal of Educational Psychology*, 110, 1112–1126. doi:10.1037/edu0000259
- Durlak, J. A., Domitrovich, C. E., Weissberg, R. P., & Gullotta, T. P. (Eds.). (2016). *Handbook of social and emotional learning: Research and practice*. New York: Guilford Press.
- Elliot, A. J., & Thrash, T. M. (2004). The intergenerational transmission of fear of failure. *Personality and Social Psychology Bulletin*, 30, 957–971. doi:10.1177/0146167203262024
- Ellis, A. (1962). *Reason and emotion in psychotherapy*. New York: Lyle Stuart.
- Essau, C. A., Lewinsohn, P. M., Lim, J. X., Moon-ho, R. H., & Rohde, P. (2018). Incidence, recurrence and comorbidity of anxiety disorders in four major developmental stages. *Journal of Affective Disorders*, 228, 248–253. doi:10.1016/j.jad.2017.12.014

- Feldman, R. S. (2005). *Improving the first year of college: Research and practice*. Mahwah, NJ: Lawrence Erlbaum.
- Ferguson, C. J., Coulson, M., & Barnett, J. (2011). A meta-analysis of pathological gaming prevalence and comorbidity with mental health, academic and social problems. *Journal of Psychiatric Research*, 45, 1573–1578. doi:10.1016/j.jpsychires.2011.09.005
- Folkman, S., & Lazarus, R. S. (1985). If it changes it must be a process: Study of emotion and coping during three stages of a college examination. *Journal of Personality and Social Psychology*, 48, 150–170. doi:10.1037/0022-3514.48.1.150
- Foster, D. W., Hoff, R. A., Pilver, C. E., Yau, Y. H. C., Steinberg, M. A., Wampler, J., ... Potenza, M. N. (2015). Correlates of gambling on high school grounds. *Addictive Behaviors*, 51, 57–64. doi:10.1016/j.addbeh.2015.07.006
- Frenzel, A. C., Becker-Kurz, B., Pekrun, R., Goetz, T., & Lüdtke, O. (2018). Emotion transmission in the classroom revisited: A reciprocal effects model of teacher and student enjoyment. *Journal of Educational Psychology*, 110, 628–639. doi:10.1037/edu0000228
- Frenzel, A. C., Goetz, T., Lüdtke, O., Pekrun, R., & Sutton, R. (2009). Emotional transmission in the classroom: Exploring the relationship between teacher and student enjoyment. *Journal of Educational Psychology*, 101, 705–716. doi:10.1037/a0014695
- Frenzel, A. C., Pekrun, R., & Goetz, T. (2007). Girls and mathematics – A “hopeless” issue? A control-value approach to gender differences in emotions towards mathematics. *European Journal of Psychology of Education*, 22, 497–514. doi:10.1007/BF03173468
- Goetz, T., Frenzel, A. C., Pekrun, R., Hall, N. C., & Lüdtke, O. (2007). Between- and within-domain relations of students’ academic emotions. *Journal of Educational Psychology*, 99, 715–733. doi:10.1037/0022-0663.99.4.715
- Goetz, T., Frenzel, A. C., Stoeger, H., & Hall, N. C. (2010). Antecedents of everyday positive emotions: An experience sampling analysis. *Motivation and Emotion*, 34, 49–62. doi:10.1007/s11031-009-9152-2
- Graham, S., & Taylor, A. Z. (2014). An attributional approach to emotional life in the classroom. In R. Pekrun & L. Linnenbrink-Garcia (Eds.), *International handbook of emotions in education* (pp. 96–119). New York: Taylor & Francis.
- Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological Inquiry*, 26, 1–26. doi:10.1080/1047840X.2014.940781
- Gross, J. J., & Thompson, R. A. (2007). Emotion regulation: Conceptual foundations. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 3–26). New York: Guilford Press.
- Harackiewicz, J. M., & Priniski, S. J. (2018). Improving student outcomes in higher education: The science of targeted intervention. *Annual Review of Psychology*, 69, 409–435. doi:10.1146/annurev-psych-122216-011725
- Harackiewicz, J. M., Tibbetts, Y., Canning, E. A., & Hyde, J. S. (2014). Harnessing values to promote motivation in education. In S. Karabenick & T. Urden (Eds.), *Advances in motivation and achievement*, Vol. 18: *Motivational interventions* (pp. 71–105). Bingley, UK: Emerald.
- Harley, J. M., Pekrun, R., Taxer, J. L., & Gross, J. J. (2019). Emotion regulation in achievement situations: An integrated model. *Educational Psychologist*, 54, 106–126.
- Hatfield, E., Cacioppo, J. T., & Rapson, R. L. (1994). *Emotional contagion*. New York: Cambridge University Press.
- Heckhausen, H. (1991). *Motivation and action*. Berlin, Germany: Springer.
- Hembree, R. (1988). Correlates, causes, effects, and treatment of test anxiety. *Review of Educational Research*, 58, 47–77. doi:10.3102/00346543058001047
- Horwitz, E. K. (2001). Language anxiety and achievement. *Annual Review of Applied Linguistics*, 21, 112–126. doi:10.1017/S0267190501000071
- Jacobs, S. E., & Gross, J. J. (2014). Emotion regulation in education: Conceptual foundations, current applications, and future directions. In R. Pekrun & L. Linnenbrink-Garcia (Eds.), *International handbook of emotions in education* (pp. 183–201). New York: Taylor & Francis.
- Johnson, D. W., & Johnson, R. T. (1974). Instructional goal structure: Cooperative, competitive or individualistic. *Review of Educational Research*, 4, 213–240. doi:10.3102/00346543044002213
- Kaplan, A., Sinai, M., & Flum, H. (2014). Design-based interventions for promoting students’ identity exploration within the school curriculum. In S. Karabenick & T. C. Urden (Eds.), *Advances in motivation and achievement*, Vol. 18: *Motivational interventions* (pp. 243–291). Bingley, UK: Emerald.
- Kearney, C. A., Eisen, A. R., & Silverman, W. K. (1995). The legend and myth of school phobia. *School Psychology Quarterly*, 10, 65–85. doi:10.1037/h0088293
- Keyes, C. L. M. (2007). Promoting and protecting mental health as flourishing: A complementary strategy for improving national mental health. *American Psychologist*, 62, 95–108.

- Larson, R. W., & Richards, M. H. (1991). Boredom in the middle school years: Blaming schools versus blaming students. *American Journal of Education*, 99, 418–443. doi:10.1086/443992
- Lauerman, F., Eccles, J. S., & Pekrun, R. (2017). Why do children worry about their academic achievement? An expectancy-value perspective on elementary students' worry about their mathematics and reading performance. *ZDM Mathematics Education*, 49, 339–354. doi:10.1007/s11858-017-0832-1
- Marsh, H. W. (1987). The big-fish-little-pond effect on academic self-concept. *Journal of Educational Psychology*, 79, 280–295. doi:10.1037/0022-0663.79.3.280
- Marsh, H. W., Lüdtke, O., Robitzsch, A., Trautwein, U., Asparouhov, T., Muthén, B., & Nagengast, B. (2009). Doubly-latent models of school contextual effects: Integrating multilevel and structural equation approaches to control measurement and sampling error. *Multivariate Behavioral Research*, 44, 764–802. doi:10.1080/00273170903333665
- Marsh, H. W., & Shavelson, R. (1985). Self-concept: Its multifaceted, hierarchical structure. *Educational Psychologist*, 20, 107–123. doi:10.1207/s15326985ep2003_1
- Matthews, G., Zeidner, M., & Roberts, R. D. (2002). *Emotional intelligence: Science and myth*. Cambridge, MA: MIT Press.
- Meece, J. L., Wigfield, A., & Eccles, J. S. (1990). Predictors of math anxiety and its influence on young adolescents' course enrollment intentions and performance in mathematics. *Journal of Educational Psychology*, 82, 60–70. doi:10.1022-0663/90/S00.75
- Mehta, N., Croudace, T., & Davies, S. C. (2015). Public mental health: Evidenced-based priorities. *The Lancet*, 385, 1472–1475.
- Mehu, M., & Scherer, K. R. (2015). The appraisal bias model of cognitive vulnerability to depression. *Emotion Review*, 7, 272–279. doi:10.1177/1754073915575406
- Merikangas, K. R., Nakamura, E. F., & Kessler, R. C. (2009). Epidemiology of mental disorders in children and adolescents. *Dialogues in Clinical Neuroscience*, 11, 7–20.
- Metalsky, G. I., Abramson, L. Y., Seligman, M. E., Semmel, A., & Peterson, C. (1982). Attributional styles and life events in the classroom: Vulnerability and invulnerability to depressive mood reactions. *Journal of Personality and Social Psychology*, 43, 612–617. doi:10.1037/0022-3514.43.3.612
- Mogg, K., & Bradley, B. P. (2005). Attentional bias in generalized anxiety disorder versus depressive disorder. *Cognitive Therapy and Research*, 29, 29–45. doi:10.1007/s10608-005-1646-y
- Murayama, K., & Elliot, A. J. (2009). The joint influence of personal achievement goals and classroom goal structures on achievement-relevant outcomes. *Journal of Educational Psychology*, 101, 432–447. doi:10.1037/a0014221
- Murayama, K., Pekrun, R., Suzuki, M., Marsh, H. W., & Lichtenfeld, S. (2016). Don't aim too high for your kids: Parental over-aspiration undermines students' learning in mathematics. *Journal of Personality and Social Psychology*, 111, 166–179. doi:10.1037/pspp0000079
- National Institute of Mental Health. (2018). *Suicide*. Retrieved from www.nimh.nih.gov/health/statistics/suicide.shtml#part_154968
- Nett, U. E., Goetz, T., & Hall, N. C. (2011). Coping with boredom in school: An experience sampling perspective. *Contemporary Educational Psychology*, 36, 49–59. doi:10.1016/j.cedpsych.2010.10.003
- Organisation for Economic Co-operation and Development (OECD). (2010). *PISA 2009 results (Volume 3): Learning to learn—Student engagement, strategies and practices*. Paris, France: Author.
- Organisation for Economic Co-operation and Development (OECD). (2013). *PISA 2012 results (Volume 3): Ready to learn. Students' engagement, drive and self-beliefs*. Paris, France: Author.
- Organisation for Economic Co-operation and Development (OECD). (2016). *PISA 2015 results (Volume 1): Excellence and equity in education*. Paris, France: Author.
- Organisation for Economic Co-operation and Development (OECD). (2017). *PISA 2015 results (Volume 3): Students' well-being*. Paris, France: Author.
- Parker, P. D., Marsh, H. W., Jerrim, J. P., Guo, J., & Dicke, T. (2018). Inequity and excellence in academic performance: Evidence from 27 countries. *American Educational Research Journal*, 55, 836–858. doi:10.3102/0002831218760213
- Pekrun, R. (1992a). Expectancy-value theory of anxiety: Overview and implications. In D. G. Forgays, T. Sosnowski, & K. Wrzesniewski (Eds.), *Anxiety: Recent developments in self-appraisal, psychophysiological and health research* (pp. 23–41). Washington, DC: Hemisphere.
- Pekrun, R. (1992b). The impact of emotions on learning and achievement: Towards a theory of cognitive/motivational mediators. *Applied Psychology: An International Review*, 41, 359–376. doi:10.1111/j.1464-0597.1992.tb00712.x

- Pekrun, R. (1993). Facets of students' academic motivation: A longitudinal expectancy-value approach. In M. Maehr & P. Pintrich (Eds.), *Advances in motivation and achievement* (Vol. 8, pp. 139–189). Greenwich, CT: JAI Press.
- Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review*, 18, 315–341. doi:10.1007/s10648-006-9029-9
- Pekrun, R. (2009). Global and local perspectives on human affect: Implications of the control-value theory of achievement emotions. In M. Wosnitza, S. A. Karabenick, A. Efklides, & P. Nenniger (Eds.), *Contemporary motivation research: From global to local perspectives* (pp. 97–115). Cambridge, MA: Hogrefe.
- Pekrun, R. (2014). *Emotions and learning* (Educational Practices Series, Vol. 24). Geneva, Switzerland: International Academy of Education and International Bureau of Education of UNESCO.
- Pekrun, R. (2018a). Control-value theory: A social-cognitive approach to achievement emotions. In G. A. D. Liem & D. M. McInerney (Eds.), *Big theories revisited 2: A volume of research on sociocultural influences on motivation and learning* (pp. 162–190). Charlotte, NC: Information Age.
- Pekrun, R. (2018b, April). *Achievement emotions: State of the art, challenges, and new directions*. Sylvia Scribner Award address presented at the Annual Meeting of American Educational Research Association, New York.
- Pekrun, R. (2019). Self-appraisals and emotions: A control-value approach. Chapter prepared for T. Dicke, F. Guay, H. W. Marsh, R. G. Craven, & D. M. McInerney (Eds.). *Self – a multidisciplinary concept*. Charlotte, NC: Information Age Publishing (forthcoming).
- Pekrun, R., Elliot, A. J., & Maier, M. A. (2006). Achievement goals and discrete achievement emotions: A theoretical model and prospective test. *Journal of Educational Psychology*, 98, 583–597. doi:10.1037/0022-0663.98.3.583
- Pekrun, R., Goetz, T., Daniels, L. M., Stupnisky, R. H., & Perry, R. P. (2010). Boredom in achievement settings: Control-value antecedents and performance outcomes of a neglected emotion. *Journal of Educational Psychology*, 102, 531–549. doi:10.1037/a0019243
- Pekrun, R., Goetz, T., Frenzel, A. C., Barchfeld, P., & Perry, R. P. (2011). Measuring emotions in students' learning and performance: The Achievement Emotions Questionnaire (AEQ). *Contemporary Educational Psychology*, 36, 36–48. doi:10.1016/j.cedpsych.2010.10.002
- Pekrun, R., Goetz, T., Titz, W., & Perry, R. P. (2002). Academic emotions in students' self-regulated learning and achievement: A program of qualitative and quantitative research. *Educational Psychologist*, 37, 91–106. doi:10.1207/S15326985EP3702_4
- Pekrun, R., Lichtenfeld, S., Marsh, H. W., Murayama, K., & Goetz, T. (2017). Achievement emotions and academic performance: Longitudinal models of reciprocal effects. *Child Development*, 88, 1653–1670. doi:10.1111/cdev.12704
- Pekrun, R., Murayama, K., Marsh, H. W., Goetz, T., & Frenzel, A. C. (2019). Happy fish in little ponds: Testing a reference group model of achievement and emotion. *Journal of Personality and Social Psychology*, 117, 166–185. doi: 10.1037/pspp0000230.
- Pekrun, R., & Perry, R. P. (2014). Control-value theory of achievement emotions. In R. Pekrun & L. Linnenbrink-Garcia (Eds.), *International handbook of emotions in education* (pp. 120–141). New York: Taylor & Francis.
- Pekrun, R., & Stephens, E. J. (2012). Academic emotions. In K. R. Harris, S. Graham, T. Urden, S. Graham, J. M. Royer, & M. Zeidner (Eds.), *APA educational psychology handbook* (Vol. 2, pp. 3–31). Washington, DC: American Psychological Association.
- Perry, R. P., Chipperfield, J. G., Hladkyj, S., Pekrun, R., & Hamm, J. M. (2014). Attribution-based treatment interventions in some achievement settings. In S. Karabenick & T. C. Urden (Eds.), *Advances in motivation and achievement, Vol. 18: Motivational interventions* (pp. 1–35). Bingley, UK: Emerald.
- Preckel, F., Zeidner, M., Goetz, T., & Schleyer, E. J. (2008). Female “big fish” swimming against the tide: The “big-fish-little-pond effect” and gender-ratio in special gifted classes. *Contemporary Educational Psychology*, 33, 78–96. doi:10.1016/j.cedpsych.2006.08.001
- Putwain, D. W., Pekrun, R., Nicholson, L. J., Symes, W., Becker, S., & Marsh, H. W. (2018). Control-value appraisals, enjoyment, and boredom in mathematics: A longitudinal latent interaction analysis. *American Educational Research Journal*, 55, 1339–1368.
- Putwain, D. W., Remedios, R., & Symes, W. (2015). Experiencing fear appeals as a challenge or a threat influences attainment value and academic self-efficacy. *Learning and Instruction*, 40, 21–28. doi:10.1016/j.learninstruc.2015.07.007

- Roseth, C. J., Johnson, D. W., & Johnson, R. T. (2008). Promoting early adolescents' achievement and peer relationships: The effects of cooperative, competitive, and individualistic goal structures. *Psychological Bulletin*, 134, 223–246. doi:10.1037/0033-2909.134.2.223
- Royal College of Psychiatrists. (2010). *No health without public mental health*. (Position Statement PS4/2010). London, UK: Author.
- Sansone, C., Weir, C., Harpster, L., & Morgan, C. (1992). Once a boring task always a boring task? Interest as a self-regulatory mechanism. *Journal of Personality and Social Psychology*, 63, 379–390. doi:10.1037/0022-3514.63.3.379
- Scherer, K. R., & Brosch, T. (2009). Culture-specific appraisal biases contribute to emotion dispositions. *European Journal of Personality*, 23, 265–288. doi:10.1002/per.714
- Scherer, K. R., & Mehu, M. (Eds.). (2015). Normal and abnormal emotions—The quandary of diagnosing affective disorder [special issue]. *Emotion Review*, 7(3).
- Scherer, K. R., Schorr, A., & Johnstone, T. (Eds.). (2001). *Appraisal processes in emotion*. Oxford, UK: Oxford University Press.
- Seegol, N. K., Carlson, J. S., Goforth, A. N., von der Embse, N., & Barterian, J. A. (2013). Heightened test anxiety among young children: Elementary school students' anxious responses to high-stakes testing. *Psychology in the Schools*, 50, 489–499. doi:10.1002/pits.21689
- Sisk, D. A. (1988). The bored and disinterested gifted child: Going through school lockstep. *Journal for the Education of the Gifted*, 11, 5–18.
- Snyder, T. D., & Dillow, S. A. (2013). *Digest of education statistics 2012*. Washington, DC: U.S. Department of Education.
- Steinmayr, R., Crede1, J., McElvany, N., & Wirthwein, L. (2016). Subjective well-being, test anxiety, academic achievement: Testing for reciprocal effects. *Frontiers in Psychology*, 6, Article 1994r. doi:10.3389/fpsyg.2015.01994
- Szumski, G., & Karwowski, M. (2015). Emotional and social integration and the big-fish-little-pond effect among students with and without disabilities. *Learning and Individual Differences*, 43, 63–74. doi:10.1016/j.lindif.2015.08.037
- Tinto, V. (2010). From theory to action: Exploring the institutional conditions for student retention. In J. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. 25, pp. 51–89). New York: Springer.
- Turner, J. E., & Schallert, D. L. (2001). Expectancy-value relationships of shame reactions and shame resiliency. *Journal of Educational Psychology*, 93, 320–329. doi:10.1037/0022-0663.100.2.460
- United Nations Organization (UNO). (2006). *Convention on the Rights of Persons with Disabilities* (CRPD). Retrieved from www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities.html
- Westefeld, J. S., Homaifar, B., Spotts, J., Furr, S., Range, L., & Werth, J. L. (2005). Perceptions concerning college student suicide: Data from four universities. *Suicide and Life Threatening Behavior*, 35, 640–645.
- Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology*, 25, 68–81. doi:10.1006/ceps.1999.1915
- Wiliam, D. (2010). Standard testing and school accountability. *Educational Psychologist*, 45, 107–122. doi:10.1080/00461521003703060
- World Health Organization (WHO). (1993). *ICD-10, the ICD-10 classification of mental and behavioural disorders: Diagnostic criteria for research*. Geneva, Switzerland: Author.
- World Health Organization (WHO). (2018a). *Child and adolescent mental health*. Retrieved from www.who.int/mental_health/maternal-child/child_adolescent/en/
- World Health Organization (WHO). (2018b). *ICD-11. International classification of diseases 11th revision. The global standard for diagnostic health information*. Geneva, Switzerland: Author.
- World Health Organization (WHO). (2018c). *Gender and women's mental health*. Retrieved from www.who.int/mental_health/prevention/genderwomen/en/
- Yeager, D. S., & Dweck, C. S. (2012). Mindsets that promote resilience: When students believe that personal characteristics can be developed. *Educational Psychologist*, 47, 302–314.
- Zeidner, M. (1998). *Test anxiety: The state of the art*. New York: Plenum.
- Zeidner, M. (2007). Test anxiety in educational contexts: What I have learned so far. In P. A. Schutz & R. Pekrun (Eds.), *Emotion in education* (pp. 165–184). San Diego, CA: Academic Press.
- Zeidner, M. (2014). Anxiety in education. In R. Pekrun & L. Linnenbrink-Garcia (Eds.), *International handbook of emotions in education* (pp. 265–288). New York: Taylor & Francis.

Part III

Special Needs and Constructs Relevant to Psycho-Educational Development

Kristie J. Newton

In her 2001 Presidential Address to Division 15 of the American Psychological Association, Patricia Alexander made predictions for educational psychology in the year 2020 based on what she described as trends influencing the postindustrial society. Among these predictions were a renewed interest in and partnership between educational psychology and educational practice. Alexander noted that a tenuous relationship has historically existed between these fields; in a subsequent 2004 publication of her address, she cited a time when “educational psychology sought refuge in the sanitized laboratory where the unpredictability of everyday educational practice could be purged.”¹ It is in this vein of renewed partnership and mutual benefit that Part III of this handbook is envisioned and positioned.

Classrooms are complex places. Students are engaged in academic content such as writing and mathematics, but they are not doing so in isolation. They are with their peers. A classroom teacher structures their environment, from where they sit to the tasks they engage in. They may be tired, bored, intrigued, or anxious, any of which can affect their attention and engagement and, ultimately, their learning. For students with disabilities or otherwise at risk for low achievement, navigating the classroom environment can be especially challenging.

In this part, authors were pressed to consider psycho-educational constructs and processes as relevant to learning in classrooms. In Part I, authors identified a disability or disorder and considered how psycho-educational theories or perspectives can provide insight into or further our understanding of those areas of need. In Part II, authors identified a major theory in educational psychology and considered how that theory can be applied to and further our understanding of one or more special needs areas. In other words, either the area of special need or the educational psychology theory was in the forefront. Authors in Part III, on the other hand, were challenged to consider both psycho-educational perspectives *and* areas of special need as they focused on constructs or processes relevant to the classroom. They responded to this challenge in different ways.

Some authors summarized the literature specific to their construct, educational psychology, and students with special needs. For example, in Chapter 23, O'Donnell and Reschly provide an overview of major perspectives on engagement in the classroom and share current engagement research related to students with attention, behavior, emotional, or learning difficulties. Based on this research, they describe implications for assessment and classroom interventions for these students, who are at risk of poor outcomes owing to engagement difficulties. Similarly, in Chapter 22, Gillies reviews the literature related to interpersonal relationships and students with autism spectrum disorder (ASD). Using theory of mind as an organizing lens, she summarizes findings from neuroscience that help explain the difficulties that students with ASD can experience with peer relationships. She also describes evidence-based training programs that can support these relationships. In Chapter 26, on technology, Okolo and Ferretti focus on students with learning disabilities in reading. They assert that technology can help alleviate some of the challenges experienced by these students, including difficulties related to attention, self-regulation, and motivation, and they provide an overview of five types of such technology and their affordances. Morsanyi focuses on reasoning skills and their relation to mathematics learning and performance in Chapter 21. She notes that students with learning disabilities in mathematics struggle with a range of cognitive processes that underlie both mathematics performance and reasoning skills. Although reasoning skills have not been a major empirical focus with this population, she provides evidence that these skills are impacted for students with learning disabilities in mathematics.

Another group of authors adopted more of an applied approach to their chapter, considering ideas germane to educational psychology and their implications for students with special needs. For example, in Chapter 20, Graham and Harris describe how ideas such as long-term memory, working memory, cognitive load, attention, problem-solving, goals, and beliefs have influenced the development of various models of writing. They describe a recently formulated model that also highlights the situated nature of learning and writing. Using this model, they are able to synthesize and critically analyze what we know about writing and students with learning disabilities. In Chapter 19, Jordan, Barbieri, Dyson, and Devlin describe how research-based learning principles, such as comparison of worked examples, use of gestures, and interleaved practice, can be applied to students with mathematics difficulties. Reasoning, working memory, and attention are among the processes they highlight as important to support using these principles. In their chapter on sociocultural influences, Chapter 25, Macfarlane, Macfarlane, and Mataiti emphasize culture and community in supporting students with special needs. Using the indigenous Māori as an illustrative example, they focus in particular on students with ASD or visual impairment. In their chapter, self-determination is described as a key goal for these students, with inclusion and collaboration with family and other community members being critical for reaching this goal.

Finally, some authors chose to push boundaries or provide new perspectives on current findings and practices. In Chapter 27, Byrnes and Eaton share research from neuroscience on students with disabilities in mathematics or reading, as well as on students with disorders such as ASD, conduct disorder, and attention-deficit/hyperactivity disorder. They highlight research that has moved beyond merely identifying active

regions of the brain to considering psychological theories implicated in student learning and how neuroscience can contribute to and further shape those theories. In their chapter on classroom environment, Chapter 24, Tracey, Merom, Morin, and Maïano address the practice of inclusion from a psychological perspective. They identify how this common practice, which allows students with mild disabilities to learn in the regular classroom setting, may have unintended consequences for these students' academic self-concepts. In particular, these researchers recommend more research to understand the impact of social comparisons on students with mild disabilities, as well as research on ways to mitigate any negative impact of these comparisons within an inclusive classroom.

In all cases, the authors in this part have made clear that harnessing key psycho-educational constructs, and crossing disciplinary boundaries in the application of these constructs, enables us to more comprehensively attend to the learning requirements of students with special needs. In doing so, these authors have illuminated the complex nature of learning in classrooms and highlighted the role of psycho-educational perspectives for understanding and supporting students with disabilities or disorders. Their chapters draw together and highlight what we currently know, but also crystallize the need for more work in this important space.



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IMPROVING LEARNING IN STUDENTS WITH MATHEMATICS DIFFICULTIES

Contributions from the Science of Learning

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Mathematics difficulties (MD) are pervasive in U.S. classrooms. According to the most recent U.S. “nation’s report card” (National Assessment of Educational Progress, 2019), just 34% of eighth graders nationwide scored at or above proficiency in mathematics, with the situation being most critical for non-Asian racial and ethnic minority students, low-income students, and students with diagnosed disabilities. For example, only 14% of black children and 19% of Hispanic children scored proficient or above in eighth grade. Among low-income students, only 18% showed proficiency, and, among students with disabilities, only 9% were proficient. Internationally, U.S. students rank in the bottom half of countries participating in the Organisation for Economic Co-operation and Development (OECD, 2012), even though we spend more per student than many other countries. Thus, it is not surprising that the majority of Americans view our K–12 STEM education as being average or below average compared with other developed nations (Funk & Parker, 2018).

Lack of proficiency in mathematics has serious consequences for individuals as well as for society more generally (NMAP, 2008). Mathematics proficiency predicts college success and wider job opportunities in STEM (science, technology, engineering, and mathematics) fields, as well as in business and financial sectors. Even students who might not pursue mathematics-intensive fields increasingly need mathematics proficiency to contribute to the work force. Moreover, mathematics is essential for daily life; mathematical knowledge helps us make better healthcare decisions, manage our finances, cook meals, and make home improvements – and thus increases our personal well-being. Addressing mathematics difficulties must be a national priority at all grade levels, from building early foundational skills in preschool and kindergarten, to learning whole numbers and fractions in elementary school, to developing proficiency in algebra and more advanced topics in middle and secondary school.

In 2005, Gersten, Jordan, and Flojo observed that research on mathematics difficulties was in its “infancy” (p. 293), in contrast to the substantial body of research that had been conducted on reading difficulties. At that time, schools were successfully incorporating research-based literacy interventions, especially in the early grades. On the other hand, far less research had been conducted on MD, with only a small body of evidence-based mathematics interventions available for use in schools. Since then, though, the field of MD has grown considerably. Researchers have identified key characteristics and predictors of MD, validated screeners for identifying difficulties in mathematics, and developed interventions to determine best practices for children with MD.

Around the same time, cognitive research on the science of learning expanded, especially since the inception of the Institute of Education Sciences (IES) of the U.S. Department of Education in 2002 (Rittle-Johnson & Jordan, 2016). In 2007, IES published a research-based practice guide on how to organize instruction and improve student learning more generally (Pashler et al., 2007). This work, along with the subsequent publication of a practice guide for assisting students struggling in mathematics (Gersten et al., 2009), evaluates the evidence for effective practice and provides recommendations for teachers and administrators.

In this chapter, we address the intersection between cognitive research on the science of learning and the education of students with MD. We first provide a framework for thinking about individual differences and mathematics difficulties. We next address cognitive learning principles and techniques that promote successful learning in mathematics and provide examples of how the principles can be translated into educational practice for students with MD in particular. The learning principles we highlight include studying and comparing correct, as well as incorrect, worked-out problem solutions; using integrated visual and verbal models to reduce splitting attention; interleaving or varying practice with problems of different types; providing frequent cumulative practice or review that is spaced out over time; connecting and integrating concrete and symbolic representations; presenting arithmetic problems in different formats; using physical movements and gestures to promote learning; and incorporating activities with number lines to increase learning of whole numbers and fractions. Future directions for improving educational practice and creating durable learning for students with MD are also discussed.

CONCEPTUAL FRAMEWORK

Understanding the principles that govern a mathematical topic is often called *conceptual knowledge*, and executing steps or applying an algorithm to solve a computational problem is called *procedural knowledge*. Students with MD may have difficulties with mathematics concepts, procedures, or both of these areas (Geary, 2004). For example, competency with fractions involves both multiplicative reasoning and facility with procedures for finding common denominators, both areas that are problematic for middle schoolers who are struggling with mathematics (e.g., Jordan, Resnick, Rodrigues, Hansen, & Dyson, 2017). Competency with addition and subtraction involves knowledge of mathematical principles and properties (e.g., commutativity, inverse relationships, and so forth), as well as fact fluency. Computational

fluency, or automatic application of procedures, is also needed to free up cognitive resources for problem-solving. Weakness with computational fluency is a signature characteristic of mathematics difficulties starting in the early grades (e.g., Jordan, Hanich, & Kaplan, 2003).

Knowledge of concepts supports learning of procedures and vice versa (Rittle-Johnson & Siegler, 1998). For example, learning how to separate a number line into tenths to find the correct placement of a decimal fraction can help support conceptual understanding of place value and the importance of attending to the first number to the right of the decimal point. Alternatively, a good understanding of decimal place value can help a student develop a procedure of separating a number line into tenths (Rittle-Johnson, Siegler, & Alibali, 2001).

Domain-General Competencies

Multiple cognitive processes support the acquisition of mathematics concepts and procedures. Individual differences in these supporting processes help explain why many students struggle with mathematics (Kaufmann et al., 2013; Rittle-Johnson & Star, 2007). Domain-general cognitive processes include executive function, language, and visual-spatial processing (Geary, 2004). *Executive function* is associated with attentional processes needed to solve mathematics problems (see Follmer & Sperling, Chapter 5, this volume). For example, students need to stay on task, attend to instruction and the materials, and inhibit irrelevant information to learn mathematics (Fuchs et al., 2005). Working memory is a crucial central executive skill that involves manipulating information in one's short-term memory store in conjunction with information stored in long-term memory to solve a problem (e.g., repeating a set of digits presented in random order from smallest to largest; Baddeley & Hitch, 1974). Children with MD tend to perform more poorly than children with normal achievement in working memory, although there are individual differences within the MD population (Fuchs et al., 2014; Swanson, 2014). It has been shown that working memory skill moderates the effects of interventions in students with MD (Fuchs et al., 2014). For example, MD students with weaker working memory benefited more from instructional adjustments that focused on building strong conceptual knowledge (e.g., comparing fraction magnitudes and indicating whether they are equal to $\frac{1}{2}$), whereas students with better working memory learned better with fluency activities (e.g., answering which of two fractions is larger quickly). *Language* is involved in most aspects of mathematics learning. Students with MD often have comorbid reading and language difficulties (e.g., Jordan, Hanich, & Kaplan, 2003), which may hinder learning of number words and mathematical terms (e.g., "equivalence," "factors," "denominators," etc.) and solving word problems (Seethaler, Fuchs, Star, & Bryant, 2011). *Visual-spatial reasoning* helps students form an accurate mental number line to represent proportions and scales spatially (Gunderson, Ramirez, Beilock, & Levine, 2012; Resnick, Newcombe, & Jordan, 2019). A meta-analysis (Swanson & Jerman, 2006) found that children with MD have lower spatial memory than typically achieving students; for a related discussion, see Morsanyi, Chapter 21, this volume).

Overall, many students with MD show weaknesses in one or more domain-general areas (e.g., Jordan et al., 2017). And, of course, these domains interact with each other. For example, working memory can involve visual-spatial reasoning (remembering

written symbols), language (number words), or both areas; visual-spatial working memory, in particular, appears uniquely important for learning mathematics skills in the elementary grades (Li & Geary, 2017).

Domain-Specific Numerical Competencies

Early symbolic *number sense*, including knowledge of number, number relations, and number operations, reliably identifies students who are at risk for later MD when accounting for domain-general processes (Jordan & Dyson, 2016; Jordan, Fuchs, & Dyson, 2015; Jordan, Kaplan, Ramineni, & Locuniak, 2009). Core deficits in understanding numerical magnitudes in symbolic contexts underpin many mathematics difficulties (e.g., Butterworth, 1999, 2005; Butterworth & Reigosa-Crespo, 2007; Landerl, Bevan, & Butterworth, 2004). For example, children with MD perform worse than their typically achieving counterparts when asked to indicate which of two numerals is larger and to relate quantities to their symbols (Butterworth & Reigosa-Crespo, 2007; Landerl et al., 2004; Rousselle & Noël, 2007).

Understanding numerical magnitudes, in particular, provides students with a foundational structure for learning about all numbers, including whole numbers, fractions, and decimals (Geary, 2013; Siegler & Lortie-Forgues, 2014). That is, students should eventually learn that all real numbers can be assigned specific locations on the number line. (Siegler & Lortie-Forgues, 2014; Siegler, Thompson, & Schneider, 2011). Accurate representation of numerical magnitudes is associated with learning about both whole numbers and fractions. For example, Jordan et al. (2013) found that whole number line estimation makes a large, independent contribution to fraction concepts and procedures in fourth grade, even after controlling for general cognitive competencies. Moreover, the ability to estimate fraction magnitudes on 0–1 and 0–2 number lines predicts later mathematics achievement, over and above general and other mathematics-specific competencies (Resnick et al., 2016). In Resnick and colleagues' longitudinal study, the majority of students who showed low growth in fraction number line estimation acuity between fourth and sixth grades performed below basic mathematics benchmarks on a state test at the end of sixth grade.

Social Class Disparities

In addition to cognitive considerations, as noted earlier, there continues to be a stubborn income gap in mathematics achievement, with low-income children being overrepresented among those with MD. Children from low-income families perform worse in mathematics than middle-income children, and these differences emerge well before kindergarten (National Mathematics Advisory Panel, 2008). Children living in poverty are 1.5 times more likely to have a learning disability than their middle-income peers, and many eventually drop out of high school (Duncan & Brooks-Gunn, 2001). Jordan & Levine (2009) observe that, "Learning opportunities and social experiences along with basic learning and cognitive abilities all contribute to children's mathematics learning from early childhood onward. The number competencies that children bring to school set the stage for learning complex mathematics" (p. 60).

Intervention Research

Although randomized studies of the effects of interventions on children with MD have shown promising results, many of these studies examine effects at only one time point right, after the intervention (e.g., Fuchs et al., 2013, 2014). Other studies using several data points have shown durable effects after 2–3-month delays (e.g., Dyson, Jordan, Beliakoff, & Hassinger-Das, 2015; Jitendra et al., 2015). However, a recent study (Hallstedt, Klingberg, & Ghaderi, 2017) examined effects of an arithmetic intervention for second graders with MD immediately post-test, after a 6-month delay, and again after 1 year. The large effects at the immediate post-test point faded over time, resulting in no meaningful effects between intervention and control children 1 year after the completion of the intervention. Attenuation of treatment effects over time has also been a troubling issue in early childhood mathematics intervention research (Clements, Sarama, Wolfe, & Spitler, 2013). Bailey et al. (2016) found that much of the fadeout effect in preschool is attributable to preexisting skill and ability differences between children in the mathematics treatment and control groups, and that early mathematics interventions only helped at-risk children temporarily compensate for these initial differences.

How can interventions improve retention and produce long-lasting effects for students with or at risk for MD? We argue that, in addition to providing developmentally appropriate instruction in content knowledge, such as whole numbers and fractions, application of more general learning principles validated by cognitive research will lead to deeper and more durable learning for struggling students. Below we address key learning principles that have been rigorously tested and applied to mathematics more generally. Implications for teachers of students with MD are addressed.

GENERAL LEARNING PRINCIPLES

Background

Many of the learning principles presented here originate from research on cognitive load theory. Cognitive load is especially important for students with MD because, as noted earlier, many are characterized by weaknesses in working memory capacity (e.g., Geary, 2004; Swanson, Jerman, & Zheng, 2008). Cognitive load theory, originally proposed by Sweller (1988), was inspired by the lack of evidence that problem-solving alone fosters learning. Sweller suggests that humans' cognitive capacity, as characterized by working memory, is limited in what it can process. Traditional problem-solving may overload this capacity, leaving little room for the acquisition and development of new knowledge structures. The limitations of humans' cognitive capacity must be considered while developing instructional practices in order to enhance learning in the classroom (Chandler & Sweller, 1991; Sweller, 2006, 2012; Tricot, Vandenbroucke, and Sweller, Chapter 15, this volume).

Providing Worked Examples of Problems

Worked examples are written examples of a solution to a problem, presented either procedurally or with explanations of the process. For example, a student might be shown a worked example of a long division problem, which involves

multiple sequential steps for reaching a solution. Worked examples have been used to improve learning in mathematics and other STEM areas (Booth et al., 2015a; Carroll, 1994; Kalyuga, Chandler, & Sweller, 2001; Ward & Sweller, 1990). Studying worked-out problem solutions reduces extraneous load normally present in traditional problem-solving; while students study these examples, they are not required to generate random processes to solve the problem or attend to irrelevant features. Instead, they can devote their cognitive effort to studying and understanding the relevant aspects for solving the problem and the correct process to acquire and develop schemata for the problem type studied (Sweller, 2006). Worked examples increase learning in the classroom (Carroll, 1994) and, in some cases, through homework assignments (Ward & Sweller, 1990) in mathematics (Rittle-Johnson & Star, 2007; Zhu & Simon, 1987) as well as science (Pol, Karskamp, Suhre, & Goedhart, 2009). The effectiveness for worked examples is often increased by supplementing the examples with self-explanation prompts (Berthold, Eysink, & Renkl, 2009; Catrambone & Yuasa, 2006; Huang & Reiser, 2012). After studying multiple worked examples, students can extract the features of, or a rule for, a problem that is common to other problems of that type.

Worked examples improve both procedures and concepts in mathematics. For example, fifth graders using worked examples demonstrated improved procedural skill in working with equivalent fractions (Lee & Chen, 2015). Middle school students showed conceptual improvements in mathematics when working with examples in the form of video podcasts (Kay & Edwards, 2012). Worked examples can be used to scaffold independent problem-solving with *backward fading* or a reduction of steps displayed within examples as the student progresses in skill (Renkl, Atkinson, Maier, & Staley, 2002). For example, when learning how to add two fractions with unlike denominators, students could first be presented with a fully worked-out solution with all steps of the procedure displayed. This may include first demonstrating how to find common denominators and appropriately rename the fractions, then adding, and finally presenting the sum in simplest form. As students develop skill in this procedure, the later steps could be removed so that students are shown how to begin the problem, but then must complete the missing steps on their own. Gradual reduction of displayed steps continues until students are solving problems on their own.

More recently, research has demonstrated learning benefits from critiquing common incorrect solutions to problems that address common misconceptions (Adams et al., 2014; Durkin & Rittle-Johnson, 2012; Star & Rittle-Johnson, 2009) – in other words, using worked examples that are clearly marked as incorrect and reveal a common misconception for a learner to study, explain, and correct. Interestingly, worked examples with errors have been found to be most effective for students with low prior knowledge, which includes students with MD (Barbieri & Booth, 2016). Booth and colleagues (Booth, Lange, Koedinger, & Newton, 2013) show that studying incorrect worked examples improves encoding of features within algebraic equations. Through studying and explaining common errors displayed within worked examples, learners focus on particular features of the problem that produced the mistake, leading to correction of faulty knowledge and fine-tuning of problem-solving strategies (Ohlsson, 1996). Explaining errors helps students articulate why a procedure or

strategy is incorrect and, in turn, reduces the likelihood of making that specific mistake on future problems (Siegler, 2002; Siegler & Chen, 2008).

Worked examples can be used to compare solution methods. Comparing two worked examples demonstrating the same problem solved in two different ways (e.g., either both correct or one correct and one incorrect method) promotes problem-solving and flexibility (Durkin & Rittle-Johnson, 2012; Rittle-Johnson & Star, 2007; Star & Rittle-Johnson, 2009). Durkin & Rittle-Johnson (2012) found that comparing incorrect and correct worked examples in which the same problems were solved promotes students' learning of the correct procedures and concepts of decimal magnitude. In this study, students studied a correct example of a decimal magnitude problem and an incorrect example of that same problem displaying a common error. For example, students were shown the correct placement of 0.15 on a number line accompanied by a fictitious student's correct rationale for the placement. They were also shown a fictitious student's incorrect placement accompanied by the faulty reasoning that, because the decimal has two numbers, it is a medium-sized number and should be placed close to the midpoint. Students were asked to explain why the incorrect method cannot be used to solve the problem. As opposed to students who compared two correct solutions, those who compared correct and incorrect solutions showed a reduction in misconceptions (e.g., fewer errors indicating a whole number bias such as stating that 0.835 is larger than 0.87 because 835 is larger than 87) and more frequently discussed correct decimal magnitude concepts in the classroom (e.g., "That's not right because 0.08 is not the same as 0.8").

Implications for Teachers of Students with MD

Rather than simply assigning a series of practice problems, teachers might replace half of the problems to be solved with worked-out problem solutions. Practice problems should be paired with a worked example displaying the strategy to be used. Questions or written self-explanation prompts will help students focus on aspects of the example that are particularly important. Although the IES Practice Guide reports more than 20 studies that support the use of worked examples and meet the standards of What Works Clearinghouse on scientific quality (Pashler et al., 2007), worked examples are not prevalent in U.S. textbooks. A recent textbook analysis of two popular U.S. mathematics textbooks revealed that less than 10% of problems within the text are presented in the form of worked examples (Ding, 2016). Fortunately, researchers in the science of learning have been translating these findings into resources for practitioners that are easily accessed online (e.g., see McGinn, Lange, & Booth, 2015, for a step-by-step guide on creating worked examples).

Teachers can create erroneous examples from common errors seen in their practice. For example, low-performing mathematics students often have trouble with modeling a fraction of a given figure when the denominator does not match the number of partitions in the whole (Hansen, Jordan, & Rodrigues, 2017; see Figure 19.1). Students with MD often attend to the numerator alone, not recognizing that the whole is not partitioned into the number of portions designated by the denominator (Dyson, Barbieri, Rodrigues, Rinne, & Jordan, in press). Teachers may present the problem in Figure 19.1 as a common error and ask the student(s), "Why is this shading incorrect?"

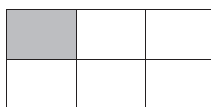
Shade $\frac{1}{3}$ the boxes.

Figure 19.1 Students Attend Only to the Numerator when Shading the Boxes

Future Directions

Future investigation needs to determine how best to design worked examples materials that can be implemented in classrooms (e.g., Booth et al., 2015b) and targeted for students with MD in particular. Another consideration is the role of self-explanation prompts in the worked example effect. For example, it would be important to know how teachers can best provide feedback on these explanations. Further, although some research suggests that incorrect worked examples are more effective for students with low prior knowledge (Barbieri & Booth, 2016), this work was conducted mainly with typically developing students. Students with MD in particular should be considered in similar investigations.

Integrating Visual and Verbal Models

The split-attention effect occurs when students split their attention and attend to two different sources of information to solve a problem, thus decreasing learning (Tarmizi & Sweller, 1988). Atkinson and colleagues (2000) provide a thorough review in which they make several suggestions on how to structure instructional materials, mainly worked examples and diagrams, to reduce splitting attention. Multiple sources of provided information should be spatially contiguous, or physically integrated, to avoid splitting attention (Mayer, 2001). This is particularly relevant when learners are working with materials with interactive elements that require them to integrate information from text and visuals (e.g., diagrams or graphs). For example, when designing a diagram, descriptors of key components within the diagram should be placed as close to the corresponding feature as possible. Descriptors should not be placed separately in a key on another part of the page. Kester, Kirschner, and van Merriënboer (2005) found that learners who studied worked examples in an electronic circuitry task that integrated descriptors of diagram components (e.g., electrical potential, switch, resistor) within the diagram, as opposed to within a separate keyed table, showed greater transfer of circuitry trouble-shooting skills. Thus, close proximity between text and visual diagrams improves learning, especially when the material to be learned is complex (Ginns, 2006). This principle takes into account humans' limited dual-channel working memory system. Information is encoded into long-term memory via visual and verbal pathways that are interconnected, but these pathways also function independently (Paivio, 1986; Welcome, Paivio, McRae, Joannis, 2011). Retention of learning material is greatest when visually and verbally presented information is integrated rather than disparate (see Cuevas, 2016, for review).

Visual signaling cues help students integrate multiple sources of information. Visual signaling is the method of using cues in the form of labels, arrows, or color

codes to highlight important information (Mayer, 2009). Signaling cues reduce the time it takes for learners to identify important information in instructional materials (e.g., diagrams; de Koning, Tabbers, Rikers, & Paas, 2010). Using eye-tracking technology, Ozcelik, Arslan-Ari, and Cagiltay (2010) found that individuals exposed to signaling cues found relevant information in problems more quickly than their non-signaled counterparts, had longer fixation times on relevant information, and exhibited higher transfer compared with a non-signaling group. Scheiter and Eitel (2015) found that, with university students, signaling cues work best when they serve to improve text–diagram correspondences, as opposed to simply increasing attention to specific diagram features.

Learning improves when visuals are presented with auditory, or spoken, information rather than written text (Mayer, 2009). One explanation provided for this assertion is that, when a learner is presented with information in two visual formats (i.e., diagram and written text), the learner experiences an overload in their visuospatial working memory. However, when visuals are presented with auditory information, the learner can encode the auditory information through both the verbal (e.g., phonological loop) and visual channels of working memory (Moreno & Mayer, 1999). Processing the to-be-learned material via both pathways as opposed to one is said to lead to improvements in retention. Although there is some debate on the plausibility of this explanation (e.g., Rummer, Schweppe, Fürstenberg, Scheiter, & Zindler, 2011), research on the modality principle consistently reveals larger benefits of visual plus auditory information rather than visual plus textual information (Ginns, 2005).

It should also be noted that using a student's "learning style" to teach a content area has not been supported by research (Pashler, McDaniel, Rohrer, & Bjork, 2009; Brown, Roedinger, & McDaniel, 2014). Although learners are likely to have preferences in instructional approaches, preference does not always correspond to greater learning. Rather, what appears to be most important for promoting learning is for the instruction to match the content area (e.g., visual approaches are more effective for teaching geometry). Moreover, integrating the visual and verbal models in ways that reduce overload, as described above, is an example of a more useful approach for designing instruction.

Implications for Teachers of Students with MD

When choosing visuals, teachers must carefully select visuals that are highly relevant to the mathematics topic, that have clear labels for important parts of the process being conveyed, and that reduce the prominence of irrelevant features. Visuals and diagrams should be presented with auditory rather than textual description, when possible. That is, it would be more helpful to students if an instructor displays a diagram of a mathematical process on the board and describes the process verbally, rather than having students read a written description of the process while studying the diagram. Oral counting with a visual model of magnitude is an effective way to improve both early number and fraction knowledge (Dyson et al., in press; Dyson et al., 2015). Oral counting while moving along a number list has been shown to improve knowledge of numerical magnitudes in young children at risk for MD (Dyson et al., in press). In *The Great Race* game (Siegler & Ramani, 2008), which has been shown to be effective for at-risk preschoolers, children say the numbers in the count sequence while

simultaneously viewing the sequence of numerals on the game board. Although counting fractions is not a common middle school activity, an intervention that involved counting fractions with common denominators while touching a visual number line marked and labeled in fourths increased fraction magnitude understanding in sixth graders with MD (Dyson et al., in press). Counting with whole and mixed numbers also likely helps students hear the pattern of four fourths in a whole which may serve to improve understanding of fraction equivalence (e.g., “one-fourth, two-fourths, three-fourths, one, one and one-fourth, one and two-fourths, one and three-fourths, two”).

Future Directions

The split-attention effect would be even more likely to occur in students with MD who typically struggle to maintain attention. As such, the effect should be studied in this population in particular. Increased vigilance is needed in designing instructional materials to avoid splitting attention for students with MD.

Interleaving Practice Problems

Practice problems in mathematics are commonly blocked (i.e., clustered) by content or problem type (e.g., practice five addition problems and then five subtractions problems), with the idea being that this makes it easier for students to attend to the problems. However, interleaved – or varied – practice is much more effective for developing and retaining problem-solving skills in the long term. Solving interleaved problems requires effort; it forces students to evaluate the problem to determine the strategy needed, thereby deepening their thinking and building their repertoire of strategies (Rohrer, Dedrick, & Burgess, 2014). Students who use blocked practice are more likely to make errors in choosing the appropriate strategy on summative tests for a certain problem type than when using interleaved practice that alternates types of problem (Taylor & Rohrer, 2010). During interleaved practice, when students are completing a practice problem that requires a specific solution strategy, they likely still have the solution strategy from the prior practice problem in working memory. Thus, students can compare solution strategies for problem types and refine their organizational frameworks for problem-solving in that content area. Additionally, interleaving practice problems across instructional units increases spacing of the practice (Carpenter, Cepeda, Rohrer, Kang, & Pashler, 2012), which has also been shown to improve retention of learning material (see next section). However, it is important to note that the effect of interleaving practice remains even when controlling for spacing effects (Kang & Pashler, 2012; Rohrer, Dedrick, & Stershic, 2015). Important for educational practice, interleaving is effective even when learners practice with very different problem types, such as practice in solving a word problem using a proportion, graphing a linear equation, and finding the slope of a line from a pair of coordinates, all within the same practice session (Rohrer et al., 2014).

However, when interleaved practice is used, consideration must be given to learners' prior knowledge. That is, should practice be interleaved immediately after learners have been introduced to new material, or should blocked practice be used initially, followed by interleaved practice? Rau, Aleven, and Rummel (2010) found that prior knowledge plays an important role in determining the type of practice that should

be used. Fifth- and sixth-grade students learning fractions were assigned to practice conditions within a computerized tutorial that varied by the degree that problems were blocked or interleaved by the type of fraction representation used (e.g., number line, pie chart, sets). Students in the blocked condition worked through three representation types consecutively in three long blocks (36 problems per block). Students in the moderate (blocking) condition completed the same number of problems but in shorter blocks. Students in the interleaved condition switched representation type after every problem. Students in the increased (interleaving) condition started off with long blocks (12 problems per block) that gradually reduced to single or fully interleaved problems. At post-test, participating in either blocked practice or increased interleaved practice was most beneficial for students with low prior fraction representational knowledge. Thus, it is likely that using blocked practice in the early stages of knowledge acquisition and then gradually employing interleaved practice is most beneficial. This concern is especially applicable to students with MD, who often have limited prior knowledge.

Implications for Teachers of Students with MD

As mathematics textbooks often focus on blocked practice, teachers of students with MD should supplement these types of textbook with practice problems that explicitly interleave problem types. When first introducing a topic or strategy, it is likely best to begin with blocked practice to foster automaticity and then gradually increase the rate at which problem types are interleaved. Throughout practice, teachers should actively help students select and properly use the strategy appropriate for a particular problem type. After all strategies within a unit are introduced, problem types for every other problem can be interleaved to encourage students to select the appropriate strategy and fine-tune their organizational framework for problem-solving within that domain (Barbieri, Rodrigues, Dyson, & Jordan, 2019).

Future Directions

More research is needed to show the efficacy of interleaved practice for students with MD, in particular. These students probably will require a gradual transition from blocked to interleaved practice, but this transition may need to be slower than for typically developing students that are in the earlier stages of knowledge acquisition. Alternatively, considering that interleaved practice has proven to have robust effects on reducing forgetting, students with MD, who often have limited working memory capacity, may show even greater improvements from its use than typically developing students with low prior knowledge. Thus, work is needed to assess how interleaved practice extends to students with MD.

Spacing Practice Activities over Time

Distributed practice, or providing learning opportunities that are spaced out over time, either within a study session or across several study sessions, is more effective for improving long-term retention of study material than massed practice or the same amount of practice completed in a shorter amount of time or over fewer study sessions

(Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013). The benefits of distributed learning relate both to *spacing* effects and *lag* effects. Lag refers to how long the delay is between spaced study sessions. Generally, longer lags between study sessions are more beneficial for learning than are shorter ones. However, the timing of the lag corresponds to how long one needs to retain the material. Cepeda and colleagues (Cepeda, Vul, Rohrer, Wixted, & Pashler, 2008) examined different combinations of lags and retention intervals (i.e., the time between the last study session and test) and found that retention was optimal when study sessions had a lag of 10–20% of how long the material was meant to be retained. For example, if one needs to remember something for 5 years (i.e., 60 months), study sessions need to be 6–12 months apart. More realistically, if a teacher only has control over the practice that happens within 1 school year, a lag of 1 month may be ideal. When material is reintroduced to students, they are primed or reminded of the first learning experience. This priming aids retrieval of the information. Shorter intervals between study times, on the other hand, result in easier retrieval of the study material, which leads students to believe that they have a good grasp of the material (Bahrck & Hall, 2005). This impression, in turn, may lead students to reduce the effort they put into studying. However, longer intervals between study times will result in more retrieval failures (i.e., forgetting). In the face of forgetting, students may put more effort into studying, which improves long-term retention.

Implications for Teachers of Students with MD

Mathematics is a cumulative domain in which understanding and mastery of earlier concepts are often vital for later understanding of more advanced topics. Distributed practice is an instructional tool that is relatively simple to implement in any educational setting. Cumulative review sessions should be held several weeks and, if possible, several months after the material was initially learned. Use of intermittent low-stakes quizzes, in particular, is an excellent way to practice the material and bolster retrieval (Roediger, Agarwal, McDaniel, & McDermott, 2011). The quizzes can be cumulative in that material covered earlier on in the school year can continue to be quizzed later. Homework assignments should include practice problems that address material that was covered in classes several weeks or months earlier. As textbooks typically present practice problem sets that focus solely on the content just learned, this particular recommendation may require teachers of students with MD to add in problems that address earlier content in addition to these more focused blocks.

Future Directions

Spaced practice is most commonly used to improve retention of simple facts such as addition (Schutte et al., 2015) and multiplication (Donovan & Radosevich, 1999; Rea & Modigliani, 1985). However, some evidence exists of the benefits for more abstract mathematical concepts, such as determining simple permutations (Rohrer & Taylor, 2006, 2007). Although retention of arithmetic facts is indeed a vital component for later success in mathematics – and highly troublesome for students with MD (Jordan et al., 2003) – more work is needed on how spacing and lag effects influence learning of more complex mathematics topics. The large body of literature on spaced practice

effects shows its benefits across the life span. Even 2-year-olds can benefit from distributed practice (Childers & Tomasello, 2002). However, this work has primarily been conducted on typically developing adults and children. Still unknown is the extent to which these effects hold for students with MD. Nevertheless, intervention work with MD students employing distributed practice or cumulative review as one component of the approach has shown promising results with its inclusion (e.g., Fuchs et al., 2008).

Connecting and Integrating Concrete and Symbolic Representations

Rather than relying primarily on concrete or abstract representations, learning is best promoted through connecting and integrating concrete and symbolic representations (Pashler et al., 2007). Concrete representations are important for learning, because they are thought to ground new information in students' prior knowledge and promote conceptual understanding (De Bock, Deprez, Van Dooren, Roelens, & Verschaffel, 2011). Abstract or symbolic representations promote transfer (Kaminski, Sloutsky, & Heckler, 2008) or the use of new knowledge in other situations (see Belenky & Schalk, 2014, for a review). When integrating concrete and abstract representations in mathematics learning, improvements in both conceptual understanding and transfer have been found (Uttal et al., 2013).

Concreteness fading is a promising technique that is rooted in Bruner's theory of instruction (Bruner, 1966). Bruner argued that instruction must help students move through three stages. First, concrete or *enactive* representations of the concept/skill are introduced. Then, students progress to the *iconic* stage, where representations are presented as images rather than concrete objects. Finally, students interact with the concept/skill using abstract or *symbolic* representations, such as words or numbers. Students move through all three representations each time they learn a new concept, although students with high prior knowledge may be able to skip the enactive stage.

Bruner's theory of instruction influenced the concrete–representational–abstract (CRA) instructional method, which is reflected in reform mathematics curricula and has become especially popular with those teaching students with MD (see Bouck, Satsangi, & Park, 2017, for a review). The CRA approach has given rise to widely used mathematics manipulatives, such as base ten blocks and fraction circles/bars. For example, addition with whole numbers is first introduced using base ten blocks, which not only gives a physical representation of the numbers but also allows students to physically show the action of addition (including trading between place values). Next, the student makes and/or interprets pictures of base ten blocks that represent a particular addition problem. Finally, students perform the addition problem using just numerals.

Concreteness fading is more nuanced than CRA in its definitions of concrete and abstract representations. Concreteness fading involves three steps in which the concreteness of a representation is “faded” until one is left only with the symbolic representation of the object. (Fyfe & Nathan, 2018, p. 17). Concrete and abstract have multiple levels of representation and interpretations of meaning. Many mathematics manipulatives, although physical, are representational and not real-life objects that students can connect to their own experiences. For example, a fraction bar can be used as a concrete representation of a cup of flour, but is not as concrete as an actual cup of flour. Instruction can pass through several levels of concreteness fading and still remain in the enactive stage. In the same way, symbolic representations have an

element of concreteness. As soon as they are written on paper, they become an object and not just an idea (Funk & Parker, 2018). When correctly implemented, however, concreteness fading has shown to be effective in promoting students' ability to transfer mathematical concepts to novel situations (McNeil & Fyfe, 2012).

Implications for Teachers of Students with MD

Although prior work suggests that it is generally beneficial to begin instruction with concrete representations and then gradually fade to more abstract or symbolic representations for most learners (Braithwaite & Goldstone, 2013; McNeil et al., 2012), the concrete representations used should be chosen carefully. Uttal, Scudder, and DeLoache (1997) demonstrated that concrete representations with features that are irrelevant to the concept to be learned can sometimes be harmful to learning; for example, children struggled to understand that toy-like manipulatives can be used as representations of an abstract concept. Uttal and colleagues suggest using manipulatives that are not inherently interesting or attractive (and thus distracting) but that allow children to focus on the underlying mathematical concepts. For example, using food items (e.g., candy) to model arithmetic problems is often distracting to children. Rather, simple concrete manipulatives that are solely used for mathematics instruction (e.g., base ten blocks) would encourage children to focus on them as symbolic representations rather than the objects themselves.

Dyson and colleagues (Dyson, Jordan, Beliakoff, Hassinger-Das, 2015) encouraged MD students to move effectively through all three of Bruner's stages in one lesson by purposely integrating concrete and abstract representations of a few integers (i.e., 0, 1, and 2). Students explored basic number sense activities using real-life contexts (stories), representational objects of various levels of concreteness (toy pigs and chickens, tokens, Unifix cubes), images of objects (drawing representations of stories using circles or tally marks, counting drawings of objects), and purely symbolic representations ($2 + 1 = 3$). Representations at multiple levels were used simultaneously to make the connections explicit among them. For example, students put tokens on a number list to connect accumulation of quantity to the corresponding numeral. Similarly, Dyson and colleagues integrated concrete and abstract representations of fractions in a fractions intervention (Dyson et al., in press). When learning about halves, students began the unit by folding paper strips to create halves. This more concrete representation was paired with the symbolic form of " $\frac{1}{2}$." Students also worked with representations of halves in the form of measuring cups, rulers, and also on number lines. Students practiced marking a number line representing a racecourse, with tick marks for whole and half miles. They labeled tick marks symbolically for each value (e.g., $\frac{1}{2}$, $\frac{2}{2}$, $\frac{3}{2}$). These activities combined were found to be effective in increasing students' sense of fraction magnitude as measured by a symbolic fraction number line task as well as general fraction concepts. Systematic concreteness fading, however, was not examined.

Future Directions

The use of concreteness fading needs to be examined carefully in students with MD. Considerations include choosing the most effective representations (Lubienski, 2000); making explicit connections between representations within a stage and across stages

(i.e., enactive, iconic, symbolic) to promote transfer and enable students to draw on these representations in novel situations (Hiebert & Grouws, 2007); and determining the amount of time spent in each stage. The optimal time for each stage may vary for individual learners. More work is needed to determine whether teachers should plan small interventions to be completed in one class period or lessons designed to spend multiple days on each stage, waiting for students to master a stage before moving to the next. Although taking students through a focused fading experiment during one class period was found to be effective (Fyfe, McNeil, & Borjas, 2015), more complex mathematics concepts and skills may require more time spent within each stage.

Using Gestures to Improve Learning

Students' spontaneous gestures can give teachers information about their level of understanding beyond verbal explanations alone. When asked to explain how they arrived at an answer when solving a mathematics problem, children may gesture to represent an aspect of their explanation. These representational gestures often correspond to the words a child has spoken; however, sometimes the gestures and speech convey separate information. Research suggests that this *mismatch* in speech and gestures shows that a child has knowledge of an additional concept or strategy that they cannot yet verbally express. Goldin-Meadow (2009) studied children's gesture-speech mismatches during mathematics problem-solving and found that children's gesture-speech mismatches reflect knowledge of multiple strategies that would not have been apparent in speech alone. When solving a problem such as $2 + 4 + 3 = __ + 3$, a child may state aloud that he or she found an answer of 9 by adding the 2, the 4, and the 3, which indicates the *add up* strategy (i.e., add up to the equal sign), while at the same time pointing to the numbers on both sides of the equal sign. These types of mismatch can communicate that children are ready to learn new mathematical information (e.g., how to take into account numbers on both sides of the equations), even though both the verbal and gestured strategies were incorrect.

Gestures can also be used to help students learn new mathematics concepts. Watching a teacher point to materials during instruction helps children connect the teacher's words to the present context (Valenzeno, Alibali, & Klatzky, 2003). Gesturing externalizes the speaker's thoughts, freeing cognitive resources for learning new information (Ping & Goldin-Meadow, 2008). Several studies have experimentally manipulated children's gesture production during mathematics learning, with encouraging results. In one study, experimenters asked children to gesture while solving mathematics problems such as the one described in the previous paragraph. Children who were not initially able to solve the problems began to demonstrate the correct strategy through their gesture but not their speech, and this led to improved learning (Broaders, Cook, Mitchell, & Goldin-Meadow, 2007). Providing children with gestures while teaching with these types of mathematics problem helped children to retain and transfer the new knowledge better than children who were taught to explain the correct procedure through words alone (Cook, Mitchell, & Goldin-Meadow, 2008).

The gestures described above mostly served the purpose of drawing attention to important parts of a mathematics problem through pointing. However, teachers can also use *iconic* gestures, or gestures that capture and convey information that is not

explicitly linked to the present environment, in their mathematics instruction. An example of an iconic gesture in early mathematics teaching is gesturing to convey the difference in size between hypothetical objects, one as “small,” with hands close together, and another as “large,” with hands farther apart. Ping and Goldin-Meadow (2008) found that iconic gesturing in the air positively impacted student learning in lessons about conservation of materials. In fact, children provided explanations for problem-solving beyond what they were explicitly instructed when concrete materials were *not* linked to the gesture. Iconic gestures help students abstract new concepts beyond the context in which they are first taught, which may be particularly helpful for teaching new mathematics concepts.

Implications for Teachers of Students with MD

According to Goldin-Meadow (2009):

Gesture can change thought indirectly by revealing children’s unspoken thoughts to listeners who can then adjust their input accordingly. It can also change thought more directly by having an impact on the child learners themselves, perhaps by allowing them to express knowledge using their own bodies.

(p. 109)

Findings from the study of gesture’s effect on student learning suggest that intentionally incorporating gesture into mathematics lessons helps students with MD learn and retain new information (Goldin-Meadow, 2009). Lessons that require children to perform the gesture themselves may be particularly helpful for learning on the number line (Dyson et al., in press). For example, a looping gesture from whole number to whole number when counting on a number line fosters understanding of the continuity of numerical magnitude (i.e., that whole numbers are not just points on a line but that their magnitude also includes the space between the whole number points).

Future Directions.

Future work must explore how to best incorporate gesture into mathematics instruction for struggling learners in particular. Because much of present literature on the subject has been conducted one-on-one or in laboratory settings with typically developing children, more work is needed to determine the benefits of gesturing in the classroom, by the student and the instructor, specifically for students with MD.

Mixing Up Equation Formats

Mathematics equations are often presented in the same format. For example, students encounter most equations in a conventional format where the equal sign appears at the end of the problem (e.g. $3 + 4 = 7$; McNeil & Alibali, 2005). As such, children frequently interpret the equal sign as an operator (like an addition or subtraction sign) instructing them to “do something” to the numbers in the equation, rather than as a relational symbol of equivalence (Baroody & Ginsburg, 1983; Behr, Erlwanger, & Nichols, 1980). In other words, they see the equal sign as indicating the answer

to the problem rather than meaning “the same as.” When shown problems such as $7 = 3 + 4$ or $7 = 7$, many students say the problems do not make sense or that they are incorrect. This misconception becomes problematic when children later encounter the equal sign outside of traditional arithmetic, such as in pre-algebra instruction. Students’ misunderstanding of the equal sign appears due, in large part, to their limited experiences with solving problems in nonconventional formats (e.g. $x = 3 + 4$; McNeil & Alibali, 2005). Seeing the equal sign in different positions leads children to interpret it as a symbol that has to do with the relationships between the quantities on either side rather than an operator. Later, children should solve problems with operations on both sides of the equation (or $3 + 4 = 2 + 5$) to help them understand equivalence (Baroody & Ginsburg, 1983). It should be noted that mixing up different formats of problems during practice also addresses the previously discussed principle of interleaving.

Implications for Teachers of Students with MD

Arithmetic practice can be modified in several ways to be more effective. The equal sign should be placed in nonconventional places in the problem (e.g. $7 = 3 + 4$ as well as $3 + 4 = 7$; McNeil, Fyfe, Petersen, Dunwiddie, & Brletic-Shipley, 2011; Seo & Ginsburg, 2003). When referencing the equal sign, teachers should use relational phrases such as “is the same amount as” as opposed to just “equals.” Relational phrases activate children’s understanding of equivalence (McNeil, Fyfe, & Dunwiddie, 2015). To support relational learning further, a scale analogy could be used for learning how to balance equations, and teachers could even put even put a picture of a scale below the equal sign in the equation (Richland, Zur, & Holyoak, 2007). Children should practice these problems grouped by equivalent sums or totals (e.g., $__ + 4 = 7$, $2 + __ = 7$, $3 + __ = 2 + 5$). Such practice helps children understand that there are multiple ways to break apart each whole number into addends, and that addend pairs equivalent to a value are also equivalent to each other (e.g., if $3 + 4 = 7$ and $2 + 5 = 7$, then $3 + 4 = 2 + 5$; McNeil et al., 2012). One classroom intervention study assessed the effectiveness of a combination of the last three arithmetic modifications listed above by presenting many of these modifications in an arithmetic practice workbook. Students who practiced with the modified nontraditional arithmetic developed a greater understanding of mathematical equivalence after the intervention than did a control group of children who practiced with traditional arithmetic problems only (McNeil et al., 2015).

Future Directions

More work is needed to investigate additional modifications to arithmetic practice that will help children build an understanding of equivalence, especially for MD populations. The research summarized here focuses on a specific concept in mathematics (i.e., equivalence), but further study is needed to examine how varying problem formats can help to teach other important mathematical concepts beyond equivalence understanding. For example, anecdotally, in our intervention work we have found that students with MD find it easier and more understandable to add and subtract with fractions when using a vertical rather than a horizontal format. Varying vertical and horizontal formats in arithmetic likely increases flexibility and retention.

Using the Number Line as a Teaching Tool

The number line is the most accurate way to represent all numbers. It can be used to help children learn whole numbers and fractions as well as concepts of positive and negative numbers in an integrated way (Siegler et al., 2011).

Young children's understanding of the number line shifts from a logarithmic (i.e., overestimating the size of smaller numbers and underestimating the size of larger numbers) towards a linear representation over time (Booth & Siegler, 2006). In other words, children gradually develop an understanding that all whole numbers are positioned an equal distance from each other on the number line, and that the next whole number is always one more than the previous one or one less than the next one. The ability to estimate a whole number's place on a number line where only the end points are labeled (e.g., 0 and 100 or 0 and 1,000) predicts performance on early mathematics tasks, including counting and calculation (Booth & Siegler, 2008). This same type of estimation task has been used with fractions (e.g., on 0–1 and 0–2 number lines) later in elementary school. Accuracy and growth on fraction number line estimation tasks identifies those in need of fractions intervention (Jordan et al., 2017). That is, students who have difficulty estimating fraction placements on 0–1 and 0–2 number lines (e.g., $1/19$ vs. $1/3$ or $3/2$) tend to struggle with basic fraction concepts more generally. Children's early whole number line estimations can be improved by playing board games that involve number lines (e.g., Chutes and Ladders; Siegler & Ramani, 2008). Later in schooling, number lines are effective tools for building fraction knowledge (Gersten, Schumacher, & Jordan, 2017). Number lines allow students to view the magnitude of fractions more directly than the popular part-whole or "pie" models of fraction representation. Although exposure to different types of fraction models is important for developing fraction knowledge, the number line can be used to foster a more comprehensive concept of fractions (Gersten et al., 2017). When students are presented with a number line representation of fractions, they can more easily see that there are fractions between whole numbers, and that fractions can be greater than one. Number lines also allow for students to view relationships between equivalent fractions (e.g., that $2/4$, and $3/6$ occupy the same place on the number line and thus have the same magnitude).

Implications for Teachers of Students with MD

As noted earlier, children with MD often hold inaccurate representations of numerical magnitudes (Gersten et al., 2017). Incorporating number line models into mathematics instruction helps children think about the magnitude of numbers. Although most state standards and benchmarks (e.g., Common Core State Standards in Mathematics; National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010) now encourage the use of number lines along with other representations for teaching whole numbers and fractions, the extent to which the number line is being used to teach students with MD in particular is not clear (Gersten et al., 2017).

An intervention for kindergartners struggling with early number knowledge (Dyson et al., 2015) focused heavily on a symbolic number *list* that presented numerals linearly from 1 to 10 (as opposed to a conventional number line that starts with 0).

Each activity featured a cardinality chart along with the linear number list, which allowed children to see how numbers accumulate as they moved up the list (Figure 19.2). In a randomized trial, the intervention group improved number competencies relative to a business-as-usual control group, with large effect sizes.

Later in elementary school, children should be introduced to fractions on the number line. It is helpful to anchor the number line model in meaningful contexts (Bottge, Rueda, Grant, Stephens, & Laroque, 2010), such as measuring with a ruler or setting up a story that features the number line as a racecourse. Rodrigues, Dyson, Hansen, and Jordan (2016), for example, conducted a series of lessons that followed the story of a color-run race, with various check points along the course (e.g., drink stations every fourth mile). Students marked and labeled the racecourse and used it to learn about fraction magnitude, equivalent fractions, and, later, fraction arithmetic. The racecourse “number line” provided a concrete representation for students to use while working with fractions. Partitioning and labeling this number line model encouraged students to see fractions’ magnitudes in relation to the whole numbers, and also to identify equivalent fractions at places where labels overlapped. Randomized trials show that this approach led to lasting gains in fractions concepts (Barbieri et al., 2017; Dyson et al., in press).

Fuchs and colleagues (2013) studied the effectiveness of a conceptually based number line intervention for at-risk fourth graders in comparison with a control group that was taught using a part-whole-focused curriculum. Their intervention focused mainly on placing, ordering, and comparing fractions on a number line from 0 to 1, although this material was supplemented with part-whole models, as well. Fuchs et al. (2013) found that the intervention group outperformed the control on both procedural and conceptual fraction outcome measures immediately after the intervention.

Future Directions

More research is needed to directly test the utility of a number line model against the part-whole model for improving conceptual understanding as well as arithmetic skills of children with MD. Recent research shows that number lines are effective for teaching early fraction concepts in second grade (Hamdan & Gunderson, 2017), although this has not been studied with young children with or at risk for MD.

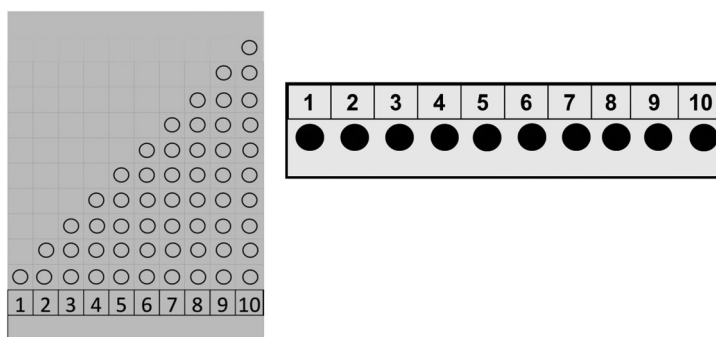


Figure 19.2 Children Begin with a Cardinality Chart, Each Number Showing Its Own Magnitude, and then Move on to a Number List where the Magnitude Accumulates as You Go up the Number List

CONCLUSIONS

Mathematics proficiency is increasingly important in our highly technological society, yet MD continue to be widespread in American schools. MD are associated with cognitive factors, environmental factors, or a combination of these factors. More general weaknesses in executive functioning, language, and visual-spatial learning may compromise student learning of mathematics concepts and procedures. Delays in working memory appear to be especially pervasive among children with MD. Students with or at risk for MD are often characterized by weak number sense, especially with respect to thinking about numerical magnitudes (for a related discussion, see Morsanyi, Chapter 21, this volume). Number sense deficiencies lead to poor fact retrieval as well as poor conceptual understanding. Although effective interventions with explicit instruction have been developed to help struggling students learn mathematics, many of these interventions do not have long-lasting effects. In other words, many of the gains children make relative to children who do not receive an intervention attenuate over time. As such, mathematics achievement gaps continue.

How can we increase mathematics learning in students with MD? Findings from the science of learning provide insight into principles and techniques that can be incorporated in mathematics instruction to increase depth and durability of learning. These techniques include providing worked examples of math problems, using integrated visual and verbal models to explain concepts, interleaving and spacing out practice opportunities, integrating concrete and abstract representations of mathematical concepts, mixing up equation formats to increase flexibility, using gestures to highlight information, and using the number line as a primary teaching tool. Although much of the research on these learning strategies has been conducted with general populations of students, we argue that they have particular relevance for students with MD. Use of evidence-based learning principles in mathematics instruction for this population is a promising direction for future investigations.

NOTE

- 1 Alexander, P. A. (2004). In the year 2020: Envisioning the possibilities for educational psychology. *Educational Psychologist*, 39(3), 149–156, p.153.

REFERENCES

- Adams, D. M., McLaren, B. M., Durkin, K., Mayer, R. E., Rittle-Johnson, B., Isotani, S., & van Velsen, M. (2014). Using erroneous examples to improve mathematics learning with a web-based tutoring system. *Computers in Human Behavior*, 36, 401–411.
- Atkinson, R. K., Derry, S. J., Renkl, A., & Wortham, D. (2000). Learning from examples: Instructional principles from the worked examples research. *Review of Educational Research*, 70(2), 181–214.
- Baddeley, A. D., & Hitch, G. (1974). Working memory. In G. H. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory* (pp. 47–89). New York: Academic Press.
- Bahrick, H. P., & Hall, L. K. (2005). The importance of retrieval failures to long-term retention: A metacognitive explanation of the spacing effect. *Journal of Memory and Language*, 52(4), 566–577.
- Bailey, D. H., Nguyen, T., Jenkins, J. M., Domina, T., Clements, D. H., & Sarama, J. S. (2016). Fadeout in an early mathematics intervention: Constraining content or preexisting differences? *Developmental Psychology*, 52(9), 1457–1469. doi:10.1037/dev0000188
- Barbieri, C., & Booth, J. L. (2016). Support for struggling students in algebra: Contributions of incorrect worked examples. *Learning and Individual Differences*, 48, 36–44.

- Barbieri, C. A., Rodrigues, J., Dyson, N., & Jordan, N. C. (2019). Improving fraction understanding in sixth graders with mathematics difficulties: Effects of a number line approach combined with cognitive learning strategies. *Journal of Educational Psychology*. Advance online publication. <http://dx.doi.org/10.1037/edu0000384>
- Baroody, A. J., & Ginsburg, H. P. (1983). The effects of instruction on children's understanding of the "equals" sign. *Elementary School Journal*, 84, 198–212. doi:10.1086/461356
- Behr, M., Erlwanger, S., & Nichols, E. (1980). How children view the equals sign. *Mathematics Teaching*, 92(1), 13–15.
- Belenky, D. M., & Schalk, L. (2014). The effects of idealized and grounded materials on learning, transfer, and interest: An organizing framework for categorizing external knowledge representations. *Educational Psychology Review*, 26(1), 27–50.
- Berthold, K., Eysink, T. H. S., & Renkl, A. (2009). Assisting self-explanation prompts are more effective than open prompts when learning with multiple representations. *Instructional Science*, 37, 345–363.
- Booth, J. L., Cooper, L. A., Donovan, M. S., Huyghe, A., Koedinger, K. R., & Paré-Blagoev, E. J. (2015a). Design-based research within the constraints of practice: AlgebraByExample. *Journal of Education for Students Placed at Risk*, 20(1–2), 79–100.
- Booth, J. L., Lange, K. E., Koedinger, K. R., & Newton, K. J. (2013). Using example problems to improve student learning in algebra: Differentiating between correct and incorrect examples. *Learning and Instruction*, 25, 24–34.
- Booth, J. L., Oyer, M. H., Paré-Blagoev, E. J., Elliot, A., Barbieri, C., Augustine, A. A., & Koedinger, K. R. (2015b). Learning algebra by example in real-world classrooms. *Journal of Research on Educational Effectiveness*, 8(4), 530–551.
- Booth, J. L., & Siegler, R. S. (2006). Developmental and individual differences in pure numerical estimation. *Developmental Psychology*, 42(1), 189.
- Booth, J. L., & Siegler, R. S. (2008). Numerical magnitude representations influence arithmetic learning. *Child Development*, 79(4), 1016–1031.
- Bottge, B. A., Rueda, E., Grant, T. S., Stephens, A. C., & Laroque, P. T. (2010). Anchoring problem-solving and computation instruction in context-rich learning environments. *Exceptional Children*, 76(4), 417–437. doi:10.1777/001440291007600403
- Bouck, E. C., Satsangi, R., & Park, J. (2017). The concrete-representational-abstract approach for students with learning disabilities: An evidence-based practice synthesis. *Remedial and Special Education*, 1–18. doi:10.1177/0741932517721712
- Braithwaite, D. W., & Goldstone, R. L. (2013). Integrating formal and grounded representations in combinatorics learning. *Journal of Educational Psychology*, 105(3), 666.
- Broaders, S. C., Cook, S. W., Mitchell, Z., & Goldin-Meadow, S. (2007). Making children gesture brings out implicit knowledge and leads to learning. *Journal of Experimental Psychology*, 136(4), 539–550. doi:10.1037/0096-3445.136.4.539
- Brown, P. C., Roedinger, H. L., & McDaniel, M. A. (2014). *Make it stick: The science of successful learning*. Cambridge, MA: Harvard University Press.
- Bruner, J. S. (1966). *Toward a theory of instruction*. Cambridge, MA: Harvard University Press.
- Butterworth, B. (1999). Perspectives: Neuroscience – A head for figures. *Science*, 284(5416), 928–929. doi:10.1126/science.284.5416.928
- Butterworth, B. (2005). The development of arithmetical abilities. *Journal of Child Psychology and Psychiatry*, 46(1), 3–18. doi:10.1111/j.1469-7610.2004.00374.x
- Butterworth, B., & Reigosa-Crespo, V. (2007). Information processing deficits in dyscalculia. In D. B. Berch & M. M. Mazzocco (Eds.), *Why is math so hard for some children? The nature and origins of mathematical learning difficulties and disabilities* (pp. 65–81). Baltimore, MD: Paul H. Brookes.
- Carpenter, S. K., Cepeda, N. J., Rohrer, D., Kang, S. H., & Pashler, H. (2012). Using spacing to enhance diverse forms of learning: Review of recent research and implications for instruction. *Educational Psychology Review*, 24(3), 369–378.
- Carroll, W. M. (1994). Using worked examples as an instructional support in the algebra classroom. *Journal of Educational Psychology*, 86(3), 360–367.
- Catrambone, R., & Yuasa, M. (2006). Acquisition of procedures: The effects of example elaborations and active learning exercises. *Learning and Instruction*, 16(2), 139–153.
- Cepeda, N. J., Vul, E., Rohrer, D., Wixted, J. T., & Pashler, H. (2008). Spacing effects in learning: A temporal ridge line of optimal retention. *Psychological Science*, 19(11), 1095–1102.

- Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and Instruction*, 8(4), 293–332.
- Childers, J. B., & Tomasello, M. (2002). Two-year-olds learn novel nouns, verbs, and conventional actions from massed or distributed exposures. *Developmental Psychology*, 38(6), 967–978.
- Clements, D. H., Sarama, J., Wolfe, C. B., & Spitler, M. E. (2013). Longitudinal evaluation of a scale-up model for teaching mathematics with trajectories and technologies: Persistence of effects in the third year. *American Educational Research Journal*, 50(4), 812–850.
- Cook, S. W., Mitchell, Z., & Goldin-Meadow, S. (2008). Gesturing makes learning last. *Cognition*, 106(2), 1047–1058. doi:10.1016/j.cognition.2007.04.010
- Cuevas, J. (2016). An analysis of current evidence supporting two alternate learning models: Learning styles and dual coding. *Journal of Educational Sciences and Psychology*, 6, 1.
- De Bock, D., Deprez, J., Van Dooren, W., Roelens, M., & Verschaffel, L. (2011). Abstract or concrete examples in learning mathematics? A replication and elaboration of Kaminski, Sloutsky, and Heckler's study. *Journal for Research in Mathematics Education*, 42(2), 109–126.
- de Koning, B. B., Tabbers, H. K., Rikers, R. M., & Paas, F. (2010). Learning by generating vs. receiving instructional explanations: Two approaches to enhance attention cueing in animations. *Computers & Education*, 55(2), 681–691.
- Ding, M. (2016). Opportunities to learn: Inverse relations in US and Chinese textbooks. *Mathematical Thinking and Learning*, 18(1), 45–68.
- Donovan, J. J., & Radosevich, D. J. (1999). A meta-analytic review of the distribution of practice effect: Now you see it, now you don't. *Journal of Applied Psychology*, 84(5), 795–805.
- Duncan, G. J., & Brooks-Gunn, J. (2001). Poverty, welfare reform, and children's achievement. In B. J. Biddle (Ed.), *Social class, poverty, and education: Policy and practice* (pp. 49–75). New York: Routledge Falmer.
- Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, 14(1), 4–58.
- Durkin, K., & Rittle-Johnson, B. (2012). The effectiveness of using incorrect examples to support learning about decimal magnitude. *Learning and Instruction*, 22, 206–214.
- Dyson, N., Barbieri, C. A., Rodrigues, J., Rinne, L., & Jordan, N. C. (in press). A fraction sense intervention for students with or at risk for mathematics difficulties. *Remedial and Special Education*. Advance online publication. doi: 10.1177/0741932518807139
- Dyson, N., Jordan, N. C., Beliakoff, A., & Hassinger-Das, B. (2015). A kindergarten number-sense intervention with contrasting practice conditions for low-achieving children. *Journal for Research in Mathematics Education*, 46(3), 331–370.
- Fuchs, L. S., Compton, D. L., Fuchs, D., Paulsen, K., Bryant, J. D., & Hamlett, C. L. (2005). The prevention, identification, and cognitive determinants of math difficulty. *Journal of Educational Psychology*, 97(3), 493–513.
- Fuchs, L. S., Fuchs, D., Powell, S. R., Seethaler, P. M., Cirino, P. T., & Fletcher, J. M. (2008). Intensive intervention for students with mathematics disabilities: Seven principles of effective practice. *Learning Disability Quarterly*, 31(2), 79–92.
- Fuchs, L. S., Schumacher, R. F., Long, J., Namkung, J., Hamlett, C. L., Cirino, P. T., ... Chngas, P. (2013). Improving at-risk learners' understanding of fractions. *Journal of Educational Psychology*, 105(3), 683–700. doi:10.1037/a0032446
- Fuchs, L. S., Schumacher, R. F., Sterba, S. K., Long, J., Namkung, J., Malone, A., ... Chngas, P. (2014). Does working memory moderate the effects of fraction intervention? An aptitude–treatment interaction. *Journal of Educational Psychology*, 106(2), 499–514.
- Funk, C., & Parker, K. (2018, January 09). Most Americans evaluate STEM education as middling compared with other developed nations. Retrieved from www.pewsocialtrends.org/2018/01/09/5-most-americans-evaluate-stem-education-as-middling-compared-with-other-developed-nations/
- Funk, C., & Parker, K. (2018, January 9). Women and men in STEM often at odds over workplace equity. Retrieved from <https://www.pewsocialtrends.org/2018/01/09/women-and-men-in-stem-often-at-odds-over-workplace-equity/>
- Fyfe, E., McNeil, N., & Borjas, S. (2015). Benefits of “concreteness fading” for children's mathematics understanding. *Learning and Instruction*, 35, 104–120.
- Fyfe, E.R., & Nathan, M.J. (2019) Making “concreteness fading” more concrete as a theory of instruction for promoting transfer, *Educational Review*, 71(4), 403–422, DOI: 10.1080/00131911.2018.1424116

- Geary, D. C. (2004). Mathematics and learning disabilities. *Journal of Learning Disabilities*, 37(1), 4–15.
- Geary, D. C. (2013). Early foundations for mathematics learning and their relations to learning disabilities. *Current Directions in Psychological Science*, 22(1), 23–27.
- Gersten, R., Beckmann, S., Clarke, B., Foegen, A., Marsh, L., Star, J. R., & Witzel, B. (2009). *Assisting students struggling with mathematics: Response to intervention (RtI) for elementary and middle schools*. NCEE 2009-4060. Princeton, NJ: What Works Clearinghouse.
- Gersten, R., Jordan, N. C., & Flojo, J. R. (2005). Early identification and interventions for students with mathematics difficulties. *Journal of Learning Disabilities*, 38(4), 293–304.
- Gersten, R., Schumacher, R. F., & Jordan, N. C. (2017). Life on the number line: Routes to understanding fraction magnitude for students with difficulties learning mathematics. *Journal of Learning Disabilities*, 50(6), 655–657.
- Ginns, P. (2005). Meta-analysis of the modality effect. *Learning and Instruction*, 15(4), 313–331.
- Ginns, P. (2006). Integrating information: A meta-analysis of the spatial contiguity and temporal contiguity effects. *Learning and Instruction*, 16(6), 511–525.
- Goldin-Meadow, S. (2009). How gesture promotes learning throughout childhood. *Child Development Perspectives*, 3(2), 106–111. doi:10.1111/j.1750-8606.2009.00088.x
- Gunderson, E. A., Ramirez, G., Beilock, S. L., & Levine, S. C. (2012). The relation between spatial skill and early number knowledge: The role of the linear number line. *Developmental Psychology*, 48(5), 1229–1241.
- Hallstedt, H. M., Klingberg, T., & Ghaderi, A. (2017). Short and long-term effects of a mathematics tablet intervention for low performing second graders. *Journal of Educational Psychology*, 110(8), 1127–1148. <https://doi.org/10.1037/edu0000264>
- Hamdan, N., & Gunderson, E. A. (2017). The number line is a critical spatial-numerical representation: Evidence from a fraction intervention. *Developmental Psychology*, 53(3), 587–596.
- Hansen, N., Jordan, N. C., & Rodrigues, J. (2017). Identifying learning difficulties with fractions: A longitudinal study of student growth from third through sixth grade. *Contemporary Educational Psychology*, 50, 45–59.
- Hiebert, J., & Grouws, D. A. (2007). The effects of classroom mathematics teaching on students' learning. In F. K. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 371–404). Charlotte, NC: Information Age.
- Huang, X., & Reiser, R. A. (2012). The effect of instructional explanations and self-explanation prompts in worked examples on student learning and transfer. *International Journal of Instructional Media*, 39, 331.
- Jitendra, A. K., Petersen-Brown, S., Lein, A. E., Zaslofsky, A. F., Kunkel, A. K., Jung, P. G., & Egan, A. M. (2015). Teaching mathematical word problem solving: The quality of evidence for strategy instruction priming the problem structure. *Journal of Learning Disabilities*, 48(1), 51–72. doi:10.1177/0022219413487408
- Jordan, N. C., & Dyson, N. (2016). Catching math problems early: Findings from the number sense intervention project. In A. Henik (Ed.), *Continuous issues in numerical cognition: How many or how much?* (pp. 60–79). New York: Elsevier.
- Jordan, N. C., Fuchs, L. S., & Dyson, N. (2015). Early interventions and mathematical cognition. In R. Cohen Kadosh & A. Dowker (Eds.), *Oxford handbook on numerical cognition* (pp. 1079–1097). Oxford: Oxford University Press.
- Jordan, N. C., Hanich, L. B., & Kaplan, D. (2003). Arithmetic fact mastery in young children: A longitudinal investigation. *Journal of Experimental Child Psychology*, 85, 103–119.
- Jordan, N. C., Hansen, N., Fuchs, L. S., Siegler, R. S., Gersten, R., & Micklos, D. (2013). Developmental predictors of fraction concepts and procedures. *Journal of Experimental Child Psychology*, 116(1), 45–58.
- Jordan, N. C., Kaplan, D., Ramineni, C., & Locuniak, M. N. (2009). Early math matters: Kindergarten number competence and later mathematics outcomes. *Developmental Psychology*, 45(3), 850–867.
- Jordan, N. C., & Levine, S. C. (2009). Socio-economic variation, number competence, and mathematics learning difficulties in young children. *Developmental Disabilities Research Reviews*, 15, 60–68.
- Jordan, N. C., Resnick, I., Rodrigues, J., Hansen, N., & Dyson, N. (2017). Delaware longitudinal study of fraction learning: Implications for helping children with mathematics difficulties. *Journal of Learning Disabilities*, 50(6), 621–630.
- Kalyuga, S., Chandler, P., & Sweller, J. (2001). Learner experience and efficiency of instructional guidance. *Educational Psychology*, 21(1), 5–23.
- Kaminski, J. A., Sloutsky, V. M., & Heckler, A. F. (2008). The advantage of abstract examples in learning math. *Science*, 320(5875), 454–455.
- Kang, S. H., & Pashler, H. (2012). Learning painting styles: Spacing is advantageous when it promotes discriminative contrast. *Applied Cognitive Psychology*, 26(1), 97–103.

- Kaufmann, L., Mazzocco, M. M., Dowker, A., von Aster, M., Goebel, S., Grabner, R., & Rubinsten, O. (2013). Dyscalculia from a developmental and differential perspective. *Frontiers in Psychology*, 4, 516. doi:10.3389/fpsyg.2013.00516
- Kay, R., & Edwards, J. (2012). Examining the use of worked example video podcasts in middle school mathematics classrooms: A formative analysis. *Canadian Journal of Learning and Technology*, 38(3), 1–20.
- Kester, L., Kirschner, P. A., & van Merriënboer, J. J. (2005). The management of cognitive load during complex cognitive skill acquisition by means of computer-simulated problem solving. *British Journal of Educational Psychology*, 75(1), 71–85.
- Landerl, K., Bevan, A., & Butterworth, B. (2004). Developmental dyscalculia and basic numerical capacities: A study of 8–9-year-old students. *Cognition*, 93, 99–125. doi:10.1016/j.cognition.2003.11.004
- Lee, C., & Chen, M. (2015). Effects of worked examples using manipulatives on fifth graders' learning performance and attitude toward mathematics. *Journal of Educational Technology & Society*, 18(1), 264–275.
- Li, Y., & Geary, D. C. (2017). Children's visuospatial memory predicts mathematics achievement through early adolescence. *PLoS One*, 12(2), e0172046. doi:https://doi.org/10.1371/journal.pone.0172046
- Lubienski, S. T. (2000). Problem solving as a means toward mathematics for all: An exploratory look through a class lens. *Journal for Research in Mathematics Education*, 31(4), 454–482.
- Mayer, R. E. (2001). *Multimedia learning*. Cambridge: Cambridge University Press.
- Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). New York: Cambridge University Press.
- McGinn, K. M., Lange, K. E., & Booth, J. L. (2015). A worked example for creating worked examples. *Mathematics Teaching in the Middle School*, 21(1), 26–33.
- McNeil, N. M., & Alibali, M. W. (2005). Why won't you change your mind? Knowledge of operational patterns hinders learning and performance on equations. *Child Development*, 76, 883–899. doi:10.1111/j.1467-8624.2005.00884.x
- McNeil, N. M., Chesney, D. L., Matthews, P. G., Fyfe, E. R., Petersen, L. A., Dunwiddie, A. E., & Wheeler, M. C. (2012). It pays to be organized: Organizing arithmetic practice around equivalent values facilitates understanding of math equivalence. *Journal of Educational Psychology*, 104(4), 1109–1121. doi:10.1037/a0028997
- McNeil, N. M., Fyfe, E. R., & Dunwiddie, A. E. (2015). Arithmetic practice can be modified to promote understanding of mathematical equivalence. *Journal of Educational Psychology*, 107, 423–436.
- McNeil, N. M., Fyfe, E. R., Petersen, L. A., Dunwiddie, A. E., & Brletic-Shipley, H. (2011). Benefits of practicing $4 = 2 + 2$: Nontraditional problem formats facilitate children's understanding of mathematical equivalence. *Child Development*, 82, 1620–1633. doi:10.1037/a0037687
- Moreno, R., & Mayer, R. E. (1999). Cognitive principles of multimedia learning: The role of modality and contiguity. *Journal of Educational Psychology*, 91(2), 358–368.
- National Assessment of Educational Progress (NAEP) (2019). The Nation's Report Card: 2015 Mathematics and Reading Assessments. Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Retrieved from <https://nces.ed.gov/pubsearch/pubinfo.asp?pubid=2015136>
- National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010). *Common core state standards for mathematics*. Retrieved from www.corestandards.org/Math/
- National Mathematics Advisory Panel. (2008). *Foundations for success: The final report of the national mathematics advisory panel*. Washington, DC: U.S. Department of Education. Retrieved from www2.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf
- OECD. (2012). *Programme for International Assessment (PISA) results from PISA 2012*. Paris: Author. Retrieved from www.oecd.org/unitedstates/PISA-2012-results-US.pdf
- Ohlsson, S. (1996). Learning from performance errors. *Psychological Review*, 103(2), 241–262.
- Ozcelik, E., Arslan-Ari, I., & Cagiltay, K. (2010). Why does signaling enhance multimedia learning? Evidence from eye movements. *Computers in Human Behavior*, 26(1), 110–117.
- Paivio, A. (1986). *Mental representations: A dual-coding approach*. Oxford: Oxford University Press.
- Pashler, H., Bain, P. M., Bottge, B. A., Graesser, A., Koedinger, K., McDaniel, M., & Metcalfe, J. (2007). *Organizing instruction and study to improve student learning. IES practice guide*. NCER 2007-2004. Washington, DC: National Center for Education Research.
- Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2009). Learning styles: concepts and evidence. *Psychological Science in the Public Interest*, 9(3), 105–119. <http://dx.doi.org/10.1111/j.1539-6053.2009.01038.x>
- Ping, R. M., & Goldin-Meadow, S. (2008). Hands in the air: Using ungrounded iconic gestures to teach children conservation of quantity. *Developmental Psychology*, 44(5), 1277–1287.

- Pol, H. J., Harskamp, E. G., Suhre, C. J. M., & Goedhart, M. J. (2009). How indirect supportive digital help during and after solving physics problems can improve problem-solving abilities. *Computers & Education*, 53, 34–50.
- Rau, M. A., Aleven, V., & Rummel, N. (2010, June). Blocked versus interleaved practice with multiple representations in an intelligent tutoring system for fractions. In *International Conference on Intelligent Tutoring Systems* (pp. 413–422). Berlin, Heidelberg: Springer.
- Rea, C. P., & Modigliani, V. (1985). The effect of expanded versus massed practice on the retention of multiplication facts and spelling lists. *Human Learning: Journal of Practical Research & Applications*, 4(1), 11–18.
- Renkl, A., Atkinson, R. K., Maier, U. H., & Staley, R. (2002). From example study to problem solving: Smooth transitions help learning. *The Journal of Experimental Education*, 70, 293–315.
- Resnick, I., Jordan, N. C., Hansen, N., Rajan, V., Rodrigues, J., Siegler, R. S., & Fuchs, L. S. (2016). Developmental growth trajectories in understanding of fraction magnitude from fourth through sixth grade. *Developmental Psychology*, 52(5), 746–757.
- Resnick, I., Newcombe, N. S., & Jordan, N. C. (2019). The relation between spatial reasoning and mathematics in children with mathematics learning difficulties. In A. Fritz-Stratman, V. G. Haase, & P. Rasanen Eds. *International handbook of mathematics learning difficulties* (pp. 423–434). New York: Springer International AG.
- Richland, L. E., Zur, O., & Holyoak, K. J. (2007). Cognitive supports for analogies in the mathematics classroom. *Science*, 316, 1128–1129.
- Rittle-Johnson, B., & Jordan, N. C. (2016). *Synthesis of IES-funded research on mathematics: 2002–2013*. (NCER 2016-2003). Washington, DC: National Center for Education Research.
- Rittle-Johnson, B., & Siegler, R. S. (1998). The relation between conceptual and procedural knowledge in learning mathematics: A review. In C. Donlan (Ed.), *Studies in developmental psychology. The development of mathematical skills* (pp. 75–110). Hove, UK: Psychology Press/Taylor & Francis.
- Rittle-Johnson, B., Siegler, R. S., & Alibali, M. W. (2001). Developing conceptual understanding and procedural skill in mathematics: An iterative process. *Journal of Educational Psychology*, 93(2), 346–362. doi:10.1037//0022-0663.93.2.346
- Rittle-Johnson, B., & Star, J. R. (2007). Does comparing solution methods facilitate conceptual and procedural knowledge? An experimental study on learning to solve equations. *Journal of Educational Psychology*, 99(3), 561–574.
- Roediger III, H. L., Agarwal, P. K., McDaniel, M. A., & McDermott, K. B. (2011). Test-enhanced learning in the classroom: long-term improvements from quizzing. *Journal of Experimental Psychology: Applied*, 17(4), 382–395.
- Rodrigues, J., Dyson, N., Hansen, N., & Jordan, N. C. (2016). Preparing for algebra by building fraction sense. *Teaching Exceptional Children*, 49(2), 134–141.
- Rohrer, D., Dedrick, R. F., & Burgess, K. (2014). The benefit of interleaved mathematics practice is not limited to superficially similar kinds of problems. *Psychonomic Bulletin & Review*, 21, 1323–1330.
- Rohrer, D., Dedrick, R. F., & Stershic, S. (2015). Interleaved practice improves mathematics learning. *Journal of Educational Psychology*, 107(3), 900.
- Rohrer, D., & Taylor, K. (2006). The effects of overlearning and distributed practice on the retention of mathematics knowledge. *Applied Cognitive Psychology*, 20, 1209–1224.
- Rohrer, D., & Taylor, K. (2007). The shuffling of mathematics practice problems boosts learning. *Instructional Science*, 35, 481–498.
- Rousselle, L., & Noël, M. P. (2007). Basic numerical skills in children with mathematics learning disabilities: A comparison of symbolic vs non-symbolic number magnitude processing. *Cognition*, 102(3), 361–395.
- Rummer, R., Schweppe, J., Fürstenberg, A., Scheiter, K., & Zindler, A. (2011). The perceptual basis of the modality effect in multimedia learning. *Journal of Experimental Psychology: Applied*, 17(2), 159–173.
- Scheiter, K., & Eitel, A. (2015). Signals foster multimedia learning by supporting integration of highlighted text and diagram elements. *Learning and Instruction*, 36, 11–26.
- Schutte, G. M., Duhon, G. J., Solomon, B. G., Poncy, B. C., Moore, K., & Story, B. (2015). A comparative analysis of massed vs. distributed practice on basic math fact fluency growth rates. *Journal of School Psychology*, 53(2), 149–159.
- Seethaler, P. M., Fuchs, L. S., Star, J. R., & Bryant, J. (2011). The cognitive predictors of computational skill with whole versus rational numbers: An exploratory study. *Learning and Individual Differences*, 21(5), 536–542. doi:10.1016/j.lindif.2011.05.002

- Seo, K.-H., & Ginsburg, H. P. (2003). "You've got to carefully read the math sentence ...": Classroom context and children's interpretations of the equals sign. In A. J. Baroody & A. Dowker (Eds.), *Studies in mathematical thinking and learning. The development of arithmetic concepts and skills: Constructing adaptive expertise* (pp. 161–187). Mahwah, NJ: Lawrence Erlbaum.
- Siegler, R. S. (2002). Microgenetic studies of self-explanations. In N. Granott & J. Parziale (Eds.), *Microdevelopment: Transition processes in development and learning* (pp. 31–58). New York: Cambridge University Press.
- Siegler, R. S., & Chen, Z. (2008). Differentiation and integration: Guiding principles for analyzing cognitive change. *Developmental Science*, 11(4), 433–453.
- Siegler, R. S., & Lortie-Forgues, H. (2014). An integrative theory of numerical development. *Child Development Perspectives*, 8(3), 144–150. doi:10.1111/cdep.12077
- Siegler, R. S., & Ramani, G. B. (2008). Playing linear numerical board games promotes low-income children's numerical development. *Developmental Science*, 11(5), 655–661.
- Siegler, R. S., Thompson, C. A., & Schneider, M. (2011). An integrated theory of whole number and fractions development. *Cognitive Psychology*, 62(4), 273–296.
- Star, J. R., & Rittle-Johnson, B. (2009). Making algebra work: Instructional strategies that deepen student understanding, within and between algebraic representations. *ERS Spectrum*, 27(2), 11–18.
- Swanson, H. L. (2014). Does cognitive strategy training on word problems compensate for working memory capacity in children with math difficulties? *Journal of Educational Psychology*, 106(3), 831.
- Swanson, H.L. & Jerman, O. (2006) Math Disabilities: A Selective Meta-Analysis of the Literature. *Review of Educational Research*, 76, 249–274.
- Swanson, H. L., Jerman, O., & Zheng, X. (2008). Growth in working memory and mathematical problem solving in children at risk and not at risk for serious math difficulties. *Journal of Educational Psychology*, 100(2), 343–379.
- Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 12, 257–285.
- Sweller, J. (2006). The worked example effect and human cognition. *Learning and Instruction*, 16, 165–169.
- Sweller, J. (2012). Human cognitive architecture: Why some instructional procedures work and others do not. In K. R. Harris, S. Graham, & T. Urdan (Eds.), *APA educational psychology handbook; Volume 1: Theories, constructs, and critical issues* (pp. 295–325). Washington, DC: American Psychological Association.
- Tarmizi, R. A., & Sweller, J. (1988). Guidance during mathematical problem solving. *Journal of Educational Psychology*, 80(4), 424–436.
- Taylor, K., & Rohrer, D. (2010). The effect of interleaving practice. *Applied Cognitive Psychology*, 24, 837–848.
- Uttal, D., Scudder, K., & DeLoache, J. (1997). Manipulatives as symbols: A new perspective on the use of concrete objects to teach mathematics. *Journal of Applied Developmental Psychology*, 19, 37–54.
- Uttal, D. H., Amaya, M., Del Rosario Maita, M., Hand, L. L., Cohen, C. A., O'Doherty, K., & DeLoache, J. S. (2013). It works both ways: Transfer difficulties between manipulatives and written subtraction solutions. *Child Development Research*, 2013, 1–13.
- Valenzeno, L., Alibali, M. W., & Klatzky, R. (2003). Teachers' gestures facilitate students' learning: A lesson in symmetry. *Contemporary Educational Psychology*, 28(2), 187–204.
- Ward, M., & Sweller, J. (1990). Structuring effective worked examples. *Cognition and Instruction*, 7, 1–39. doi:10.1016/s0361-476x(02)0007-3
- Welcome, S. E., Paivio, A., McRae, K., & Joanisse, M. F. (2011). An electrophysiological study of task demands on concreteness effects: Evidence for dual coding theory. *Experimental Brain Research*, 212(3), 347–358.
- Zhu, X., & Simon, H. (1987). Learning mathematics from examples and by doing. *Cognition and Instruction*, 4(3), 137–166.

20

WRITING AND STUDENTS WITH LEARNING DISABILITIES

Steve Graham and Karen R. Harris

The study of writing has a long and storied history in educational psychology. Right from its initial inception, educational psychologists studied various aspects of this complex skill. Edward Thorndike, whose theory of connectionism laid the groundwork for the field of educational psychology, published a paper in *Teachers College Record* in 1910 examining how to measure handwriting quality in a reliable and valid manner. This was followed by writing research conducted by other psychologists interested in education, studying topics ranging from spelling (Turner, 1912) to sentence structure (Poley, 1929) to creative writing (Sofell, 1929).

Although writing was viewed as an important skill at the start of the previous century (Copeland & Rideout, 1901), I doubt that any of these early pioneers anticipated how essential writing would become in the next century. More than 85% of people worldwide write today (Swedlow, 1999), and writing is now closely tied to success in almost all aspects of life, especially in informational societies such as the United States. At school, writing is used to assess students' knowledge (Graham, 2006), and learning is enhanced when students write about materials read or presented in class (Bangert-Drowns, Hurley, & Wilkinson, 2004; Graham & Hebert, 2011). At work, most employees use writing to perform their jobs (Light, 2001), and writing skills are increasingly assessed by employers to make decisions about hiring and promoting salaried workers (National Commission on Writing, 2004). At home, writing provides a powerful tool for keeping us connected, as we tweet, text, email, and friend each other using a variety of social networks and media. We also use writing to persuade others, record information, create imaginary worlds, express feelings, entertain others, heal psychological wounds, chronicle experiences, and explore the meaning of events and situations (Graham, 2018a, 2018b).

Because writing is such a versatile and ubiquitous tool in everyday 21st-century life, those who fail to master it are at a distinct disadvantage. Poor writing skills limit academic, occupational, and personal attainments (Troia, Graham, & Harris, 2017).

Persons with a disability are at special risk for experiencing the effects of poor writing skills. According to the data from the 2011 National Assessment of Educational Progress (NAEP) writing assessment in the United States (National Center for Educational Statistics, 2012), 95% of eighth- and twelfth-grade students with a disability scored at or below the basic level (denoting only partial mastery of grade-level writing skills). A sizable proportion of these youngsters are students with a learning disability (LD): 35% according to the National Center for Educational Statistics (2016). Challenges mastering fundamental writing skills are a key ingredient in the definition of an LD, as this disability is defined as a disorder in one or more basic psychological processes that result in imperfect abilities in academic skills such as learning to spell and write (Pullen, Lane, Ashworth, & Lovelace, 2017). This focus on academic skills in general, as well as writing in particular, may explain why educational psychologists and special education researchers have focused more attention on the writing of these students than youngsters with other disabilities (Graham & Harris, 2011).

The purpose of this chapter is to synthesize theory and research on the writing of students with LD. In doing so, we draw implications for practice and future research. Although we might have focused on other disabilities such as ADHD (see Graham, Fishman, Reid, & Hebert, 2016; Reid, Hagaman, & Graham, 2014), the research base in these areas is not as rich as it is in LD (Graham & Harris, 2011), providing a less fertile ground for exploration.

THEORY, WRITING, AND LD

LD is a relatively new construct in comparison with other areas of disabilities such as deafness and visual impairment. The term first appeared in 1963, and, despite the many controversies that surround its definition, most experts agree that it is a “neurological disorder that affects the brain’s ability to receive, process, store, and respond to information” (Pullen et al., 2017, p. 286). Given the cognitive and information processing nature of this definition, it is not surprising that most educational psychologists and writing researchers apply a cognitive perspective to writing research conducted with students with LD. This is not the only perspective applied, as some researchers employ a behavioral framework (e.g., Hopman & Glynn, 1989), others a social cultural one (Englert et al., 1991), and too often no theoretical framework is applied at all.

Below we review the major cognitive models that influence writing research with students with LD. We further indicate ways in which each theory impacts the type of research undertaken with these students. At the end of this section, we present a new model that combines both a cognitive and social cultural perspective.

HAYES AND FLOWER MODEL

A model of skilled writing developed by the psychologist John Hayes and the writing expert Linda Flower (1980) provided one of the most influential early frameworks for thinking about writing and LD. This model contained three basic components: *task environment* (attributes of the writing assignment and the text produced so far), *cognitive processes* (the mental operations employed during writing, including

planning what to say and how to say it, translating plans into written text, and reviewing to improve existing text), and *writer's long-term memory* (writer's knowledge about the topic, the intended audience, and general plans or formulas for accomplishing various writing tasks). Hayes and Flower further maintained that writing is a goal-oriented process, the deployment of writing processes is controlled by the writer, and writers must deal with many demands at once (failure to do so can lead to cognitive overload).

Even though the Hayes and Flower model (1980) described the processing of skilled writers, it served as a catalyst for testing the effectiveness of teaching students with LD *cognitive processes* or strategies for planning, drafting, revising, and editing text (e.g., Harris & Graham, 1985). Its emphasis on writing as a goal-directed process led researchers to examine how different attributes of goals influenced the writing of students with LD, such as whether more elaborated goals resulted in better writing performance (e.g., Ferretti, MacArthur, & Dowdy, 2000). It further resulted in research examining how much knowledge about writing students with LD hold in their *long-term memory* (e.g., Englert, Raphael, Fear, & Anderson, 1988). Perhaps even more importantly, it was the starting point for a reoccurring theme in writing research with these students – the impact of cognitive overload (Berninger, 1999; for a discussion of cognitive load and text *comprehension*, see Tricot, Vandenbroucke, & Sweller, Chapter 15, this volume).

KNOWLEDGE TELLING MODEL

A cognitive model of writing developed by Bereiter and Scardamalia (1987) provided an especially useful tool for considering the role of cognitive overload in the writing of students with LD. These two theorists proposed that novice or immature writers are able to deal with the multiple demands of writing by simplifying it. They treat writing as a knowledge telling process, generating a first sentence that is topic-appropriate, which serves as a stimulus for the next sentence, and so forth. For students with LD who typically experience considerable difficulties mastering and automatizing basic transcriptions skills such as handwriting and spelling (Berninger, 1999), the knowledge telling approach provides an adaptive strategy for writing, as it allows them to produce text while minimizing or eliminating other cognitively demanding processes such as planning, organizing text, or considering the needs of the reader. In essence, it turns writing into a one-trick pony of generating content on the fly.

The knowledge telling model was especially important in guiding how the writing of students with LD was conceptualized, leading researchers to test if this model provided an accurate description of these youngsters' writing (e.g., Thomas, Englert, & Gregg, 1987). It served as a catalyst for research examining how text transcription skills such as handwriting and spelling constrained these children's writing (e.g., Graham, Harris, & Adkins, 2018). Perhaps most importantly, researchers deliberately set out to determine if the knowledge telling approach could be upgraded or supplanted by teaching students with LD how to apply other cognitively demanding writing activities such as planning, monitoring, evaluating, and revising (e.g., Harris, Graham, & Mason, 2006).

THE REVISED HAYES AND FLOWER MODEL

In 1996, John Hayes revised the model he created with Linda Flower (1980). *Task environment* from the old model was expanded to include both a social component (audience, other texts read while writing, and collaborators) and a physical component (text read so far and the writing medium, such as a word processor). The new model incorporated *motivation/affect* to account for how goals, predispositions, beliefs, and attitudes influence the writing process. *Long-term memory* was upgraded to include other types of knowledge (task schemas as well as genre and linguistic knowledge), and *working memory* was added to the model, providing a space and mechanism for carrying out cognitive activities that require the writer's conscious attention. *Cognitive processes* were further overhauled to emphasize that writers rely on general problem-solving (including planning) and decision-making skills to devise a sequence of steps to attain one or more writing goals. These processes are facilitated by inferencing, as writers make judgments or draw conclusions about their audience, possible writing content, and so forth. Further, reading plays a more central role in the new model, as a writer may read and evaluate text when revising, read source texts to obtain writing content, and read to define the writing task.

The main impacts of this model on writing research with students with LD were threefold. First, the role of working memory and its interaction with the difficulties students with LD experience mastering fundamental writing skills received increased attention (Saddler & Graham, 2005; Swanson & Berninger, 1996). Second, it prompted an interest in the role that motivation plays in the writing of these youngsters (MacArthur, Philappakos, & Graham, 2016). Third, it raised awareness that an expanded view of the environment in which students with LD write must take place if we are to understand their writing development fully (Graham, 2018a).

NOT-SO-SIMPLE MODEL OF WRITING

Berninger and her colleagues devised the not-so-simple model of writing, which served as a framework for much of their research studying the writing of students with LD (see Berninger & Richards, 2012) and the research of others with these same students (e.g., Hooper, Swartz, Wakely, de Kruif, & Montgomery, 2002). This model modified and expanded the simple view of writing model proposed by Juel, Griffith, and Gough (1986). This prior model maintained that writing involves two tasks: (1) *spelling*, which serves a similar role to decoding in reading; and (2) *ideation*, which involves the formation and organization of ideas for writing. Berninger and Winn (2006) reworked the simple view of writing so that it included the following three tasks: *text generation* (language production, genre, and content), *transcription* (spelling and handwriting), and *executive functions* (attention, goal-setting, planning, reviewing, revising, self-monitoring, and self-regulation; for further discussion of executive functions, see Follmer & Sperling, Chapter 5, this volume). They further indicated that the operation of these tasks was constrained by *short-term*, *long-term*, and *working memory*, and indicated when each of these memory components was applied (e.g., short-term memory was applied during reviewing and revising).

The not-so-simple view of writing provided a useful theoretical framework for studying specific aspects of writing such as text transcription (e.g., Graham, Berninger,

Abbott, Abbott, & Whitaker, 1997). Berninger and colleagues also applied it as an organizing structure for determining the differential impact of the three writing tasks in the model at different points in development (e.g., Berninger & Swanson, 1994). Further, this model spawned a robust series of investigations examining if improving specific tasks described in the model resulted in improved writing by students with LD (e.g., Berninger et al., 2002). Finally, the model served to guide research aimed at determining the writing characteristics of these children (Wakely, Hooper, de Kruif, & Swartz, 2006).

WRITERS-WITHIN-COMMUNITY MODEL

The cognitive models reviewed so far are primarily based on the assumption that writing is mostly shaped and bound by the cognitive resources and capabilities of individual writers. Although the Hayes (1996) model recognized the social nature of writing and expanded the conceptualization of the task environment, it did not delve too deeply into these waters. In a recently constructed model of writing, I (Graham, 2018a, 2018b) argued that writing is a social activity, situated within the context of many different writing communities. These communities do not serve as background variables exerting little or no influence on writing. Rather, the *purposes* of each writing community shape and bound the type of writing undertaken, its intended audiences and stances, norms for writing, and identity (including the identity of its *members*, who are likely to differ in terms of levels of affiliation, participation, roles and responsibilities, presumed value to the community, and power). A specific writing community further shapes writing through its use of *tools* and *reoccurring typified actions* that members apply to meet a community's writing goals. Moreover, what happens in a writing community – and, ultimately, the writing produced by community members – does not happen by chance, as it is molded by a *collective history*, the *social and physical context of the community* (e.g., online versus brick and mortar), and the other writing communities in which its members are currently or were previously engaged (e.g., writing practices learned at home are brought to school).

The writers-within-community (WiC) model stresses that what a person writes, including someone with LD, is not only a function of the community in which writing takes place, but is also dependent on the cognitive capabilities and resources of the community members who produce it, as well as the reciprocal interaction between context and individual differences. So, in addition to defining and describing the characteristics of a writing community, the model describes the cognitive architecture of writers, including the *long-term memory resources* used when writing (e.g., specialized writing knowledge and knowledge of the writing community, as well as beliefs about the value/utility of writing, one's competence as a writer, and reasons for writing), *production processes* used to create text (conceptualization, ideation, translation, transcription, and reconceptualization), *control mechanisms* for orchestrating and directing the process of writing (attention, working memory, and executive functioning), and *modulators* that influence writing (emotions, personality traits, and physical states). The cognitive portion of the model builds on the earlier work by Hayes (1996) but extends it considerably, especially in specifying how context and individual differences interact.

One consequence of considering the role of a writing community in writing and its development is that it raises questions about what constitutes good writing. For example, good writing when texting with a friend online may differ from what is considered good writing for an academic assignment. Even for academic writing, what is considered good writing is not constant across communities. For instance, a well-written, persuasive text in the United States typically presents a specific point of view and provides evidence to support it, whereas, in China, a writers' argument is not as directly stated (Li, 1996). This is not to say that writing is so different from one community to the next that common conceptions of good writing do not exist. The more similar the writing community (e.g., elementary classrooms in the United States where writing is taught), the more likely members will hold similar (if not identical) conceptions of good writing. Even so, this has implications for writing instruction, as conceptualizations of what constitutes good writing will vary at least somewhat, even in classrooms in the same school.

Although the WiC model is new, it provides a useful tool for organizing relevant writing research with students with LD, as it places a premium on considering both context and the capabilities of the writer. We use this model throughout the paper as an organizing structure and touchstone to guide recommendations for both future research and practice.

WRITING RESEARCH WITH STUDENTS WITH LD

Writing research conducted specifically with students with LD has primarily clustered in three areas: writing characteristics, assessment, and writing interventions. We draw on systematic reviews of the literature and meta-analysis to summarize the research conducted in each of these areas. It is also important to note that very little research has examined the communities in which students with LD learn to write. This can include both the regular classroom as well as any writing instruction these students receive from special education teachers or others in or outside the regular classroom. As the writing difficulties that students with LD experience can be due to or exacerbated by the instruction they receive in school (Troia & Graham, 2017), this is the starting point for our examination.

WRITING INSTRUCTION WITHIN THE CLASSROOM COMMUNITY

Students with LD spend most of the school day in the regular classroom (U.S. Department of Education, 2015). The instruction they receive there is often classified as Tier 1 instruction (Lane, Menzies, & Kalberg, 2012). For students who experience academic difficulties at Tier 1, many schools (at least in the United States) now provide a second tier of instruction, where these youngsters receive targeted and more intensive small-group instruction (usually from their regular teacher) for a short period of time (for 6 weeks, for example). If the targeted instruction is effective and the youngster's performance improves, Tier 2 instruction is terminated, and it is presumed that the problem(s) experienced by the child are not due to a learning disability or some other disability. If Tier 2 instruction is not effective, then the youngster may be referred for special education services as well as an evaluation to determine disability

status. Although the number of instructional tiers applied by schools can and does differ, a basic assumption underlying this approach is that, if instruction at Tiers 1 and 2 is maximally effective, then fewer students will be referred and identified as LD. The logic of this argument is that such instruction decreases the likelihood that students will be identified as LD due to poor instruction.

Although data on the characteristics of Tier 2 writing instruction in schools is notably missing, researchers have studied writing instructional practices in the regular classroom (Tier 1). Much of this research involves surveying a large number of teachers using questionnaires. In many instances, but not all, these surveys represent a random sample or a reasonably representative sample of teachers. These surveys have been conducted in a variety of countries and covered all grade levels (e.g., Applee & Langer, 2013; Brindle, Harris, Graham, & Hebert, 2016; Cutler & Graham, 2008; De Smedt, van Keer, & Merchie, 2016; Dockrell, Marshall, & Wyse, 2016; Gilbert & Graham, 2010; Hsiang & Graham, 2016; Kiuahara, Graham, & Hawken, 2009; Michaelowa, 2001; Parr & Jesson, 2016; Simao, Malpique, Frison, & Marques, 2016). The overall finding from these studies is that students in regular classrooms receive little writing instruction and spend very little time writing. This is the case in both elementary and secondary schools. Further, although teachers reported using evidence-based writing practices in these surveys, these procedures are applied infrequently. On a more positive note, most teachers indicated they make a variety of instructional adaptations for writing for students with disabilities (Troia & Graham, 2017).

One exception to these relatively dismal survey findings concerning writing instruction in the regular classroom was provided by Cutler and Graham (2008). They indicated teachers in the United States reported spending an hour a day on writing instruction (students spent 20 minutes writing and 40 minutes receiving writing instruction). Unfortunately, observational studies of writing with very young students do not paint such a positive picture. Coker and colleagues' (2016) observation of 50 first-grade classes found that about 25 minutes a day was devoted to writing instruction, whereas Puranik, Al Otaiba, Sidler, and Greulich (2014) observed only 8 minutes of writing instruction per day in kindergarten. Observational investigations conducted with students in older grades are more consistent with survey findings, as little writing or instruction was observed in the classrooms studied (e.g., Applee & Langer, 2013).

Findings from survey and observational studies provide information relevant to several of the characteristics of a writing community as defined in the WiC model (Graham, 2018a, 2018b). Although students typically spend little time writing, they wrote many different types of text for a variety of different *purposes* across the school year (e.g., Brindle et al., 2016). The writing *tools* they used to accomplish classroom writing goals mostly involved paper and pencil, even at the high school level (e.g., Kiuahara et al., 2009). The most prominent *reoccurring typified actions* involved how the composing process was structured, as students were commonly encouraged to plan, draft, revise, and edit their papers (e.g., Cutler & Graham, 2008). Some degree of interactive writing (*social contexts*) among students was also evident in many studies (Gilbert & Graham, 2010).

We do not want to paint too negative of a picture of the writing instruction students with and without LD receive in regular classes. In both the survey and observational studies (Coker et al., 2016; Kiuahara et al., 2009), there was considerable variability in

how writing was taught. More importantly, as Applee and Langer (2013) noted, there were pockets of excellence where teachers provided very strong writing programs. For most students with LD, however, it is unlikely they will find themselves in one of these classrooms, as they were not the norm.

The poor quality of Tier 1 or regular classroom writing instruction might be blunted in part if students with LD received effective writing instruction from special education teachers or other school personnel. The only study we located that examined this issue was conducted in 1989 by Christenson, Thurlow, Ysseldyke, and McVicar, who observed both regular and special education teachers. They found that very little writing instruction was provided by either group of teachers to students with LD or other disabilities.

The state of writing instruction worldwide presents a serious challenge to ensuring students with LD maximize their writing development. This is unfortunate, as researchers have identified a variety of evidence-based practices for teaching writing to all students in the regular classroom (Tier 1) and to students with LD in particular, including instructional methods that can be applied in Tiers 2 and 3 settings (see section entitled Teaching Writing to Students with LD). Additional research is needed, particularly observational studies, to map the types and quality of instruction students with LD receive in Tiers 1, 2, and 3 at all grade levels and over time. Consistent with the WiC model (Graham, 2018a, 2018b), such analyses should consider purposes, tools, characteristics of classroom members, typified reoccurring actions, and social and physical contexts of the classroom as they relate to such instruction. Qualitative studies that examine the writing practices and the classroom communities of teachers who are highly successful in teaching writing to students with LD could also provide important insight into how to create a classroom community where these students thrive. These analyses should occur with both regular and special education teachers.

A final point in terms of writing instruction. A common finding in the survey studies referenced above is that many teachers express concerns about their preparation to teach writing. Given the writing difficulties faced by students with LD (see next section), we strongly suspect both regular and special education teachers feel even more unprepared to teach writing to these youngsters. Research is needed to explore this supposition and test possible solutions to this problem if this is the case.

WRITING CHARACTERISTICS OF STUDENTS WITH LD

Research examining the writing characteristics of students with LD mainly involve three types of study: (1) investigations that compare students with LD with their typically developing peers on one or more writing attributes (e.g., Klassen, 2007), (2) studies that examine the writing or writing process of these students without making normative comparisons (e.g., Thomas et al., 1987), and (3) experimental manipulations designed to identify factors that contribute to the writing difficulties of students with LD (e.g., De La Paz, Swanson, & Graham, 1998). In most studies comparing students with LD with their typically developing peers (number 1 above), students with LD were not first identified as having difficulties in writing. In studies that did not compare students with LD with typically developing peers (number 2 above) or ones that involved an experimental

manipulation (number 3 above), students with LD were often identified as having a LD in writing specifically.

A recent meta-analysis by Graham, Collins, and Rigby-Wills (2017) illustrates just how pervasive writing difficulties are for students with LD. They reviewed 53 studies comparing the writing of students with LD with that of their classroom peers (approach 1 above). Most of these studies involved school-identified students with LD. They included 25 studies that involved just elementary grade students, 12 investigations with secondary students, and 16 studies that included both elementary and secondary students. Twelve of the studies only administered a task that measured a specific writing skill such as spelling; all other studies involved the collection of one or more samples of writing (some studies included both types of measure). Students wrote stories in 21 studies, expository compositions in 15 studies, narratives in 8 studies, and persuasive text in 7 investigations. Seven studies administered self-report measures of motivation, three studies interviewed students to determine their knowledge of writing, and two investigations involved tasks that assessed writing self-regulation. Multiple outcomes were derived from the writing samples students wrote, including measures of overall quality (e.g., holistic and analytic), output (e.g., numbers of words or sentences written), conventions (e.g., numbers of spelling, grammar, usage errors), structural elements (e.g., numbers of genre elements included in a composition), vocabulary (e.g., numbers of different words, ratings of vocabulary diversity), as well as ratings of ideation, organization, and voice.

On every single writing measure in every study in the Graham et al. (2017) meta-analysis, students with LD performed more poorly than their typically developing counterparts (scores for the overall quality of their text was a full standard deviation lower than quality scores of their classmates). Drawing on this study and the other two types of research identified above, we describe the writing of students with LD using the cognitive architecture put forward in the WiC model (Graham, 2018a, 2018b). Evidence for any statement in the paragraphs below that references comparing students with LD with their classmates is taken from Graham and colleagues' meta-analysis. Evidence for all other claims are referenced directly by referring to a supporting study.

Each of the *production processes* described in the WiC model are problematic for students with LD. First, students with LD are less adept than their classmates at constructing a mental representation of the writing task (conceptualization), as represented by poorer organization of ideas and a less salient voice in their compositions. When asked to create a mental representation of their text by planning in advance, they average less than a single minute (MacArthur & Graham, 1987). Second, they are not as facile as their peers at generating ideas for their compositions (ideation), as they produce text with fewer ideas, less elaboration, and fewer of the basic elements for the type of text they are creating. Third, students with LD experience more difficulties than classmates translating ideas into acceptable sentences (translation), as they create text with less sophisticated syntactic structures, less sophisticated vocabulary, and more grammar and syntactical errors. Fourth, in comparison with peers, they experienced considerably more difficulty mastering the spelling and handwriting skills needed to transform their ideas into printed text (transcription). The impact of text transcription skills on the writing of students with LD is also evident when they are asked to dictate a composition, as their dictated papers are longer than handwritten

ones (Gillespie & Graham, 2014), and this appears to be owing to the mechanics of transcription and not increased speed afforded by dictation (Graham, 1990). Fifth, students with LD use an ineffective approach to reworking their manuscript through revising (reconceptualization), as less than 20% of their revisions appreciably change what they write, and the only major modification in their paper is that it becomes more legible (MacArthur, Graham, & Schwartz, 1991).

Students with LD have fewer resources to draw on from *long-term memory* than their classroom counterparts. They possess less knowledge about how to write than their peers, and they are not as familiar with the basic features of common types of writing task. They harbor fewer favorable beliefs about writing than their classmates, especially in terms of their beliefs about their own writing capabilities. Their unfavorable beliefs about writing likely explain why many of them experience difficulty sustaining effort when writing (Graham, 1990).

When compared with their peers, students with LD also experience difficulties with the *control mechanisms* needed to orchestrate and direct the writing process. They are less adept than classmates at self-regulating the writing process (executive functioning). As noted earlier, they often apply a schema for writing that converts composing into a single process: generating content via knowledge telling (Thomas et al., 1987). They further appear to experience difficulty managing the various processes involved in composing, as illustrated by improved writing performance when they are directed to apply simple routines designed to ensure that specific writing processes are coordinated and occur in a regular fashion (De La Paz et al., 1998). In terms of attention and working memory, several studies demonstrated that students with LD are likely to experience difficulties with these two other important aspects of *executive control* (Sandler et al., 1992; Swanson & Berninger, 1996).

The available evidence examining the writing of students with LD is unequivocal. They experience considerable difficulty mastering writing, and their problems with writing are pervasive, touching on virtually every aspect of the composing processes. If the writing growth of students with LD is to be maximized, they must receive strong writing instruction at every level (regular and special education instruction). Such instruction needs to begin as early and be as potent as possible (see Graham, Harris, & Larsen, 2001). As we saw in the previous section, this is currently not the case.

The research conducted to date provides a general portrait of the writing of students with LD. It is far from complete. Most of it focuses on younger students, so there is considerable need to examine the writing of older students with LD. For the most part, available studies are cross-sectional, and little is known about how the writing of these students unfolds longitudinally. In addition, data on the *long-term memory resources* (both writing knowledge and beliefs), *control processes*, and *writing production processes* (especially conceptualization and reconceptualization) of students with LD are quite thin, as none of these basic elements of writing have been studied extensively. Further, we are aware of no studies that examine how *modulators* such as emotions, personality traits, and physical states influence these students' writing and writing development. Consequently, there is much to learn about the writing of students with LD. Such research is important not only for what it tells us about the writing of students with LD, but also because it also informs us about writing more generally. The identification of factors that contribute to writing difficulties for

students with LD provides useful information for drawing a better understanding of how writing develops, as it implicates the types of process, skill, knowledge, and disposition that underlie successful writing.

ASSESSING WRITING AND STUDENTS WITH LD

The writing of students with LD is assessed at school to determine if they have a LD in writing, provide data to guide instruction, and gauge these students' progress in relation to their peers. Although there are multiple approaches to identifying students with LD, assessment plays an important role in this process (Swanson, Harris, & Graham, 2013). For example, if identification involves determining if measured achievement is below estimated ability (the discrepancy approach), one or more tests of writing may be administered. If identification is based on students' lack of responsiveness to targeted and intensive Tier 2 instruction (response to treatment approach), then curriculum-based measures (CBM) of writing may be used to judge students' responsiveness.

Identification of a LD in writing via the discrepancy method generally involves performance on a single norm-referenced writing test (Harris et al., 2012). Such tests typically assess performance on one type of writing (Calfee & Wilson, 2004). This assumes that a single assessment provides a reliable measure of a student's ability to write in multiple genres. Unfortunately, this is not a legitimate presumption, as even poor writers show considerable variability in their performance across genres, and multiple samples of writing are needed to obtain a reliable estimate of their writing performance (Graham, Hebert, Sandbank, & Harris, 2016). Moreover, available norm-referenced writing tests fail to assess many of the writing production processes described in the WiC model (especially conceptualization and reconceptualization). The obvious implication is that students' writing should be assessed across multiple genres, and these assessments need to be supplemented with other measures of writing processes.

When students with LD are identified through a response to intervention model, CBM measures may be administered frequently (e.g., once a week) to monitor the success of the targeted and supplementary instruction provided. On the plus side, writing is assessed repeatedly and in an efficient manner (e.g., 5-minute samples of writing are collected), and available CBM writing measures are reliable and relatively easy to score (Graham, Harris, & Hebert, 2011). Even so, research has failed to establish that CBM writing measures are sensitive to the effects of instruction delivered over a short period of time, and the available CBM measures in writing focus mostly on ideation (number of words), translation (correct word sequences), and transcription (words spelled correctly). As with norm-referenced writing tests, other important writing processes such as conceptualization and reconceptualization are not addressed. This may inadvertently narrow the focus of the targeted Tier 2 instruction students receive.

CBM writing assessment is also used to provide data for designing instruction (Graham et al., 2011), but the same limitations noted above still apply. This may be why Graham, Harris, and Santangelo (2015) did not find in their meta-analysis that CBM approaches statistically enhanced students' writing performance. Other formative assessment approaches teachers reported using in survey research include

writing portfolios, student self-assessment, rubrics to score writing, grading, teacher feedback, peer assessment, and professional judgment (e.g., Cutler & Graham, 2008; Hsiang & Graham, 2016; Kiuahara et al., 2009). A meta-analysis by Graham, Hebert, and Harris (2015) provided broad support for using teacher, student, and peer assessments in writing, but this applied to students in general and not students with LD specifically.

Many countries now assess students' writing at various points in their education. This typically involves administering a standardized test at particular grade levels or shortly before students are set to graduate. Increasingly, students with disabilities, including those with LD, are expected to participate in these assessments. Although the value of such summative assessment has been hotly debated (Graham, Hebert, & Harris, 2011), a possible value of these tests is teachers may come to view writing as an important skill to teach to students with LD. In essence, the test holds them or schools accountable for the writing success of these youngsters.

Test accommodations provide one means for facilitating the participation of students with LD in these high-stakes assessments (Graham et al., 2011). Possible accommodations include extended time, different modes of responding, and taking the test in a different setting. There is surprisingly little research on the value of such accommodations for students with LD, although MacArthur and Cavalier (2004) reported that changing the response mode from writing by hand to dictation or speech-to-text synthesis enhanced the writing of high school students with LD, but not the writing of their peers (this is the pattern of finding that best validates the use of a test accommodation with specific groups of students).

At a practical level, writing assessments for students with LD need to be more expansive, testing a broader array of genres and aspects of composing. This applies at all levels of assessment – identification as well as formative and summative assessment. Additional research is needed to identify a broader array of valid assessments to meet these purposes as well as to examine how these different forms of assessment impact the writing development of students with LD and the instructional practices applied by their teachers. Further, research is needed to determine the contextual nature of assessment in the classroom, with a particular focus on students with LD. This includes classroom research aimed at understanding the purposes of assessments, tools used for assessments, reoccurring actions that are created around the use of these tools, how assessments influence the social relations of teachers and students, and the impact of assessments on writing instruction.

Some of the limitations of norm-referenced instruments and CBM assessments described above can be addressed in at least two ways. If the purpose of the assessment is to identify a student as having a LD in writing, then it is preferable to administer more than one norm-referenced writing instrument or to supplement one or more norm-referenced writing assessments by collecting other compositions in the same, as well as different, genres. This provides a more representative sample of writing from which to make decisions about a child's writing capabilities.

Further, writing process can be assessed by directly assessing students' capabilities to plan, evaluate, revise, and edit. To illustrate, students can be asked to plan before writing, and the resulting plan can be analyzed. Their ability to evaluate text difficulties can be assessed by asking them to highlight problems in their own text or the text of others. Facility with editing and revising can be assessed

by asking them to revise, edit, or both, specific compositions to determine the frequency and quality of the changes they make.

TEACHING WRITING TO STUDENTS WITH LD

Evidence-Based Practices

By the time that students with LD are identified, they are behind their typically developing classmates in one or more academic subjects. Current approaches to identification (e.g., discrepancy and response to intervention models) ensure this outcome, as students must demonstrate significant difficulties and failure before they receive targeted or specialized instruction. If they are experiencing difficulty learning to write, the reality for these youngsters is they are mastering writing at a slower pace than their classmates. If they are to catch up (or not fall further behind), then the writing instruction they receive must be as effective and efficient as possible. This urgent need helps to explain why the field of special education has so vigorously championed the use of evidence-based practices. Such procedures have been scientifically tested and demonstrated a track record of success across multiple studies.

Evidence supporting a potentially effective practice can come from both teachers and researchers. Many teachers develop or apply instructional practices they view as successful based on their observations of the positive impact of these methods. Particularly useful, in our opinion, are instructional practices applied by teachers with a demonstrable track record of success in teaching writing. These are teachers whose students make substantially greater gains in writing than expected.

Even greater confidence can be placed in instructional writing practices that demonstrate consistent and significant gains in students' writing when they are scientifically tested in multiple intervention studies. This does not mean that practices identified in this manner will be successful in all situations and all classrooms. Instead, there is reason to be optimistic about their potential success, just as there is reason to be optimistic about the success of the practices applied by exceptional writing teachers.

Because the writing difficulties of students with LD are substantial and tenacious (Graham et al., 2017), the regular and special education teachers who teach them need to draw on proven practices, whether they are practices commonly used by highly effective teachers or ones validated scientifically. This does not mean that teachers should throw aside the clinical knowledge and skills in teaching writing they acquire over time. Rather, their writing program should be informed by the best scientific evidence available (Graham, Harris, & Chambers, 2016).

In three recent reviews (Graham & Harris, 2018; Graham et al., 2016, 2015), we and our colleagues synthesized the findings from close to 20 different meta-analyses of the writing intervention literature to identify effective writing practices for the regular classroom (Tier 1). These meta-analyses summarized the findings from true and quasi-experiments, single subject design studies, and qualitative investigations of highly effective teachers of writing. Several additional reviews (Gillespie & Graham, 2014; Graham, 1999; Rogers & Graham, 2008; Williams, Austin, & Vaughn, 2018; Williams, Walker, Vaughn, & Wanzek, 2017) identified effective writing practices for students with LD by analyzing available single subject design studies as well as true

and quasi-experiments conducted with these students. These practices were mostly administered to individual or small groups of students with LD, making them particularly suitable at Tier 2 or in special education settings.

We present evidence-based writing practices for the regular classroom (Tier 1) first, as students with LD spend most of their time there. This is followed by practices identified as effective with students with LD specifically. We use the WiC model of writing (Graham, 2018a, 2018b) to organize the presentation of these writing practices, as theories such as this one provide a useful framework for thinking about what is important in writing and what needs to be taught.

Effective Writing Instruction at Tier 1 (the Regular Class)

An integral part of designing effective instruction for students with LD in the regular classroom is to create a classroom writing community where they and other students can thrive. Using the WiC model of writing as a guide (Graham, 2018a, 2018b), teachers need to establish the *purposes* of writing in their classrooms, determine the writing *tools* and *reoccurring typified actions* used to accomplish these goals, and construct a supportive *social and physical context* that makes it possible for class *members* to succeed.

In terms of establishing *purposes* for writing, the study of exceptional teachers is particularly instructive (Graham et al., 2016). They dedicate time to teaching writing, their students write for varying purposes, and writing is integrated throughout the curriculum. These teachers further set high but realistic expectations for all students and adapt writing assignments and instruction to meet specific students' needs. Writing intervention studies provide direct support for most of these purposes, as students become better writers by writing and through instruction, and writing about content or text in science, social studies, or other content areas boosts learning (Graham et al., 2015).

Writing in regular classrooms is further enhanced when students use word processing as their primary *tool* for writing. As long as students develop reasonable efficiency with keyboarding, word processors make it easier to write, as text can be revised readily, and feedback is routinely provided for spelling and grammar.

Again drawing on exceptional teachers (Graham et al., 2016), these educators put into place a variety of *reoccurring typified actions* to help them and their students accomplish established goals for writing and writing instruction. These include treating writing as a process, where students plan, draft, revise, edit, and share their work. They also provide whole-class, small-group, and individual instruction where they teach these processes and other important writing skills through modeling, explanation, and guided practice. The effectiveness of these types of routine is supported by evidence from intervention studies testing the process approach to writing and procedures for teaching writing skills and strategies (Graham & Harris, 2018).

Exceptional teachers further establish a supportive *social and physical context* in their class (Graham et al., 2016). They are enthusiastic about writing and create a positive environment, where students are encouraged to try hard, believe what they are learning permits them to write well, and attribute success to effort. These teachers provide students with the support they need to make progress or carry out writing tasks, but encourage students to do as much as they can on their own. Writing

intervention studies also demonstrate that students' writing improves when students are supported with feedback (including praise) from their teacher or peers and they are taught how to collaboratively plan, draft, revise, and edit their compositions with one or more classmates (Graham & Harris, 2018).

Table 20.1 presents instructional procedures that improve the quality of students' writing by upgrading the cognitive resources they bring to the task of writing. This includes practices for improving writing *production processes*, resources held in *long-term memory* (specialized knowledge of writing and positive beliefs about writing), and *control processes* (procedures for facilitating executive functioning and self-regulation). These practices were effective in multiple intervention studies (Graham & Harris, 2018; Graham et al., 2016, 2015).

Table 20.1 Evidence-Based Instructional Procedures for Upgrading the Cognitive Resources Students Bring to the Task of Writing in Regular Classrooms

Writing Production Processes	
Conceptualization	Teach students strategies for planning text
Ideation	Teach creativity and imagery processes
	Engage students in prewriting activities to gather writing content
	Use inquiry methods to help students gather ideas for their writing
Translation	Teach sentence construction skills via sentence combining
	Enhance students' writing vocabulary
Transcription	Teach handwriting and spelling (grades 1–3)
Reconceptualization	Teach students strategies for revising and editing
	Teach students how to evaluate their own writing
Long-Term Memory Resources	
Knowledge	Ask students to examine and emulate model text
	Teach students the elements of different genres
Beliefs	Ask students to monitor progress so they can see their growth as writers
	Teach students the skills and strategies needed to be an effective writer
Control Processes	
Executive functioning	Teach students schemas for carrying out writing processes
	Teach students to use goal-setting and self-monitoring to regulate the planning and revising strategies

Although an impressive array of regular classroom evidence-based instructional writing practices exist, and their implementations should reduce to some degree the writing problems experienced by students with LD, additional research is needed to

(1) identify what combination of, and how often, these procedures should be applied to maximize the success of all students in the regular classroom (including students with LD); (2) construct professional development programs for making these evidence-based practices a routine and effective part of regular classroom instruction; (3) create and scientifically test other writing practices to expand the number of evidence-based practices available (including ones for teaching grammar, addressing attention and working memory issues, fostering positive beliefs about writing, and helping students manage emotions, personality traits, and physical states when writing); and (4) design productive approaches for applying clinical knowledge and evidence-based practices together.

Effective Writing Instruction Practices for Students with LD

Much less attention has been devoted to identifying evidence-based writing practices specifically for students with LD (Graham et al., 2015). The practices that have been validated scientifically are presented in Table 20.2 (references to supporting reviews are also presented in the table). Many of the procedures that are effective in the regular classroom (i.e., process approach to writing, setting goals for writing, using word processing as a tool for writing, handwriting and spelling instruction, instruction on how to construct more complex sentences, use of prewriting activities, and teaching planning, revising and editing skills) are also effective when tested specifically with students with LD. It is important to note, the procedures identified as effective for students with LD were typically tested under more intense instructional conditions, as they were commonly evaluated when students were taught in small groups or individually.

Other differences also existed. For example, productivity goals were tested with students with LD, but not more broadly with students in the regular classroom. Likewise, a broader array of alternative modes for writing (beyond word processing) were tested with students with LD. This included assessing the effectiveness of dictation and speech-to-text synthesis. Both of these procedures make it possible for students with LD to circumvent their handwriting and spelling difficulties (Graham et al., 2017).

For both dictation and speech-to-text synthesis, some cautions are in order. Dictating a composition via a scribe is not very practical in a school setting. Likewise, the use of speech-to-text synthesis may only be useful with older students with LD at this point, as their voices may be more readily translatable with current software programs. Nevertheless, the success of these two modes of writing with students with LD demonstrates the potent impact of handwriting and spelling difficulties. This was further reflected in the finding that extra instruction in these two skills in the primary grades was beneficial, as was such instruction with older students with LD.

Teaching strategies for constructing more complex sentences was also effective with students with LD, as was teaching grammar skills via modeling and guided practice. These activities directly address problems students with LD experience translating ideas into text (Graham et al., 2017). These two findings are especially interesting, but for different reasons. Traditional grammar instruction is not effective in the regular classroom (Graham & Harris, 2018), but with some adaptation (modeling and guided practice) can be effective with students with LD. In addition, sentence construction in most of the studies conducted with students with LD involved teaching them formulas

Table 20.2 Evidence-Based Practices for Teaching Writing to Students with LD.**Writing Community**

- Engage students with LD in a process approach to writing where they write for extended periods of time for real audiences, and they are encouraged to engage in cycles of planning, drafting, revising, editing, and publishing their work; take personal responsibility and ownership of their writing; work collaboratively with peers to produce text; and engage in frequent self-reflection and evaluation concerning their writing (Gillespie & Graham, 2014).
- Provide students with LD with elaborated goals as well as productivity goals to provide them with greater directions on writing expectations (Gillespie & Graham, 2014).
- Make word processing the primary mode of writing for students with LD and, in some cases, apply approaches to writing where students can dictate their writing plans or compositions via a scribe or speech-to-text synthesis (Gillespie & Graham, 2014; Rogers & Graham, 2008).

Enhance Cognitive Resources for Writing

- Provide extra instruction designed to improve the handwriting and spelling skills of students with LD. This instruction may profitably continue into secondary school for some of these youngsters (Graham, 1999).
- Teach grammar skills to students with LD through modeling and guided practice (Rogers & Graham, 2008).
- Teach students with LD how to write more complex sentences through sentence combining or by teaching sentence writing formulas (Rogers & Graham, 2008).
- Teach students with LD strategies for constructing a paragraph through modeling and guided practice (Rogers & Graham, 2008).
- Engage students with LD in prewriting strategies to help them generate and organize their writing ideas (Rogers & Graham, 2008).
- Teach students with LD strategies for planning, drafting, revising, and editing via modeling, explanation, and guided practice. The self-regulated strategy development model (Harris & Graham, 1999) is especially effective, as students are taught the skills and knowledge needed to apply the target strategies; they are taught self-regulation procedures (goal-setting, self-monitoring and -evaluation, self-instructions, and self-reinforcement) to regulate the use of the target strategies, the writing process, and writing behaviors; and instruction is designed to emphasize that students' writing success is due to effort and the use of the procedures taught (Gillespie & Graham, 2014).
- Teach students with LD to monitor their writing by recording their writing productivity or on-task behavior (Rogers & Graham, 2008).

for writing different kinds of sentence. This involved practice plugging words into these formulas as a way of constructing correct and more complex sentences. Many teachers may be reluctant to use such procedures, as many students with LD do not need such formulas to create similar oral sentences.

The most scientifically tested instructional procedures with students with LD involved teaching them strategies for planning, drafting, revising, and editing. Although the self-regulated strategy development model (Harris & Graham, 1999; Harris, Graham, Mason, & Freidlander, 2008) described in Table 20.2 is effective with regular classroom students as well (see Graham & Harris, 2018), it is especially powerful with students with LD. There are many possible reasons for its effectiveness, but particularly important is that it is designed to upgrade the approach that students

with LD apply when writing (which typically minimizes the use of effortful strategies), increase their knowledge of writing, and facilitate positive beliefs towards writing (for a related discussion see Perry, Mazabel, and Yee, Chapter 13, this volume). All of these goals address constraints that limit the writing growth of students with LD (Graham et al., 2017).

On a practical level, we have no way of knowing if special education or even regular education teachers currently use the practices identified as effective with students with LD in Table 20.2. Like evidence-based practices for the regular classroom, we need research to develop additional effective practices specifically for students with LD, provide guidelines to help teachers effectively combine and deliver evidence-based writing practices with these students, and determine how teachers can become adept at applying evidence-based practices effectively and use them in complementary ways with the clinical knowledge they acquire over time.

Although we may not be able to determine specifically how often evidence-based writing practices are applied with students with LD, it is likely the use of these instructional procedures are not used often, based on findings from examining regular classroom writing practices (e.g., Gilbert & Graham, 2010). One likely reason is that most teachers are not well prepared to teach writing (Graham, 2019). This lack of preparation is particularly problematic in terms of the implementation of many practices shown to be effective with students with LD, as many of these methods are complex and require considerable preparation to use effectively, such as strategy instruction (McKeown et al., 2019). It is further possible that many teachers are more concerned about other academic skills, such as reading or mathematics, in terms of their efforts to teach students with LD.

The writing intervention research conducted with students with LD and other youngsters informs not only practice, but theory too. Available writing intervention research demonstrates that improving writing production processes, knowledge and beliefs, and control processes enhances the overall quality of students' writing. Further, restructuring the writing community via a process approach to writing, teachers being more explicit about goals for writing with students, and changing the writing tools used to accomplish community purposes (paper and pencil to word processing) improves the quality of students' writing. Such findings provide support not only for the WiC model (Graham, 2018a, 2018b), but for other models of writing as well (e.g., Hayes, 1996).

CONCLUSION

All students, including those with LD, can learn to write effectively. The challenge in accomplishing this goal is to make sure that general and special education teachers are using the most effective instructional practices available.

In closing, it is important to note that the instructional practices identified in this chapter do not constitute all potentially effective procedures. For example, one potentially fruitful avenue for improving the writing of students with LD not explored in the preceding sections of this chapter is the possible impact of reading instruction on students' writing. In a recent meta-analysis, Graham et al. (2018) reported that involving students in reading activities and teaching reading skills enhanced their writing. This meta-analysis involved 91 research reports (some reports contained multiple studies)

that isolated the effects of reading and reading instruction on writing. Phonological awareness and phonics instruction improved students' spelling skills, whereas comprehension reading instruction enhanced the quality of students' writing. The quality of students' writing was further enhanced by increasing how much students read, as well as by having students read and analyze text, read text to emulate it, and observe readers interact with text. In addition, reading text or individual words resulted in better spelling. The effects of reading and reading instruction on writing were obtained for both good and poor readers.

In a second meta-analysis, Graham et al. (2018) found that literacy programs that combined reading and writing instruction produced better readers and writers. This review included 47 studies that examined the effectiveness of balanced reading and writing programs where no more than 60% of instruction was devoted to either reading or writing. Collectively, such programs not only improved students' reading vocabulary, decoding, and reading comprehension, but also enhanced the quality of their writing, how much they wrote, and mechanical writing skills (e.g., spelling, grammar, and usage). Not all programs were effective in improving both reading and writing (e.g., whole language). Overall, however, balanced reading and writing instruction was effective with typically developing learners, as well as with students with literacy challenges.

At present, the use of reading as a tool for enhancing specifically the writing of students with LD has mostly targeted spelling, with positive effects (Walker et al., 2017). We hope that researchers will also expand their investigations with students with LD to determine if other aspects of writing can be improved through reading instruction, by increasing how much these students read, or by combining reading and writing instruction so that instruction in each skill supports the other.

REFERENCES

- Applee, A., & Langer, J. (with Wilcox, K.C., Nachowitz, M., Mastroianni, M., & Dawson, C.). (2013). *Writing instruction that works: Proven methods for middle and high school classrooms*. New York: Teachers College Press.
- Bangert-Drowns, R., Hurley, M., & Wilkinson, B. (2004). The effects of school-based writing-to-learn interventions on academic achievement: A meta-analysis. *Review of Educational Research*, 74, 29–58.
- Bereiter, C., & Scardamalia, M. (1987). *The Psychology of Written Composition*. Hillsdale, NJ: Lawrence Erlbaum.
- Berlinger, V., & Richards, T. (2012). The writing brain: Coordinating sensory/motor, language, and cognitive systems in working memory architecture. In V. Berninger (Ed.), *Past, present, and future contributions of cognitive writing research to cognitive psychology* (pp. 537–563). New York: Psychology Press.
- Berninger, V. (1999). Coordinating transcription and text generation in working memory during composing: Automatic and constructive processes. *Learning Disability Quarterly*, 22, 99–112.
- Berninger, V., & Swanson, L. (1994). Modifying Hayes and Flower's model of skilled writing to explain beginning and developing writing. In E. C. Butterfield (Ed.), *Children's writing: Toward a process theory of the development of skilled writing* (Vol. 2, pp. 57–82). Greenwich, CT: JAI Press.
- Berninger, V., Vaughan, K., Abbott, R., Begay, K., Byrd, K., Curtain, G., ... Graham, S. (2002). Teaching spelling and composition alone and together: Implications for the simple view of writing. *Journal of Educational Psychology*, 94, 291–304.
- Berninger, V., & Winn, W. (2006). Implications of advancements in brain research and technology for writing development, writing instruction, and educational evolution. In C. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 128–254). New York: Guilford Press.
- Brindle, M., Harris, K. R., Graham, S., & Hebert, M. (2016). Third and fourth grade teachers' classroom practices in writing: A national survey. *Reading & Writing*, 29, 929–954.

- Calfee, R., & Wilson, K. (2004). A classroom-based writing assessment framework. In C. A. Stone, E. R. Silliman, B. J. Ehren, & K. Apel (Eds.), *Handbook of language and literacy: Development and disorders* (pp. 583–599). New York: Guilford Press.
- Christenson, S., Thurlow, M., Ysseldyke, J., & McVicar, R. (1989). Written language instruction for students with mild handicaps: Is there enough quantity to ensure quality? *Learning Disability Quarterly*, 12, 219–222.
- Coker, D., Farley-Ripley, E., Jackson, A., Wen, H., MacArthur, C., & Jennings, A. (2016). Writing instruction in first grade: An observational study. *Reading & Writing*, 29, 793–832.
- Copeland, C., & Rideout, H. (1901). *Freshman English and theme-correcting in Harvard College*. New York: Silver, Burdett.
- Cutler, L., & Graham, S. (2008). Primary grade writing instruction: A national survey. *Journal of Educational Psychology*, 100(4), 907–919.
- De La Paz, S., Swanson, P., & Graham, S. (1998). Contribution of executive control to the revising problems of students with writing and learning difficulties. *Journal of Educational Psychology*, 90, 448–460.
- De Smedt, F., van Keer, H., & Merchie, E. (2016). Student, teacher, and class-level correlates of Flemish late elementary school children's writing performance. *Reading & Writing*, 29, 833–868.
- Dockrell, J., Marshall, C., & Wyse, D. (2016). Teachers' reported practices for teaching writing in England. *Reading & Writing*, 29, 409–434.
- Englert, C., Raphael, T., Anderson, L., Anthony, H., Stevens, D., & Fear, K. (1991). Making writing strategies and self-talk visible: Cognitive strategy instruction in writing in regular and special education classrooms. *American Educational Research Journal*, 28, 337–372.
- Englert, S., Raphael, T., Fear, K., & Anderson, L. (1988). Students' metacognitive knowledge about how to write informational texts. *Learning Disability Quarterly*, 11, 18–46.
- Ferretti, R., MacArthur, C., & Dowdy, N. (2000). The effects of an elaborated goal on the persuasive writing of students with learning disabilities and their normally achieving peers. *Journal of Educational Psychology*, 92, 694–702.
- Gilbert, J., & Graham, S. (2010). Teaching writing to elementary students in grades 4 to 6: A national survey. *Elementary School Journal*, 110, 494–518.
- Gillespie, A., & Graham, S. (2014). A meta-analysis of writing interventions for students with learning disabilities. *Exceptional Children*, 80, 454–473.
- Graham, S. (1990). The role of production factors in learning disabled students compositions. *Journal of Educational Psychology*, 82, 781–791.
- Graham, S. (1999). Handwriting and spelling instruction for students with learning disabilities: A review. *Learning Disability Quarterly*, 22, 78–98.
- Graham, S. (2006). Writing. In P. Alexander & P. Winne (Eds.), *Handbook of educational psychology* (pp. 457–478). Mahwah, NJ: Erlbaum.
- Graham, S. (2018a). The writer(s)-within-community model of writing. *Educational Psychology*, 53, 258–279.
- Graham, S. (2018b). A writer(s) within community model of writing. In C. Bazerman, V. Berninger, D. Brandt, S. Graham, J. Langer, S. Murphy, ... M. Schleppegrell (Eds.), *The lifespan development of writing* (pp. 271–325). Urbana: National Council of English.
- Graham, S. (2019). Changing how writing is taught. *Review of Research in Education*, 43, 277–303.
- Graham, S., Berninger, V., Abbott, R., Abbott, S., & Whitaker, D. (1997). The role of mechanics in composing of elementary school students: A new methodological approach. *Journal of Educational Psychology*, 89, 170–182.
- Graham, S., Collins, A., & Rigby-Wills, H. (2017). A meta-analysis examining the writing characteristics of students with learning disabilities and normally achieving peers. *Exceptional Children*, 83, 199–218.
- Graham, S., Fishman, E., Reid, R., & Hebert, M. (2016). Writing characteristics of students with adhd and their normally achieving peers. *Learning Disabilities Research & Practice*, 31, 75–89.
- Graham, S., & Harris, K. R. (2011). Writing and students with disabilities. In L. Lloyd, J. Kauffman, & D. Hallahan (Eds.), *Handbook of special education* (pp. 422–433). London: Routledge.
- Graham, S., & Harris, K. R. (2018). Evidence-based writing practices: A meta-analysis of existing meta-analyses. In R. Fidalgo, K. R. Harris, & M. Braaksma (Eds.), *Design principles for teaching effective writing: Theoretical and empirical grounded principles* (pp. 13–37). Hershey, PA: Brill.
- Graham, S., Harris, K. R., & Adkins, M. (2018). The impact of supplemental handwriting and spelling instruction with first grade students who do not acquire transcription skills as rapidly as peers: A randomized control trial. *Reading & Writing: An Interdisciplinary Journal*, 34, 1273–1294.

- Graham, S., Harris, K. R., & Chambers, A. (2016). Evidence-based practice and writing instruction. In C. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (Vol. 2, pp. 211–226). New York: Guilford Press.
- Graham, S., Harris, K. R., & Hebert, M. (2011). *Informing writing: The benefits of formative assessment*. Washington, DC: Carnegie Corporation. Alliance for Excellence in Education.
- Graham, S., Harris, K. R., & Larsen, L. (2001). Prevention and intervention of writing difficulties for students with learning disabilities. *Learning Disability Research & Practice*, 16, 74–84.
- Graham, S., Harris, K. R., & Santangelo, T. (2015). Research-based writing practices and the common core: Meta-analysis and meta-synthesis. *Elementary School Journal*, 115, 498–522.
- Graham, S., & Hebert, M. (2011). Writing-to-read: A meta-analysis of the impact of writing and writing instruction on reading. *Harvard Educational Review*, 81, 710–744.
- Graham, S., Hebert, M., & Harris, K. R. (2011). Throw 'em out or make 'em better? High-stakes writing assessments. *Focus on Exceptional Children*, 44, 1–12.
- Graham, S., Hebert, M., & Harris, K. R. (2015). Formative assessment and writing: A meta-analysis. *Elementary School Journal*, 115, 524–547.
- Graham, S., Hebert, M., Sandbank, M., & Harris, K. R. (2016). Credibly assessing the writing achievement of young struggling writers: Application of generalizability theory. *Learning Disability Quarterly*, 39, 72–82.
- Graham, S., Liu, K., Aitken, A., Ng, C., Bartlett, B., Harris, K. R., & Holzapel, J. (2018). Balancing reading and writing instruction: A meta-analysis. *Reading Research Quarterly*, 53, 279–304.
- Graham, S., Liu, K., Bartlett, B., Ng, C., Harris, K. R., Aitken, A., ... Talukdar, J. (2018). Reading for writing: A meta-analysis of the impact of reading and reading instruction on writing. *Review of Educational Research*, 88, 243–284.
- Harris, K., & Graham, S. (1985). Improving learning disabled students composition skills: Self-control strategy training. *Learning Disability Quarterly*, 8, 27–36.
- Harris, K. R., & Graham, S. (1999). Programmatic intervention research: Illustrations from the evolution of self-regulated strategy development. *Learning Disability Quarterly*, 22, 251–262.
- Harris, K. R., Graham, S., & Mason, L. (2006). Improving the writing, knowledge, and motivation of struggling young writers: Effects of self-regulated strategy development with and without peer support. *American Educational Research Journal*, 43, 295–340.
- Harris, K. R., Graham, S., Mason, L., & Friedlander, B. (2008). *Powerful writing strategies for all students*. Baltimore, MD: Brookes.
- Harris, K. R., Lane, K., Driscoll, S., Graham, S., Wilson, K., Sandmel, K., ... Schatschneider, C. (2012). Teacher-implemented class-wide writing intervention using self-regulated strategy development for students with and without behavior concerns. *Elementary School Journal*, 113, 160–191.
- Hayes, J. (1996). A new framework for understanding cognition and affect in writing. In M. Levy & S. Ransdell (Eds.), *The science of writing: Theories, methods, individual differences, and applications* (pp. 1–27). Mahwah, NJ: Erlbaum.
- Hayes, J., & Flower, L. (1980). Identifying the organization of writing processes. In L. Gregg & E. Steinberg (Eds.), *Cognitive processes in writing* (pp. 3–30). Hillsdale, NJ: Erlbaum.
- Hooper, S. R., Swartz, C. W., Wakely, M. B., de Kruif, R. E. L., & Montgomery, J. W. (2002). Executive functions in elementary school children with and without problems in written expression. *Journal of Learning Disabilities*, 35, 57–68.
- Hopman, M., & Glynn, T. (1989). The effects of correspondence training on the rate and quality of written expression of four low achieving boys. *Educational Psychology*, 9, 197–213.
- Hsiang, T. P., & Graham, S. (2016). Teaching writing in grades 4–6 in urban schools in the greater China region. *Reading and Writing*, 29(5), 869–902.
- Juel, C., Griffith, P. L., & Gough, P. B. (1986). Acquisition of literacy: A longitudinal study of children in first and second grade. *Journal of Educational Psychology*, 78(4), 243.
- Kiuhara, S., Graham, S., & Hawken, L. (2009). Teaching writing to high school students: A national survey. *Journal of Educational Psychology*, 101, 136–160.
- Klassen, R. (2007). Using predictions to learn about the self-efficacy of early adolescents with and without learning disabilities. *Contemporary Educational Psychology*, 32, 173–187.
- Lane, K. L., Menzies, H. M., & Kalberg, J. R. (2012). An integrated, comprehensive three-tier model to meet students' academic, behavioral, and social needs. In K. Harris, T. Urdan, & S. Graham (Eds.), *American Psychological Association educational psychology handbook* (Vol. 3, pp. 351–381). Washington, DC: American Psychological Association.

- Li, X. (1996). *"Good writing" in cross cultural contexts*. New York: State University of New York Press.
- Light, R. (2001). *Making the most of college*. Cambridge, MA: Harvard University Press.
- MacArthur, C., & Cavalier, A. (2004). Dictation and speech recognition technology as test accommodation. *Exceptional Children*, 71, 43–58.
- MacArthur, C., & Graham, S. (1987). Learning disabled students' composing under three methods of text production: Handwriting, word processing, and dictation. *Journal of Special Education*, 21, 22–42.
- MacArthur, C., Graham, S., & Schwartz, S. (1991). Knowledge of revision and revising behavior among learning disabled students. *Learning Disability Quarterly*, 14, 61–74.
- MacArthur, C., Philappakos, Z., & Graham, S. (2016). A multi-component measure of writing motivation with basic college writers. *Learning Disability Quarterly*, 39, 31–43.
- McKeown, D., Brindle, M., Harris, K. R., Sandmel, K., Steinbrecher, T., Graham, S., ... Oakes, W. (2019). Teachers' voices: Understanding effective practice-based professional development for elementary teachers on SRSD in writing. *American Educational Research Journal*, 56, 753–791.
- Michaelowa, K. (2001). Primary education quality in francophone Sub-Saharan Africa: Determinants of learning achievement and efficiency considerations. *World Development*, 29, 1699–1716.
- National Center for Educational Statistics. (2012). *The nation's report card: Writing 2011 (NCES 2012-470)*. Washington, DC: Institute of Educational Sciences, US Department of Education.
- National Center for Educational Statistics. (2016). *Digest of educational statistics. 2014 (NCES 2016-006)*. Washington, DC: Institute of Educational Sciences, US Department of Education.
- National Commission on Writing. (2004). *Writing: A ticket to work or a ticket out: A survey of business leaders*. Retrieved from www.collegeboard.com
- Parr, J., & Jesson, R. (2016). Mapping the landscape of writing instruction in New Zealand. *Reading & Writing*, 29, 981–1011.
- Poley, I. (1929). Variety of sentence structure: Its relation to technical excellence in composition and to intelligence. *Elementary English Review*, 6, 126–128.
- Pullen, P., Lane, H., Ashworth, K., & Lovelace, S. (2017). Specific learning disabilities. In J. M. Kauffman, D. P. Hallahan, & P. C. Pullen (Eds.), *Handbook of special education* (2nd ed., pp. 286–299). London: Routledge.
- Puranik, C., Al Otaiba, S., Sidler, J., & Greulich, L. (2014). Exploring the amount and type of writing instruction during language arts instruction in kindergarten classrooms. *Reading & Writing*, 27, 213–236.
- Reid, R., Hagaman, J., & Graham, S. (2014). Using self-regulated strategy development for written expression with students with attention deficit hyperactivity disorder. *Learning Disabilities: A Contemporary Journal*, 12, 21–42.
- Rogers, L., & Graham, S. (2008). A meta-analysis of single subject design writing intervention research. *Journal of Educational Psychology*, 100, 879–906.
- Saddler, B., & Graham, S. (2005). The effects of peer-assisted sentence combining instruction on the writing performance of more and less skilled young writers. *Journal of Educational Psychology*, 97, 43–54.
- Sandler, A., Watson, T., Footo, M., Levine, M., Coleman, W., & Hooper, S. (1992). Neurodevelopmental study of writing disorders in middle childhood. *Developmental and Behavioral Pediatrics*, 13, 17–23.
- Simao, V., Malpique, A., Frison, L., & Marques, A. (2016). Teaching writing to middle school students in Portugal and Brazil: An exploratory study. *Reading & Writing*, 29, 955–980.
- Sofell, C. (1929). *A comparison of the use of imposed with self-chosen subjects in a creative writing program*. Unpublished master's thesis, University of Pittsburgh, Pittsburgh, PA.
- Swanson, L., & Berninger, V. (1996). Individual differences in children's working memory and writing skill. *Journal of Experimental Child Psychology*, 63, 358–385.
- Swanson, L., Harris, K. R., & Graham, S. (2013). *Handbook of learning disabilities* (2nd ed.). New York: Guilford.
- Swedlow, J. (1999). The power of writing. *National Geographic*, 196, 110–132.
- Thomas, C., Englert, C., & Gregg, S. (1987). An analysis of errors and strategies in the expository writing of learning disabled students. *Remedial and Special Education*, 8, 21–30.
- Thorndike, E. (1910). Handwriting. *Teachers College Record*, 11, 83–175.
- Troia, G., & Graham, S. (2017). Use and acceptability of adaptations to classroom writing instruction and assessment practices for students with disabilities: A survey of grade 3-8 teachers. *Learning Disabilities Research & Practice*, 32, 257–269.
- Troia, G., Graham, S., & Harris, K. R. (2017). Writing and students with language and learning disabilities. In J. M. Kauffman, D. P. Hallahan, & P. C. Pullen (Eds.), *Handbook of special education* (2nd ed., pp. 337–357). London: Routledge.

- Turner, E. (1912). Rules versus drill in teaching spelling. *Journal of Educational Psychology*, 3, 460–461.
- U.S. Department of Education. (2015). *37th Annual Report to Congress on the implementation of The Individuals with Disabilities Education Act*. Washington, DC: Office of Special Education and Rehabilitation Services, Office of Special Education Programs.
- Wakely, M., Hooper, S., de Kruif, R., & Swartz, C. (2006). Subtypes of written expression in elementary school children: A linguistic-based model. *Developmental Neuropsychology*, 29, 125–159.
- Williams, K., Austin, C., & Vaughn, S. (2018). A synthesis of spelling interventions for secondary students with disabilities. *Journal of Special Education*, 52, 3–15.
- Williams, K., Walker, M., Vaughn, S., & Wanzek, K. (2017). A synthesis of reading and spelling interventions and their effects on spelling outcomes for students with learning disabilities. *Journal of Learning Disabilities*, 50, 286–297.

21

REASONING SKILLS IN INDIVIDUALS WITH MATHEMATICS DIFFICULTIES

Kinga Morsanyi

The aim of this chapter is to address the question of how reasoning skills might be affected in individuals with mathematics difficulties. To do this, I will first consider the cognitive profile associated with dyscalculia/mathematics difficulties. Although dyscalculia is defined as a specific learning disorder in mathematics, a variety of cognitive impairments are associated with dyscalculia, including some general cognitive skills that are not specific to performing mathematical operations. It is essential to consider how general cognitive abilities and resources might be implicated in dyscalculia, as reasoning skills rely heavily on cognitive resources. I will also give an overview of the various ways in which reasoning and mathematics abilities are linked, before considering the evidence regarding the extent to which reasoning and problem-solving abilities in individuals with mathematics difficulties are affected. These questions are important both from a theoretical and practical point of view, and one aim of the chapter is to highlight and discuss these implications. Additionally, I will outline some important future directions for this line of work.

WHAT IS DYSCALCULIA?

Developmental dyscalculia is a specific impairment of mathematics ability that may affect 3.5–6.5% of the population (e.g., Butterworth, 2005; Kaufmann & von Aster, 2012; Morsanyi, van Bers, McCormack, & McGourty, 2018; von Aster & Shalev, 2007). Individuals with dyscalculia are characterized by moderate to extreme difficulties in fluent numerical computations and reasoning, in the absence of sensory difficulties, low IQ, or educational deprivation (Butterworth, 2005). Prevalence estimates for dyscalculia vary widely in the literature (from as low as 1.3% to as high as 13.8%—see Devine, Soltész, Nobes, Goswami, & Szűcs, 2013, for a review). This variation is mostly the consequence of researchers using a variety of definitions and diagnostic criteria to identify individuals with dyscalculia.

The current definition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; APA, 2013) defines a specific learning disorder as persistent, substantial difficulties in mathematics learning and using academic skills, as determined by standardized, curriculum-based tests of achievement and a comprehensive clinical assessment. These deficits must cause significant interference with academic or occupational performance, or with daily activities, and should persist over time even when learners are offered appropriate educational interventions for at least 6 months. A clinical synthesis is required, based on the person's developmental, medical, family, and educational histories. This synthesis should be used to establish that the difficulties are not better explained by intellectual disabilities or mental, neurological, vision, hearing, or motor disorders. The difficulties also must not be better explained by psychosocial adversity, lack of proficiency in the language of schooling, or inadequate educational instruction.

It is notable that these diagnostic criteria differ from the earlier, DSM-IV criteria in a number of ways. Most importantly, the previous diagnostic criteria involved the requirement that there should be a significant discrepancy (of at least 15 points) between level of intelligence and mathematics skills, as measured by standardized tests. This difference implies that previous approaches expected specific difficulties in mathematics in the absence of impairments in general cognitive skills. Another important change is that specific learning disorders (including disorders of mathematics, reading, and written expression) are now included in a single diagnostic category, with the requirement of specifying the nature of the deficit(s).

In a recent study that we conducted in Northern Ireland using data from a large group of primary school children (Morsanyi, van Bers, McCormack, et al., 2018), we found that 6% of the children had persistently very low performance in mathematics (i.e., when considered across at least 2 school years, an average standardized mathematics score of 78 or lower). After applying the exclusion criteria specified by the DSM-5 (i.e., excluding children with an IQ of 70 or below and children with neurological, sensory, or motor disorders, or where mathematics difficulties might be better explained by environmental factors), we found a prevalence rate of 5.7% for dyscalculia. There were no gender differences either in the prevalence of persistent, serious difficulties with mathematics or in the prevalence of dyscalculia. The finding of no gender difference in the prevalence of dyscalculia is in line with the conclusions of most studies in this literature (e.g., Desoete, Roeyers, & De Clercq, 2004; Devine et al., 2013; Gross-Tsur, Manor, & Shalev, 1993; Hein, Bzufka & Neumärker, 2000; Koumoula, Tsiromi, Stamouli, Bardani, Siapati, Graham et al., 2004; Lewis, Hitch, & Walker, 1994; Mazzocco & Myers, 2003), but they are in contrast with the finding that reading difficulties are more common in males (as also noted in the DSM-5).

The Heterogeneity of Dyscalculia and Comorbid Conditions

Dyscalculia is a heterogeneous condition (e.g., Kaufmann et al., 2013; Rubinsten & Henik, 2009), and comorbidity with other developmental disorders is very common (e.g., Morsanyi, van Bers, McCormack, et al., 2018). As noted above, the DSM-5 includes a single, overarching category of specific learning disorders. This contrasts with the DSM-IV approach, which included the individual diagnostic category of "mathematics disorder." This change can be interpreted as an acknowledgment that

mathematics difficulties often co-occur with impairments in reading and/or written expression. Comorbidity with other neurodevelopmental disorders (e.g., AD(H)D, communication disorders, developmental coordination disorder, autism), as well as mental disorders (e.g., anxiety disorders, depressive and bipolar disorders) can also be expected, according to the DSM-5. Thus, beyond the core deficits, additional impairments might also be present in children with persistent mathematics difficulties (for related discussions see, in this volume: Jordan, Barbieri, Dyson, and Devlin, Chapter 19; Swanson, Chapter 2).

The Cognitive Profile Associated with Developmental Dyscalculia

Magnitude Processing in Dyscalculia

A cognitive neuroscience theory that has dominated research into dyscalculia for the past decades assumes that the specific difficulties in mathematics originate in the impairment of a specialized magnitude representation system, the approximate number system (ANS; Piazza, Facoetti, Trussardi, Berteletti, Conte, Lucangeli, Dehaene & Zorzi, 2010) or “number module” (Landerl, Bevan, & Butterworth, 2004).

Approximate number representations can be used to assess and compare quantities without assigning a verbal label or symbol (e.g., 9) to them. The typical task that is used to measure approximate number representations is the dot comparison task (e.g., Halberda, Mazzocco, & Feigenson, 2008; see Figure 21.1 for illustrations). In this task, participants are briefly presented with two sets of dots on the computer screen, and they have to decide which set contains more items. When making their judgments, participants have to ignore some physical features of the displays (e.g., the overall surface area and density of the dot patterns) and base their judgments solely on the number of dots. Given that participants rely on approximations, they are more accurate when the numerical difference between the quantities represented by the dot patterns is larger (as in the panel on the right-hand side of Figure 21.1). Moreover, there are individual differences between people in their ability to discriminate between displays that contain a similar number of items.

Whereas this research paradigm has been used extensively in the mathematical cognition literature, there are some debates regarding the links between magnitude processing and dyscalculia (for a related discussion, see Byrnes & Eaton, Chapter 27, this volume). Some researchers have proposed that dyscalculia results from impaired connections between magnitude representations and numerical symbols (De Smedt

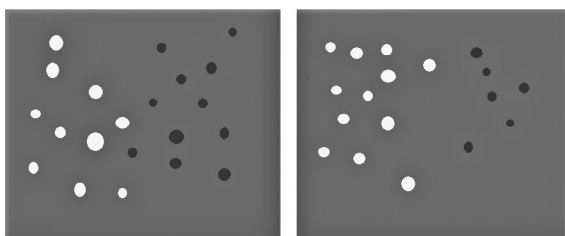


Figure 21.1 Difficult (Left) and Easy (Right) Trials from the Panamath Dot Comparison Task

& Gilmore, 2011; Iuculano, Tang, Hall, & Butterworth, 2008; Rousselle & Noël, 2007), rather than an impairment of the basic, approximate representations of numerosity. Nevertheless, given the core assumption of this research program that dyscalculia is a domain-specific deficit of the ability to process magnitudes and numerosity, much of the literature on mathematical cognition has focused on basic spatial and numerical intuitions and one key property of numbers: their magnitude. The fact that mathematics does not only involve numbers, but it is a complex system of rules and procedures, has received less acknowledgment and research attention.

Domain-General Cognitive Abilities in Dyscalculia

Whereas much research has focused on magnitude processing abilities, it has also been long acknowledged that more general cognitive resources (i.e., processes that are not specific to the domain of magnitudes and numbers) also play an important role in mathematics. For example, there is evidence that deficits in verbal and visual-spatial working memory (Bull & Scerif, 2001; Geary, 2004, 2011; Hitch & McAuley, 1991; Mammarella, Hill, Devine, Caviola, & Szűcs, 2015; Passolunghi & Siegel, 2001, 2004; Swanson, 2011; Szűcs, Devine, Soltész, Nobes, & Gabriel, 2013), inhibitory control (Blair & Razza, 2007; Bull & Scerif, 2001; Espy et al., 2004; Swanson, 2011; Szűcs et al., 2013), and attentional function (Ashkenazi, Rubinsten, & Henik, 2009; Hannula, Lepola, & Lehtinen, 2010; Swanson, 2011; Szűcs et al., 2013) are linked to mathematics difficulties (see also Jordan, Barbieri, Dyson, and Devlin, Chapter 19, this volume)

Beside their magnitude, another basic property of numbers is their ordinal position in the count list. Indeed, ordinality is important not just for learning to count, but at all levels of mathematics understanding (e.g., in processing the meaning of multi-digit numbers, or deciding which operation to start with when there are multiple steps involved in solving an arithmetic problem). In recent years, an increasing number of studies have investigated the role of order processing in mathematics, demonstrating its importance both for mathematics development (e.g., Attout, Noël, & Majerus, 2015; Lyons & Ansari, 2015; Lyons, Price, Vaessen, Blomert, & Ansari, 2014; Lyons, Vogel, & Ansari, 2016; O'Connor, Morsanyi, & McCormack, 2018; Vogel, Remark, & Ansari, 2015) and mature mathematics skills (e.g., Goffin & Ansari, 2016; Lyons & Beilock, 2011; Morsanyi, O'Mahony, & McCormack, 2017; Sasanguie, Lyons, De Smedt, & Reynvoet, 2017; Vos, Sasanguie, Gevers, & Reynvoet, 2017).

Most of these studies have focused on number ordering ability, which is typically measured using a task where three one-digit numbers are presented (e.g., 6 4 7), and participants have to decide if these numbers are in the correct order with regard to their position in the count list. Some of these studies have also investigated various types of nonnumerical ordering task and they have demonstrated that the close link between ordering abilities and mathematics skills is not limited to number ordering. Some researchers have also proposed that order processing difficulties (including both numerical and nonnumerical ordering) might be a defining feature of developmental dyscalculia (Attout & Majerus, 2014; Attout, Salmon, & Majerus, 2015; De Visscher, Szmalec, Van Der Linden & Noel, 2015; Kaufmann, Vogel, Starke,

Kremser, & Schocke, 2009; Morsanyi, van Bers, O'Connor, & McCormack, 2018; Rubinsten & Sury, 2011). These studies involved a range of ordering tasks, such as judging if three numbers/months are in the correct order, recalling the order of items within unfamiliar sequences (e.g., list of words or spatial locations), and carrying out everyday tasks that involve a sequence of actions. I will give more details of these tasks in the following sections.

Relationships between Cognitive Impairments in Dyscalculia

When we try to understand the cognitive profile of individuals with mathematics difficulties, it is important to consider that the various types of deficit that we described above are not mutually exclusive. Indeed, it is possible that individuals with dyscalculia have both a specific deficit of magnitude representation and more general deficits of ordering skills, verbal and visual-spatial working memory, inhibitory function, and attention. If this is the case, the question arises whether these impairments are independent of each other or deficits in some skills might lead to the emergence of other problems.

With regard to working memory deficits, an interesting line of work by Majerus and colleagues has investigated the possibility that it is memory for order information (and not item memory) that is particularly important for mathematics. Working memory tasks involve the requirement to recall specific items in a particular order (i.e., a combination of item and order memory). Majerus, Poncelet, Greffe, and Van der Linden (2006) have developed an order working memory task that places minimal demands on item memory. In this task, participants listen to a list of words that they have to subsequently reproduce in the correct order, using cards that represent the items. The items in the lists are highly familiar, one-syllable animal names (e.g., dog, cat, fish, sheep). Once they have heard a list of words, the participants are given the cards representing the items in the list. Thus, participants do not need to recall the number or identity of the items, they just need to arrange the cards in the correct order. Attout and Majerus (2014) found impaired order memory, but intact item memory, in children with dyscalculia. Subsequently, they replicated this finding with adults with a history of dyscalculia (Attout, Salmon, et al., 2015). An additional relevant finding from this research group is that spatial attentional processes are implicated in serial-order recall of verbal items (van Dijck, Abrahamse, Majerus, & Fias, 2013). These findings suggest that deficits in working memory, serial recall/order memory, and spatial attention are related. Thus, they can also be expected to co-occur in dyscalculia (for a related discussion, see Swanson, Chapter 2, this volume).

Some studies have also demonstrated (at least partial) overlap between ordering and magnitude processing skills. It should be noted that the ordering tasks used in these studies focused on order judgments regarding highly familiar sequences (e.g., numbers, the months of the calendar year), rather than the short-term retention of serial order for novel sequences. First, Lyons and Beilock (2011) investigated the links between arithmetic skills in adults, number ordering ability, and performance on the dot comparison task. These authors have found that both number ordering and dot comparison performance independently predicted arithmetic skills. However, when the effects of the two tasks were considered together, number ordering mediated the effect of dot comparison performance on arithmetic skills.

Morsanyi, O'Mahony, et al. (2017) and Sasanguie et al. (2017) showed that, when a symbolic comparison task was used (where participants had to compare the magnitude of two one-digit numbers), the effect of this task on arithmetic performance was mediated by number ordering ability, which replicated the findings of Lyons and Beilock (2011) using the comparison of symbolic numbers instead of dot patterns. Sasanguie and Vos (2018) also found close links between number comparison and number ordering skills in the case of children at the start of primary school. Overall, these results show that number ordering and both symbolic and nonsymbolic magnitude comparison skills are related.

Considering the above findings together, one could expect that dyscalculia might be characterized by a number of interrelated deficits. In a recent study (Morsanyi, van Bers, O'Connor, et al., 2018), we aimed to integrate these findings by administering a range of tasks to 9–10-year-old children with dyscalculia and a closely matched control group. We have found evidence for deficits in magnitude processing, as measured by a dot comparison task and a number line task (where children had to mark the position of numbers on a 1–100 or 1–1,000 number line). Additionally, order memory for both novel (including verbal and visual-spatial working memory) and familiar sequences (i.e., numbers and recurring events of the calendar year, such as summer holidays, Halloween, etc.) was impaired. The dyscalculic children's parents also reported that their child had order processing deficits in everyday settings. This was measured by a questionnaire that included eight questions related to everyday activities with an ordering component (e.g., "My son/daughter can easily recall the order in which past events happened"). Nevertheless, in our study, we did not find evidence of problems with inhibitory control (we found no impairment in either the inhibition of prepotent responses or susceptibility to interference). This finding was in contrast with a previous study (Szűcs et al., 2013) that proposed that inhibition impairments are a defining feature of developmental dyscalculia.

In summary, whereas much research has focused on deficits in basic magnitude processing skills in dyscalculia, there is also evidence for deficits in some domain-general cognitive processes, including verbal and visual-spatial working memory, memory for familiar ordinal sequences, attentional function, and inhibition. Some of these skills have been shown to be closely related and can be expected to co-occur in individuals. As we will see later, these core cognitive processes are also very important for reasoning skills.

THE LINKS BETWEEN REASONING AND MATHEMATICS

Whereas much research into mathematical cognition has focused on magnitude processing and basic mathematical intuitions, mathematics also involves memorizing and choosing between rules and procedures, as well as combining rules and procedures in order to solve problems. These processes might involve multiple steps and the integration of various sources of information. In other words, mathematical problem-solving requires complex reasoning skills.

We already know much about the development and the cognitive requirements of various types of reasoning skill, which can help us to better understand why some mathematical concepts might be particularly difficult. Additionally, if we understand the sources of difficulties, there might be a possibility to reduce the cognitive com-

plexity and reasoning requirements of some mathematical concepts and tasks, which could help learners in understanding and using some complex mathematics concepts. This could be particularly important for students with dyscalculia.

Relational Reasoning and Mathematics

One type of reasoning that is very often required in the context of mathematics is relational reasoning. I will discuss several types of relational reasoning in this chapter. Relational reasoning involves forming and manipulating mental representations of relations between objects, events, or concepts. Relational reasoning is a broad, overarching category that incorporates a variety of reasoning processes, including inductive and deductive reasoning, as well as categorization, planning, hypothesis-testing, and problem-solving (e.g., Cattell, 1971; Halford, Wilson, & Phillips, 1998; Waltz et al., 1999).

At the simplest level of forming relations, two concepts are combined. For example, “John is taller than Mary” or “3 items are more than 2 items.” Simple relations can be established on the basis of perceptual processes. For example, if John is standing next to Mary, it is immediately apparent that he is taller. Relational reasoning makes it possible to move beyond perceptually available information by integrating multiple relations. For example, if we know that “3 items are more than 2 items” and “4 items are more than 3 items,” we can conclude that “4 items are more than 2 items,” even if we never see 2 and 4 items displayed together, or if we do not know the meaning of 3, 2, and 4. This is an example of transitive reasoning, which we will discuss in more detail later.

Relational concepts are ubiquitous in mathematics. In fact, relational concepts are used to describe the connections not only between quantities (e.g., by using the equal sign), but also between operations. For example, there is an inverse relation between multiplication and division ($A \times B \div B = A$). In the case of the problem “ $2 \times 5 \div 5 = ?$,” a solution can be reached by following some procedural rules and performing the operations that are indicated. Nevertheless, performing these computations requires time, and there is a chance of error at each step. By contrast, relational reasoning (i.e., understanding that division is the inverse of multiplication) could lead to the simple answer of “2” without any computations being performed.

The above example suggests that processing relations might be easier than performing computations. But is this always the case? In fact, this depends on the type of problem that we are considering, and, of course, not all problems can be solved by relational reasoning. Nevertheless, there is evidence that relational reasoning can be very useful, even at the start of formal education. Nunes et al. (2007) conducted a longitudinal study where they assessed 6-year-old children’s understanding of some relational concepts that are implicated in mathematics (e.g., the inverse relation, seriation, one-to-one and one-to-many correspondence, etc.). For example, one of the tasks that was used to measure one-to-many correspondence required children to share some sweets equally between two dolls. An example of a task that required children to understand the inverse relation is the following story problem: “Ali had some sweets in her bag, I don’t know how many. She gave her brother three sweets and still had four sweets in her bag. How many sweets did she have in the bag before she gave some away?” Nunes et al. (2007) found that relational understanding predicted

children's mathematics achievement 16 months later, after controlling for the effect of working memory. Additionally, Nunes et al. (2007) provided a group of children with extensive training in these logical rules over a 12-week period. Children in the intervention group showed improved mathematics performance, both immediately after the training period and 1 year later, compared with a passive control group. These results demonstrate a causal link between the understanding of some basic relational rules about mathematics and mathematics learning. Relational reasoning has also been shown to longitudinally predict mathematics learning in older students from various age groups (Green, Bunge, Chiongbian, Barrow, & Ferrer, 2017).

Regarding the cognitive processes that underlie relational reasoning, Waltz et al. (1999) showed that the prefrontal cortex played a crucial role in relational processing (see also Crone et al., 2009). Additionally, Waltz et al. (1999) proposed that relational integration (including the inhibition of inappropriate, prepotent responses) may be the core function of working memory. Starting from these considerations, we could expect that relational reasoning might be impaired in dyscalculia. I will present supporting evidence for this assertion in the following sections.

Relations between Numbers: Fractions, Decimals, and Percentages

Fractions, decimals, and percentages express relations. Not only are these concepts essential for complex mathematics and science (Booth & Newton, 2012), but we also encounter them very regularly in everyday settings—for example, when we describe probabilistic events (e.g., “there is a 30% chance that it will be raining at 5 pm”). Given that proportional reasoning is essential for understanding probabilities (e.g., Van Dooren, De Bock, Depaepe, Janssens, & Verschaffel, 2003), it is also inherently related to decision-making and the understanding of risks.

Whereas one could think that expressing a rational number as a fraction, decimal, or percentage (e.g., $\frac{1}{16}$; 0.0625; 6.25%) conveys identical information, recent research has shown that this is not the case (e.g., Gray, DeWolf, Bassok, & Holyoak, 2018). One way of thinking of percentages is that they are fractions with the fixed denominator of 100. Nevertheless, they also share the important and powerful characteristic of decimals that they can be naturally ordered along a single, continuous dimension, which makes it reasonably easy to process the magnitude information that they convey. One question that Gray et al. (2018) investigated in their study was if one interpretation dominates the other when people use percentages. Gray et al. (2018) showed that people process percentages and decimals in very much the same way, whereas they use fractions differently. In particular, the most salient property of percentages and decimals is that they convey magnitude information. By contrast, the meaning of fractions is inherently relational. In fact, in addition to part-to-whole relations, ratios can also be used to express part-to-part relations. Although their eventual purpose is to express magnitudes, deriving magnitude information typically involves some computations.

An important additional insight is that people do not necessarily compute the magnitude of fractions when they work with them (Bonato, Fabbri, Umiltà, & Zorzi, 2007). For example, it is relatively easy to compare the magnitudes of two decimals (e.g., 0.0625 vs. 0.075) or two percentages (e.g., 6.25% vs. 7.5%). By contrast, comparing the magnitudes of the same numbers when they are expressed as fractions might take much effort (e.g., $\frac{1}{16}$ vs. $\frac{3}{40}$). Miller Singley and Bunge (2018) used eye-tracking to

better understand adults' spontaneous reasoning when they compared the magnitude of fractions. The eye gaze patterns revealed that participants predominantly relied on componential processing. That is, when they compared two fractions, instead of focusing on each fraction separately, they were making comparisons between the numerators and denominators of the two fractions (i.e., their eye-gaze patterns dominantly included horizontal saccades). In other words, participants' preferred strategy was to reason about *relations*,¹ instead of the option to compute/estimate the magnitude of the fractions and then compare the two numbers on that basis. In fact, they only engaged in computations if the magnitude comparison task could not be solved by a reasoning strategy.

Whereas it might be relatively easy to process the magnitude of percentages and decimals, this is not to say that people do not have difficulties with this. For example, Rittle-Johnson, Siegler, and Alibali (2001) highlighted that many children struggle to understand decimals, and some of them never master this concept. In particular, children might struggle with the interpretation of zeros (e.g., they might treat 0.07 as equal to 0.007). For this reason, training that improves children's understanding of tenths, hundredths, and thousands can be very useful.

Because even typically developing children find it hard to grasp the concept of fractions and decimals, we can expect that children with dyscalculia would find this particularly difficult. Mazzocco and Devlin (2008) conducted a longitudinal investigation into the development of understanding of decimals and fractions. The children who participated in the study ($n = 147$) were 12 years old at the start, and they were followed over a 2-year period (i.e., the children were tested three times: in grades 6, 7, and 8). The sample included 12 children with dyscalculia (≤ 10 th percentile on standardized mathematics tests). The children were presented with a decimal reading task and some additional tasks where they had to order fractions by placing them into empty spaces along a horizontal grid. The fractions were represented in a visual format (as segments of a circle) or by use of Arabic numerals (e.g., $\frac{5}{100}$, $\frac{5}{10}$, $\frac{7}{100}$, $\frac{20}{100}$, $\frac{10}{10}$, etc.), or a combination of decimals and fractions was presented (e.g., $\frac{60}{100}$, 0.2, $\frac{7}{10}$, 0.005, etc.). The lists also included some ties (e.g., 0.07 and $\frac{7}{100}$; 0.05 and $\frac{5}{100}$), which the children had to indicate in their ranking.

At the start of the study, 37 children were able to complete all tasks correctly (i.e., with at least 90% accuracy), which had increased to 61 children by the end of the study. This shows that children generally found these tasks challenging. Regarding the differences between subgroups, one important finding was that most children with dyscalculia were unable to read decimals correctly at any point in the study. Additionally, whereas most children who did not have a mathematics difficulty were able to correctly order the pictorially represented fractions (which was the easiest subtest), fewer than half of the children with dyscalculia were able to do this at any time point. Children with dyscalculia also struggled to understand that the same number can be represented in different formats (i.e., they failed to recognize ties), and, in the task that included both fractions and decimals, they did not mix the two formats in their ranking. In a later publication based on the same longitudinal study, Mazzocco, Myers, Lewis, Hanich, and Murphy (2013) also reported that children with dyscalculia did not show an advantage in using "one-half" fractions over "non-half" fractions, unlike children without mathematics difficulties.

It is possible to interpret these findings as evidence that children with dyscalculia have a problem with relational reasoning (possibly, due to working memory impairments). It is also interesting to note that the tasks used by Mazzocco and Devlin (2008) included the requirement of ordering numbers along a single continuum (with the exception of the decimal reading task). As I have described earlier, it has been proposed that ordering deficits might be a defining feature of dyscalculia (Attout & Majerus, 2014; Attout, Salmon, et al., 2015; De Visscher et al., 2015; Kaufmann et al., 2009; Morsanyi, van Bers, O'Connor, et al., 2018; Rubinsten & Sury, 2011). Unfortunately, Mazzocco and colleagues did not use any manipulations of the stimuli, apart from manipulating the presentation format (i.e., decimals, pictorial vs. Arabic numeral representation of fractions), which could give more cues regarding the underlying deficits. The topic of fraction understanding in dyscalculia has also not been investigated in more detail by other research groups, although see Montis (2000) for a case study, which also involves a description of learning about fractions in dyscalculia.

Given this gap in the literature, it would be important to conduct further studies into understanding fractions and ratios in dyscalculia. These studies could aim at checking dyscalculic learners' ability to understand part-to-whole and part-to-part relationships, assess the relative magnitude of fractions, and use this information to rank order fractions. In addition, the "whole number bias" (i.e., the tendency to rely on natural number knowledge and, in particular, to expect that the value of a fraction increases if the value of either the numerator or the denominator increases; Ni & Zhou, 2005) could also be investigated in the case of dyscalculic learners.

In summary, these results provide evidence that mathematics difficulties affect the understanding of fractions. Nevertheless, the underlying reasons are not well researched (apart from the fact that fractions are difficult even for students without learning disorders). Thus, it is unclear to what extent these findings are linked to the fact that fractions involve relational reasoning. In the next section, I will present much stronger evidence regarding the idea that relational reasoning poses a difficulty for individuals with dyscalculia, even when these problems do not include mathematical content.

Logical Reasoning and Mathematics: Shared Basic Building Blocks

Logical reasoning involves reaching a valid conclusion on the basis of multiple premises that are assumed to be true (e.g., Johnson-Laird, 1999). This implies that logical reasoning might require people to accept premises that contradict their beliefs (i.e., that are unbelievable), and it is also possible to reason logically about abstract or unknown concepts. Nevertheless, reasoning about unbelievable or abstract content poses a challenge, even for educated adults, and this ability develops gradually during late childhood and adolescence (Markovits & Lortie-Forgues, 2011).

There are two types of logical reasoning where there is good evidence for a link with various types of mathematics skill. One of these is transitive reasoning. Consider the following example (assuming that the statements are true):

Bicycles are faster than aeroplanes.

Cars are faster than bicycles.

Are cars faster than aeroplanes?

Transitive reasoning involves representing the relative position of items along a single continuum and making comparisons between them. In the example above, participants also have to ignore their prior knowledge and beliefs in order to give a logical response, although this requirement is not always present (i.e., transitive reasoning could be performed using unfamiliar or abstract content). There is behavioral (e.g., Goodwin & Johnson-Laird, 2005, 2008; Prado, Van Der Henst, & Noveck, 2008; Vandierendonck & De Vooght, 1997), as well as neuroscience, evidence (see Prado, Chadha, & Booth, 2011, for a meta-analysis) that transitive inferences utilize spatial mental representations, which are remarkably similar to the “mental number line” (Moyer & Landauer, 1967; Restle, 1970), a spatial representation of the number sequence.

Transitive reasoning has been found to be related to mathematics skills in children (Handley, Capon, Beveridge, Dennis, & Evans, 2004), adolescents (Morsanyi, Kahl, & Rooney, 2017), and adults (Morsanyi, McCormack, & O’Mahony, 2018). Moreover, Morsanyi, McCormack, et al. (2018) reported that performance on transitive reasoning problems and a number line task was related, which supports the idea of shared underlying representations.

Given these findings, it could be expected that transitive reasoning skills might be impaired in dyscalculia. Morsanyi, Devine, Nobes, and Szűcs (2013) investigated the transitive reasoning performance of three groups of 10-year-old children: children with dyscalculia, and children with average and high mathematics ability. The children with low and average mathematics ability were matched on IQ, verbal working memory, and reading skills, whereas the high mathematics ability group also had higher IQ and better reading skills than the other two groups. The transitive reasoning problems included items with a conflict between beliefs and logic, and also some belief-neutral problems (e.g., John is older than Tim. Mark is older than John. Is Tim older than Mark?).

In the case of belief-laden problems, children with dyscalculia generally relied on their beliefs when they accepted or rejected conclusions, without taking into account the logical structure of the problems. By contrast, children with typical and high mathematics ability relied on the logical structure of the problems and were able to disregard their beliefs. Moreover, the effect of logical structure was stronger in the case of children with high mathematics ability. Nevertheless, there was no difference between groups on belief-neutral problems (most likely because these “abstract” problems were too difficult for all children).

Given that group differences only emerged in the case of belief-laden problems (where children had to disregard their pre-existing beliefs), it could be argued that the three groups differed in their inhibition skills, rather than their transitive reasoning abilities. Although this possibility could not be excluded on the basis of the findings of Morsanyi et al. (2013), another study, which was conducted with adults (Morsanyi, McCormack, et al., 2018), showed that transitive reasoning (including problems with belief-laden and belief-neutral content) was related to performance on a number line task, as well as to tasks measuring mathematical reasoning skills. That is, in this study, transitive inferences, both with and without the demand of inhibiting beliefs, were related to mathematics skills, which confirms that transitive reasoning shares some basic processing demands with certain mathematical tasks. For example, divisibility and equality are transitive. If we know that 50 can be divided by 25, and 25 can be

divided by 5, then it follows that 50 can be also be divided by 5. Or, if we know that $x = y$ and $y = z$, then it follows that $x = z$.

Another possibility is that the group differences in transitive reasoning emerged because children with and without dyscalculia were not matched on visual-spatial working memory (indeed, visual-spatial working memory was not measured in this study). A related explanation is that there is an impairment in dyscalculia in the ability to represent items along a single, spatial continuum. In fact, some studies have reported poor performance on the number line task in the case of individuals with dyscalculia (e.g., Skagerlund & Träff, 2014).

In addition to transitive inferences, conditional reasoning is another form of logical reasoning related to mathematics skills. Conditional inferences require the ability to reason on the basis of *if-then* rules. For example, consider the following problem (assuming that all statements are true):

If the radio is turned on, then you will hear music.
 The radio is not turned on.
 Is it necessary that you will not hear music?

When people are presented with this problem, they typically conclude that the conclusion “you will not hear music” logically follows from the premises. This is an example of an (invalid) denial of the antecedent inference. The conclusion does not necessarily follow, as there could be other reasons why somebody hears music, even if the radio is not turned on (for example, there is a music program on TV). Conditional reasoning forms the basis of hypothetical thought (e.g., Evans, 2007), and it is considered to be essential not only for mathematical reasoning, but for scientific reasoning in general (Markovits & Lortie-Forgues, 2011; Moshman, 1990).

In a number of studies, Inglis and colleagues have investigated the relationship between conditional reasoning ability and mathematics skills (Attridge & Inglis, 2013; Inglis & Simpson, 2008, 2009). Inglis and Simpson (2008) found better conditional reasoning performance among mathematics students than arts students, and Inglis and Simpson (2009) replicated these findings in a new sample of mathematics and arts students, who were matched on their level of intelligence. Additionally, Attridge and Inglis (2013) also provided evidence that studying mathematics could be causally related to improvements in conditional reasoning skills. Specifically, Attridge and Inglis (2013) investigated the changes in the reasoning skills of mathematics and arts students during the first year of their post-compulsory studies in mathematics/arts. The conditional reasoning performance of arts students did not change between the start and the end of the academic year. By contrast, the conditional reasoning skills of mathematics students improved (especially their ability to reject invalid inferences). Other studies also showed that conditional reasoning ability and mathematics skills were related in the case of children (Handley et al., 2004; Wong, 2018).

Given that both conditional and transitive reasoning skills have been found to be related to mathematics achievement and skills, the question arises whether mathematical reasoning is generally related to logical reasoning ability. We examined this question in a study with adults (Morsanyi, McCormack, et al., 2018). As I described above, in this study we found evidence that transitive reasoning skills were linked to performance on a number line task, as well as to a series of tasks measuring

mathematical reasoning skills using mathematics word problems, including tasks that measured probabilistic reasoning ability. In the same study, we also found evidence for a link between the ability to reject invalid conditional inferences and people's mathematics skills. Interestingly, although both transitive and conditional reasoning skills were related to mathematical reasoning (i.e., performance on the word problems with mathematical content), the two types of logical inference were uncorrelated. Additionally, performance on the conditional reasoning tasks was related to arithmetic skills, as well as ordering ability, but it was unrelated to performance on a number line task. By contrast, transitive reasoning skills were related to number line performance, but were not significantly related to ordering ability or arithmetic skills.

In summary, there is good evidence that at least two types of logical inference (i.e., transitive and conditional reasoning) are related to mathematics skills. This has been confirmed by a number of studies, including both children and adults. An impairment of transitive reasoning skills in dyscalculia has also been shown. Indeed, a recent study with children with mathematics learning difficulties (Schwartz, Epinat-Duclos, Léone, Poisson, & Prado, 2018) not only found impairments in transitive reasoning in this group, but also showed that transitive inferences were associated with the activation of the intraparietal sulcus in typically developing children; this was not the case for children with mathematics difficulties. It seems that both conditional and transitive inferences share some basic building blocks with mathematics skills, which are not specific to the domain of numbers. Specifically, there is converging evidence from both behavioral and neuroscience studies that transitive reasoning skills are based on a similar “mental line” representation as the mental number line (Goodwin & Johnson-Laird, 2005, 2008; Prado et al., 2008, 2011; Morsanyi, McCormack, et al., 2018; Vandierendonck & De Vooght, 1997). Additionally, conditional reasoning skills have been found to be related to ordering ability.

There is one additional type of logical inference that could be relevant for mathematics: categorical syllogisms. These problems describe set inclusion relations, using the quantifiers “some,” “all,” and “no.” Set inclusion relationships are important in several areas of mathematics (e.g., “natural numbers are a subset of rational numbers”). Similar to transitive inference problems, categorical syllogisms also often involve a conflict between logical necessity and beliefs, although problems with belief-neutral or abstract content might also be used. As an example, consider the following problem (assuming that all statements are true):

All reptiles are crocodiles.
Snakes are reptiles.
Therefore, snakes are crocodiles.

In this example, although the conclusion is unbelievable, it logically follows from the premises. To the best of my knowledge, the only studies so far that investigated the relation between verbal categorical syllogistic reasoning and mathematics skills was conducted by our research group (Morsanyi, Kahl, et al., 2017). In the first study, 13–16-year-old adolescents were administered syllogistic reasoning problems and were asked to report their school mathematics and English performance. This study showed no relationship between syllogistic reasoning performance and school performance in either mathematics or English. In the second study, another group of

adolescents completed both transitive and categorical reasoning problems. Although performance on transitive and categorical reasoning problems with a belief–logic conflict was significantly related (probably because of the shared requirement between the two tasks to inhibit beliefs), only transitive reasoning performance was related to mathematics skills.

The finding that performance on different types of logical reasoning task is mostly independent (or only weakly related) might be surprising. Nevertheless, this finding is in line with neuroscience evidence that transitive, conditional, and categorical inferences are related to activations in three distinct brain subsystems (Prado et al., 2011).

An interesting study investigated logical reasoning performance in the context of mathematics in adolescents between the ages of 10 and 16 years (Sak, 2008). In this study, transitive reasoning (e.g., “if $A < 2B$ and $B/2 > C$, which letter signifies the smallest number?”), conditional reasoning (if $x < 0$, then select the only one that is correct: (a) $x^2 > 2x$; (b) $x^2 < 3x$; (c) $x^2 < 0$; (d) $x^2 < x + x$; (e) $x^2 > x^2$), and categorical syllogistic reasoning performance (participants had to figure out relationships between classes that were presented in tables) were measured, together with students’ knowledge of algebra, geometry, and statistics. Given the broad age range of the students, the items for all tasks were chosen to be appropriate for school grade. Sak (2008) found moderate correlations between both transitive and conditional reasoning and students’ knowledge of algebra, geometry, and statistics. However, there was no relationship between categorical syllogistic reasoning and any aspect of mathematics performance. Additionally, transitive reasoning performance and conditional reasoning performance were moderately related, but categorical syllogistic reasoning was unrelated to the other forms of logical inference.

Analogies, Conceptual Knowledge, and Solving Novel Problems

In the final section of my review of the links between reasoning and mathematics skills, I am going to focus on analogical reasoning. Analogies play a central role in mathematics learning, as they facilitate the transfer of knowledge and procedures between different contexts and help in solving novel problems (e.g., Bassok, 2001; Novick & Holyoak, 1991). Procedural knowledge is defined as the ability to execute familiar action sequences to solve routine problems (e.g., Briars & Siegler, 1984; Hiebert & Wearne, 1996). By contrast, conceptual knowledge involves implicit and explicit understanding of the principles that govern a domain and the interrelations between these concepts, and it can be generalized to novel tasks (e.g., Bisanz & LeFevre, 1992; Hiebert & Wearne, 1996). Thus, analogies can be considered to play a central role in the development of conceptual knowledge.

Analogical reasoning ability is typically measured by verbal or pictorial tasks where participants have to find a missing item by forming higher-order relationships between items. For example: a *forest* to a *tree* is like a *beach* to a ____ (choose from: *sea*; *pebble*; *peach*). As in the current example, analogical reasoning problems sometime involve resisting the temptation to choose a distractor item (e.g., in the above example, *sea* is a semantic distractor, and *peach* is a verbal perceptual distractor). The requirement to not choose a distractor item is somewhat similar to the requirement to ignore preexisting beliefs in the case of logical reasoning problems.

When solving analogical reasoning problems, reasoners first have to identify the relationships within and across pairs and then map the relationship within the first pair (which is called the source) to the second (target) pair. Apart from the possibility of being sidetracked by distractors, difficulties in analogical mapping might also arise if there are several relations that need to be considered at the same time, or if the source domain is not very familiar (e.g., Vendetti, Matlen, Richland, & Bunge, 2015).

Analogies are often used in science education (e.g., comparing the atom to the solar system). In these cases, a familiar concept is used to highlight some important properties of a novel concept. Analogies can also be used to highlight differences, not just similarities. The role of analogies in problem-solving (including solving mathematics word problems) has been studied extensively (e.g., Novick & Holyoak, 1991). In these studies, participants are typically presented with a difficult problem without an obvious, routine solution (a source analogy—see example in Table 21.1). Then they are given some cues or explanation as to the strategy for solving the problem. For example, in Table 21.1, it is explained that they should first consider that the total number of plants that the Renshaws wanted to buy can be evenly divisible by 10, 4, and 5 (so the number has to be a multiple of 20). But then, the Renshaws decided to add two more plants (so the total number could now be 22, 42, 62, etc.), and this number should be evenly divisible by 6. Thus, the smallest possible number is 42.

Using this explanation, a possible solution strategy for the second problem is to first consider the least common multiple of 5, 6, 9, and 10 that falls between 80 and 550 (which is 90), and then add 4. This gives a number that, if it is divided by 3, leaves 1 shell out. Nevertheless, 94 is not divisible by 7. So, the next possible numbers are 184 and 274, which are also not divisible by 7. The next possible number is 364, which is divisible by 7. One can also consider 454 and 544, but neither of these are divisible by 7. Thus, the correct response is 364.

Table 21.1 Example of a Source and Target Analogy

Source Analogy	Target Analogy
Mr. and Mrs. Renshaw were planning how to arrange vegetable plants in their new garden. They agreed on the total number of plants to buy, but not on how many of each kind to get. Mr. Renshaw wanted to have a few kinds of vegetables and ten of each kind. Mrs. Renshaw wanted more different kinds of vegetables, so suggested having only four of each kind. Mr. Renshaw didn't like that, because, if some of the plants died, there wouldn't be very many left of each kind. So, they agreed to have five of each vegetable. But then their daughter pointed out that there was room in the garden for two more plants, although then there wouldn't be the same number of each kind of vegetable. To remedy this, she suggested buying six of each vegetable. Everyone was satisfied with this plan. Given this information, what is the fewest number of vegetable plants the Renshaws could have in their garden?	Samantha's mother asked her how many sea shells she has in her collection. Samantha said she wasn't sure, but it was a lot—somewhere between 80 and 550. And she could count them by sevens without having any left over. However, if she counted them by threes, there was one shell left over. Things were even worse if she counted the shells by fives, by sixes, by nines, or by tens—there were always four shells left over. Samantha's mother promptly told her how many sea shells she had in her collection. What number did Samantha's mother come up with?

Novick and Holyoak (1991) identified several important prerequisites of successful analogical transfer between problem-solving contexts. First of all, the participants have to identify the relevant ideas that have to be mapped/transferred across contexts (in the present example, these are the strategy to find a least common multiple for certain numbers, combined with a trial and error process to find a number that fits the other requirements specified in the problem). The second step is to adapt these strategies to the target problem (which often presents a difficulty for reasoners). The final step is to generalize the procedure, so that it can be flexibly applied to solve other similar problems. An important finding of Novick and Holyoak (1991) is that successful transfer in the context of mathematics word problems depends on participants' domain knowledge (rather than their general ability to reason by analogy). For example, if participants struggle to compute the least common multiple of a set of numbers, or if they fail to identify which numbers should be considered when computing the least common multiple, they will not be able to find the correct solution.

Whereas analogies can help in learning new concepts, they can also hinder understanding in some cases. A classic example is provided by Rumelhart and Norman (1981). Fractions are often introduced to children using the pie (or pizza) analogy. This might make it easy to understand, for example, that $\frac{3}{4}$ equals $\frac{1}{2}$, or, if you have a whole and you take away $\frac{1}{4}$, then you have $\frac{3}{4}$. Nevertheless, using this analogy, it might be harder to grasp other operations using fractions (such as multiplication and division), or the idea that fractions can express numbers larger than 1. Once the child has learned multiplication and division, another analogy that they can utilize is that a fraction is simply a compound of a multiplication (expressed by the numerator) and a division (expressed by the denominator). When fractions are introduced in this way, multiplication and division using fractions becomes easy, but the child might struggle with understanding how fractions can be added or subtracted. Thus, although these analogies can be very useful if used in the right context, Rumelhart and Norman (1981) point out that there is no perfect analogy, and, eventually, children need to develop the right procedural and theoretical knowledge to work with fractions, rather than trying to grasp them based on a single analogy.

Regarding the cognitive underpinnings of analogical reasoning, verbal working memory (e.g., Cho, Holyoak, & Cannon, 2007; Morrison, 2005; Waltz, Lau, Grewal, & Holyoak, 2000), as well as inhibition skills (e.g., Morrison, 2005; Richland, Morrison, & Holyoak, 2006), has been implicated. Of course, domain knowledge regarding the source analogy is also very important, and it can be a limiting factor in using analogies to support learning (e.g., Novick & Holyoak, 1991; Vendetti et al., 2015). In the ecological setting of a classroom, Begolli et al. (2018) investigated the role of verbal working memory and inhibition skills in learning novel solution strategies for difficult mathematics word problems, when learning was supported by using practice problems that were conceptually similar (i.e., that allowed for analogical transfer). The lesson included solving word problems that involved ratios (for example, if Adelina's recipe uses 2 cups of lemon juice and 1 cup of water, and Marcos's recipe uses 3 cups of lemon juice and 2 cups of water, whose lemonade tastes more "lemony"?). Children were first asked to solve the problems individually, and then they were presented with both correct (e.g., comparing ratios by computing the least common multiple) and incorrect (subtracting cups of water from cups of lemon juice for each recipe) solution strategies. Then, the children's procedural and conceptual knowledge was tested on

some novel problems, both immediately and 5 days later. Begolli et al. (2018) found that both verbal working memory and inhibition skills were related to both procedural and conceptual knowledge in the immediate and delayed post-tests. That is, children with higher working memory capacity and better inhibition skills benefitted more from being exposed to conceptual analogies than children with lower processing capacity.

As analogical reasoning depends strongly both on domain knowledge and cognitive resources, we can also expect that analogical transfer could be challenging for students with mathematics learning difficulties/dyscalculia. Montis (2000) provides some vivid examples of this challenge in her case study of Kay, a 12-year-old girl with dyscalculia. Although Kay was able to work with some physical models of fractions, including cards or rods, she struggled to link these to numerical representations of the same fractions. In fact, she also struggled to make connections with different physical representations of the same fraction. As I described above, Begolli et al. (2018) also provided evidence that opportunities to learn new solution strategies for mathematics problems using analogical transfer were more beneficial for students with higher verbal working memory and better inhibition skills. Nevertheless, this study did not include children with dyscalculia.

SUMMARY, IMPLICATIONS FOR INTERVENTION STRATEGIES, AND FUTURE DIRECTIONS

In this chapter, I first described the typical cognitive profile of individuals with dyscalculia. I have highlighted that, in addition to problems within the domain of processing magnitudes and numbers, individuals with dyscalculia also have impairments in verbal and visual-spatial working memory, memory for familiar ordinal sequences, and spatial attention. For this reason, we can expect that they might experience more general cognitive and learning problems outside the domain of numbers. Indeed, the updated diagnostic criteria of the DSM-5 for specific learning disorder in mathematics (or dyscalculia) no longer require a large discrepancy between mathematics skills and intelligence. Specific learning disorders in mathematics, reading, and written expression have also been included in a single diagnostic category, acknowledging that these difficulties often co-occur. It is also emphasized that comorbidity with other neurodevelopmental disorders is common. Overall, these changes reflect the understanding that students with dyscalculia might show deficits in a range of cognitive skills.

I have also presented a brief review of the literature on reasoning skills, focusing on logical reasoning (including conditional and transitive inferences and reasoning about categorical syllogisms), analogical reasoning, and using analogies to transfer knowledge across contexts, highlighting their relevance to various areas of mathematics. I have also argued that fractions, decimals, and percentages are inherently relational constructs, and I have highlighted why fractions might be particularly challenging to grasp, even though the three kinds of numbers can be used to represent the same value.

An important insight from this review is that different forms of reasoning rely on different cognitive processes. For example, transitive inferences are most closely linked to a “mental line” representation (such as a mental number line or mental time line of events), conditional reasoning relies on the processing of ordinal information,

and categorical syllogisms and analogies rely on verbal working memory processes. Although this was not the focus of this chapter, these reasoning processes also differ in their complexity and in the time course of their development. In particular, simple transitive and analogical inferences develop in childhood, whereas conditional reasoning remains difficult even for late adolescents. For these reasons, whereas impairments of various types of reasoning process might co-occur in the same person, it is likely that not all areas will be equally affected.

Currently, research into reasoning skills in individuals with dyscalculia is very limited. Thus, an important future direction could be to investigate relative strengths and weaknesses in reasoning skills in this group. Such research could be helpful for finding the most efficient ways to support dyscalculic students' understanding of complex concepts. Based on this review, it can be expected that problems with reasoning would be common in individuals with dyscalculia, and these impairments might also be profound. When we consider mathematical reasoning, these problems might be explained in part by content effects. Preexisting (incorrect) beliefs or intuitions and distractors can interfere with reasoning. Nevertheless, abstract, belief-neutral content can be even harder to process, especially for children.

Recommendations already exist for facilitating analogical reasoning in the classroom (e.g., Richland, Zur, & Holyoak, 2007; Vendetti et al., 2015). Analogical transfer can be facilitated by providing students with opportunities to compare newly learned and already familiar content; presenting source and target problems side by side; facilitating mapping between contexts through gesturing that highlights corresponding content across examples; pointing out both similarities and differences; and using relational language. Notably, there is accumulating evidence that comparisons between solution strategies for problems can facilitate learning in the classroom (e.g., Newton, Star, & Lynch, 2010; Rittle-Johnson & Star, 2007, 2011). Although comparison is essential for analogical reasoning, it is less demanding, as it does not require the simultaneous mapping of several relations between contents. Thus, it might be a more successful strategy in the case of students with mathematics difficulties, because it is less demanding of cognitive resources and, in particular, working memory. Another point to consider is that visual cues, such as gestures, placing corresponding content side by side, or using arrows, can also reduce working memory load (cf., Richland et al., 2007). Given that individuals with dyscalculia have spatial attention deficits, visual cues might be particularly beneficial.

Another potential way of reducing the processing demands of complex, relational concepts is to use manipulatives (i.e., concrete materials that students can manipulate and arrange in different ways to represent a range of mathematical relationships; Maccini & Gagnon, 2002). The concepts that can be represented/demonstrated in this way include place values, fractions, areas, perimeters, and various types of information included in word problems. These approaches typically follow a concrete–semi-concrete/representational–abstract sequence of instruction (see Bouck, Satsangi, & Park, 2018, for a recent overview). Initially, students use manipulatives, followed by representational drawings, and then abstract mathematical notations. This procedure is aimed at supporting the gradual development of conceptual understanding via analogical transfer across representational formats. The process starts with a high level of teacher support and gradually moves towards independent problem-solving. These approaches have been successfully used not only with typically developing children,

but also in the case of children with mathematics learning difficulties (e.g., Butler, Miller, Crehan, Babbitt, & Pierce, 2003; Miller & Kaffar, 2011; Witzel, 2005).

Given the close links between reasoning and mathematics skills, it is an interesting question whether training in certain types of inference (in particular, analogical reasoning and transitive inferences in the case of children, and conditional inferences in the case of adolescents) might support the development of mathematical concepts. This approach is in line with Nunes et al. (2007), who provided training for young children in simple logical rules and found that the training facilitated early mathematics learning. Whereas interventions for students with mathematics learning difficulties almost exclusively focus on training in mathematical concepts, this approach might be particularly relevant, given the increasing evidence that individuals with dyscalculia are characterized by more general cognitive deficits and they tend to struggle with reasoning, even in the case of problems without mathematics content.

In summary, understanding the role of reasoning skills in mathematics and the cognitive demands of various forms of reasoning can be very beneficial in educational contexts. Nevertheless, currently, the relevant literature, including both lab-based and classroom-based studies, is limited, and there are even fewer studies that include participants with mathematics difficulties. This chapter includes several predictions regarding the types of reasoning skill that could be affected by dyscalculia. Testing these hypotheses could help with understanding why some tasks might pose a particular challenge to these learners. Understanding the reasoning requirements of mathematics problems could also help in the development of more accessible instructional materials and practices.

NOTE

- 1 Note that, in this case, relational reasoning involved comparisons between (rather than within) fractions.

REFERENCES

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.
- Ashkenazi, S., Rubinsten, O., & Henik, A. (2009). Attention, automaticity, and developmental dyscalculia. *Neuropsychology*, 23, 535–540. doi:10.1037/a0015347
- Attout, L., & Majerus, S. (2014). Working memory deficits in developmental dyscalculia: The importance of serial order. *Child Neuropsychology*, 21, 432–450. doi:10.1080/09297049.2014.922170
- Attout, L., Noël, M. P., & Majerus, S. (2015). The relationship between working memory for serial order and numerical development: A longitudinal study. *Developmental Psychology*, 50, 1667–1679. doi:10.1037/a0036496
- Attout, L., Salmon, E., & Majerus, S. (2015). Working memory for serial order is dysfunctional in adults with a history of developmental dyscalculia: Evidence from behavioral and neuroimaging data. *Developmental Neuropsychology*, 40, 230–247. doi:10.1080/87565641.2015.1036993
- Attridge, N., & Inglis, M. (2013). Advanced mathematical study and the development of conditional reasoning skills. *Plos One*, 8, e69399. doi:10.1371/journal.pone.0069399
- Bassok, M. (2001). Semantic alignments in mathematical word problems. In D. Gentner, K. J. Holyoak, & B. Kokinov (Eds.), *The analogical mind: Perspectives from cognitive science* (pp. 401–433). Cambridge, MA: MIT Press.
- Begolli, K. N., Richland, L. E., Jaeggi, S. M., Lyons, E. M., Klostermann, E. C., & Matlen, B. J. (2018). Executive function in learning mathematics by comparison: Incorporating everyday classrooms into the science of learning. *Thinking & Reasoning*, 24, 280–313. doi:10.1080/13546783.2018.1429306

- Bisanz, J., & LeFevre, J. A. (1992). Understanding elementary mathematics. *Advances in Psychology*, 91, 113–136. doi:10.1016/S0166-4115(08)60885-7
- Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development*, 78, 647–663. doi:10.1111/j.1467-8624.2007.01019.x
- Bonato, M., Fabbri, S., Umiltà, C., & Zorzi, M. (2007). The mental representation of numerical fractions: Real or integer? *Journal of Experimental Psychology: Human Perception and Performance*, 33, 1410–1419. doi:10.1037/0096-1523.33.6.1410
- Booth, J. L., & Newton, K. J. (2012). Fractions: Could they really be the gatekeeper's doorman? *Contemporary Educational Psychology*, 37, 247–253. doi:10.1016/j.cedpsych.2012.07.001
- Bouck, E. C., Satsangi, R., & Park, J. (2018). The concrete–representational–abstract approach for students with learning disabilities: An evidence-based practice synthesis. *Remedial and Special Education*, 39, 211–228. doi:10.1177/0741932517721712
- Briars, D., & Siegler, R. S. (1984). A featural analysis of preschoolers' counting knowledge. *Developmental Psychology*, 20, 607–618. doi:10.1037/0012-1649.20.4.607
- Bull, R., & Scerif, G. (2001). Executive functioning as a predictor of children's mathematics ability: Inhibition, switching, and working memory. *Developmental Neuropsychology*, 19, 273–293. doi:10.1207/S15326942DN1903_3
- Butler, F. M., Miller, S. P., Crehan, K., Babbitt, B., & Pierce, T. (2003). Fraction instruction for students with mathematics disabilities: Comparing two teaching sequences. *Learning Disabilities Research & Practice*, 18, 99–111. doi:10.1111/1540-5826.00066
- Butterworth, B. (2005). Developmental dyscalculia. In J. I. D. Campbell (Ed.), *Handbook of mathematical cognition* (pp. 455–467). New York: Psychology Press.
- Cattell, R. B. (1971). *Abilities: Their structure, growth, and action*. Oxford: Houghton Mifflin.
- Cho, S., Holyoak, K. J., & Cannon, T. D. (2007). Analogical reasoning in working memory: Resources shared among relational integration, interference resolution, and maintenance. *Memory & Cognition*, 35, 1445–1455. doi:10.3758/BF03193614
- Crone, E. A., Wendelken, C., Van Leijenhorst, L., Honomichl, R. D., Christoff, K., & Bunge, S. A. (2009). Neurocognitive development of relational reasoning. *Developmental Science*, 12, 55–66. doi:10.1111/j.1467-7687.2008.00743.x
- De Smedt, B., & Gilmore, C. K. (2011). Defective number module or impaired access? Numerical magnitude processing in first graders with mathematical difficulties. *Journal of Experimental Child Psychology*, 108, 278–292. doi:10.1016/j.jecp.2010.09.003
- De Visscher, A., Szmalec, A., Van Der Linden, L., & Noël, M. P. (2015). Serial-order learning impairment and hypersensitivity-to-interference in dyscalculia. *Cognition*, 144, 38–48. doi:10.1016/j.cognition.2015.07.007
- Desoete, A., Roeyers, H., & De Clercq, A. (2004). Children with mathematics learning disabilities in Belgium. *Journal of Learning Disabilities*, 37, 50–61. doi:10.1177/00222194040370010601
- Devine, A., Soltész, F., Nobes, A., Goswami, U., & Szűcs, D. (2013). Gender differences in developmental dyscalculia depend on diagnostic criteria. *Learning and Instruction*, 27, 31–39. doi:10.1016/j.tine.2013.06.004
- Espy, K. A., McDiarmid, M. M., Cwik, M. F., Stalets, M. M., Hamby, A., & Senn, T. E. (2004). The contribution of executive functions to emergent mathematic skills in preschool children. *Developmental Neuropsychology*, 26, 465–486. doi:10.1207/s15326942dn2601_6
- Evans, J. S. B. (2007). *Hypothetical thinking: Dual processes in reasoning and judgement*. Hove, UK, and New York: Psychology Press.
- Geary, D. C. (2004). Mathematics and learning disabilities. *Journal of Learning Disabilities*, 37, 4–15. doi:10.1177/00222194040370010201
- Geary, D. C. (2011). Cognitive predictors of achievement growth in mathematics: A 5-year longitudinal study. *Developmental Psychology*, 47, 1539–1552. doi:10.1037/a0025510
- Goffin, C., & Ansari, D. (2016). Beyond magnitude: Judging ordinality of symbolic number is unrelated to magnitude comparison and independently relates to individual differences in arithmetic. *Cognition*, 150, 68–76. doi:10.1016/j.cognition.2016.01.018
- Goodwin, G. P., & Johnson-Laird, P. N. (2005). Reasoning about relations. *Psychological Review*, 112, 468–493. doi:10.1037/0033-295X.112.2.468
- Goodwin, G. P., & Johnson-Laird, P. N. (2008). Transitive and pseudo-transitive inferences. *Cognition*, 108, 320–352.

- Gray, M. E., DeWolf, M., Bassok, M., & Holyoak, K. J. (2018). Dissociation between magnitude comparison and relation identification across different formats for rational numbers. *Thinking & Reasoning*, 24, 179–197. doi:10.1080/13546783.2017.1367327
- Green, C. T., Bunge, S. A., Chiongbian, V. B., Barrow, M., & Ferrer, E. (2017). Fluid reasoning predicts future mathematical performance among children and adolescents. *Journal of Experimental Child Psychology*, 157, 125–143. doi:10.1016/j.jecp.2016.12.005
- Gross-Tsur, V., Manor, O., & Shalev, R. S. (1993). Developmental dyscalculia, gender and the brain. *Archives of Disease in Childhood*, 68, 510–512. doi:10.1136/adsc.68.4.510
- Halberda, J., Mazocco, M. M., & Feigenson, L. (2008). Individual differences in non-verbal number acuity correlate with maths achievement. *Nature*, 455, 665–668. doi:10.1038/nature07246
- Halford, G. S., Wilson, W. H., & Phillips, S. (1998). Processing capacity defined by relational complexity: Implications for comparative, developmental, and cognitive psychology. *Behavioral and Brain Sciences*, 21, 803–831. doi:10.1017/S0140525X98001769
- Handley, S. J., Capon, A., Beveridge, M., Dennis, I., & Evans, J. S. B. (2004). Working memory, inhibitory control and the development of children's reasoning. *Thinking & Reasoning*, 10, 175–195. doi:10.1080/13546780442000051
- Hannula, M. M., Lepola, J., & Lehtinen, E. (2010). Spontaneous focusing on numerosity as a domain-specific predictor of arithmetical skills. *Journal of Experimental Child Psychology*, 107, 394–406. doi:10.1016/j.jecp.2010.06.004
- Hein, J., Bzufka, M., & Neumärker, K. (2000). The specific disorder of arithmetic skills. Prevalence studies in a rural and an urban population sample and their clinico-neuropsychological validation. *European Child & Adolescent Psychiatry*, 9, S87–S101. doi:10.1007/s007870070012
- Hiebert, J., & Wearne, D. (1996). Instruction, understanding, and skill in multidigit addition and subtraction. *Cognition and Instruction*, 14, 251–283. doi:10.1207/s1532690xc1403_1
- Hitch, G. J., & McAuley, E. (1991). Working memory in children with specific arithmetical learning difficulties. *British Journal of Psychology*, 82, 375–386. doi:10.1111/j.2044-8295.1991.tb02406.x
- Inglis, M., & Simpson, A. (2009). Conditional inference and advanced mathematical study: Further evidence. *Educational Studies in Mathematics*, 72, 185–198. doi:10.1007/s10649-009-9187-z
- Inglis, M. J., & Simpson, A. (2008). Conditional inference and advanced mathematical study. *Educational Studies in Mathematics*, 67, 187–204. doi:10.1007/S10649-007-9098-9
- Iuculano, T., Tang, J., Hall, C. W., & Butterworth, B. (2008). Core information processing deficits in developmental dyscalculia and low numeracy. *Developmental Science*, 11, 669–680. doi:10.1111/j.1467-7687.2008.00716.x
- Johnson-Laird, P. N. (1999). Deductive reasoning. *Annual Review of Psychology*, 50, 109–135. doi:10.1146/annurev.psych.50.1.109
- Kaufmann, L., Mazzocco, M. M., Dowker, A., von Aster, M., Goebel, S., Grabner, R., ... Rubinsten, O. (2013). Dyscalculia from a developmental and differential perspective. *Frontiers in Psychology*, 4, 516. doi:10.3389/fpsyg.2013.00516
- Kaufmann, L., Vogel, S. E., Starke, M., Kremser, C., & Schocke, M. (2009). Numerical and non-numerical ordinality processing in children with and without developmental dyscalculia: Evidence from fMRI. *Cognitive Development*, 24, 486–494. doi:10.1016/j.cogdev.2009.09.001
- Kaufmann, L., & von Aster, M. (2012). The diagnosis and management of dyscalculia. *Deutsches Ärzteblatt International*, 109, 767–778. doi:10.3238/arztebl.2012.0767
- Koumoula, A., Tsiromi, V., Stamouli, V., Bardani, I., Siapati, S., Graham, A., ... von Aster, M. (2004). An epidemiological study of number processing and mental calculation in Greek school children. *Journal of Learning Disabilities*, 37, 377e388. doi:10.1177/00222194040370050201
- Landerl, K., Bevan, A., & Butterworth, B. (2004). Developmental dyscalculia and basic numerical capacities: A study of 8–9-year-old students. *Cognition*, 93, 99–125. doi:10.1016/j.cognition.2003.11.004
- Lewis, C., Hitch, G. J., & Walker, P. (1994). The prevalence of specific arithmetic difficulties and specific reading difficulties in 9- to 10-year old boys and girls. *Journal of Child Psychology and Psychiatry*, 35, 283–292. doi:10.1111/j.1469-7610.1994.tb01162.x
- Lyons, I. M., & Ansari, D. (2015). Numerical order processing in children: From reversing the distance-effect to predicting arithmetic. *Mind, Brain, and Education*, 207–221. doi:10.1111/mbe.12094
- Lyons, I. M., & Beilock, S. L. (2011). Numerical ordering ability mediates the relation between number-sense and arithmetic competence. *Cognition*, 121, 256–261. doi:10.1016/j.cognition.2011.07.009
- Lyons, I. M., Price, G. R., Vaessen, A., Blomert, L., & Ansari, D. (2014). Numerical predictors of arithmetic success in grades 1–6. *Developmental Science*, 17, 714–726. doi:10.1111/desc.12152

- Lyons, I. M., Vogel, S. E., & Ansari, D. (2016). On the ordinality of numbers: A review of neural and behavioral studies. *Progress in Brain Research*, 227, 187–221. doi:10.1016/bs.pbr.2016.04.010
- Maccini, P., & Gagnon, J. C. (2002). Perceptions and application of NCTM standards by special and general education teachers. *Exceptional Children*, 68, 325–344. doi:10.2307/1511356
- Majerus, S., Poncelet, M., Greffe, C., & Van der Linden, M. (2006). Relations between vocabulary development and verbal short-term memory: The relative importance of short-term memory for serial order and item information. *Journal of Experimental Child Psychology*, 93, 95–119. doi:10.1016/j.jecp.2005.07.005
- Mammarella, I. C., Hill, F., Devine, A., Caviola, S., & Szűcs, D. (2015). Math anxiety and developmental dyscalculia: A study on working memory processes. *Journal of Clinical and Experimental Neuropsychology*, 37, 878–887. doi:10.1080/13803395.2015.1066759
- Markovits, H., & Lortie-Forgues, H. (2011). Conditional reasoning with false premises facilitates the transition between familiar and abstract reasoning. *Child Development*, 82, 646–660. doi:10.1111/j.1467-8624.2010.01526.x
- Mazzocco, M. M., & Devlin, K. T. (2008). Parts and 'holes': Gaps in rational number sense among children with vs. without mathematical learning disabilities. *Developmental Science*, 11, 681–691. doi:10.1111/j.1467-7687.2008.00717.x
- Mazzocco, M. M., Myers, G. F., Lewis, K. E., Hanich, L. B., & Murphy, M. M. (2013). Limited knowledge of fraction representations differentiates middle school students with mathematics learning disability (dyscalculia) versus low mathematics achievement. *Journal of Experimental Child Psychology*, 115, 371–387. doi:10.1016/j.jecp.2013.01.005
- Mazzocco, M. M. M., & Myers, G. F. (2003). Complexities in identifying and defining mathematics learning disability in the primary school-age years. *Annals of Dyslexia*, 53, 218–253. doi:10.1007/s11881-003-0011-7
- Miller Singley, A. T., & Bunge, S. A. (2018). Eye gaze patterns reveal how we reason about fractions. *Thinking & Reasoning*. doi:10.1080/13546783.2017.1417909
- Miller, S. P., & Kaffar, B. J. (2011). Developing addition with regrouping competence among second grade students with mathematics difficulties. *Investigations in Mathematics Learning*, 4, 24–49. doi:10.1080/24727466.2011.11790308
- Montis, K. K. (2000). Language development and concept flexibility in dyscalculia: A case study. *Journal for Research in Mathematics Education*, 31, 541–556. doi:10.2307/749886
- Morrison, R. G. (2005). Thinking in working memory. In K. J. Holyoak & R. G. Morrison (Eds.), *Cambridge handbook of thinking and reasoning* (pp. 457–473). Cambridge: Cambridge University Press.
- Morsanyi, K., Devine, A., Nobes, A., & Szűcs, D. (2013). The link between logic, mathematics and imagination. Evidence from children with developmental dyscalculia and mathematically gifted children. *Developmental Science*, 16, 542–553. doi:10.1111/desc.12048
- Morsanyi, K., Kahl, T., & Rooney, R. (2017). The link between math and logic in adolescence: The effect of argument form. In M. E. Toplak & J. Weller (Eds.), *Individual differences in judgment and decision making from a developmental context* (pp. 166–185). Hove, UK: Psychology Press. doi:10.4324/9781315636535
- Morsanyi, K., McCormack, T., & O'Mahony, E. (2018). The link between deductive reasoning and mathematics. *Thinking & Reasoning*, 24, 234–257. doi:10.1080/13546783.2017.1384760.
- Morsanyi, K., O'Mahony, E., & McCormack, T. (2017). Number comparison and number ordering as predictors of arithmetic performance in adults: Exploring the link between the two skills, and investigating the question of domain-specificity. *The Quarterly Journal of Experimental Psychology*, 70, 2497–2517. doi:10.1080/17470218.2016.1246577
- Morsanyi, K., van Bers, B. M. C. W., McCormack, T., & McGourty, J. (2018). The prevalence of specific learning disorder in mathematics and comorbidity with other developmental disorders in primary school age children. DOI: 10.1111/bjop.12322.
- Morsanyi, K., van Bers, B. M. C. W., O'Connor, P. A., & McCormack, T. (2018). Developmental dyscalculia is characterised by order processing deficits: Evidence from numerical and non-numerical ordering tasks. *Developmental Neuropsychology*, 43(7), doi:10.1080/87565641.2018.1502294
- Moshman, D. (1990). Rationality as a goal of education. *Educational Psychology Review*, 2, 335–364.
- Moyer, R. S., & Landauer, T. K. (1967). Time required for judgements of numerical inequality. *Nature*, 215, 1519–1520. doi:10.1038/2151519a0
- Newton, K. J., Star, J. R., & Lynch, K. (2010). Understanding the development of flexibility in struggling algebra students. *Mathematical Thinking and Learning*, 12, 282–305. doi:10.1080/10986065.2010.482150
- Ni, Y., & Zhou, Y. D. (2005). Teaching and learning fraction and rational numbers: The origins and implications of whole number bias. *Educational Psychologist*, 40, 27–52. doi:10.1207/s15326985ep4001_3

- Novick, L. R., & Holyoak, K. J. (1991). Mathematical problem solving by analogy. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 17, 398–415. doi:10.1037/0278-7393.17.3.398
- Nunes, T., Bryant, P., Evans, D., Bell, D., Gardner, S., Gardner, A., & Carraher, J. (2007). The contribution of logical reasoning to the learning of mathematics in primary school. *British Journal of Developmental Psychology*, 25, 147–166. doi:10.1348/026151006X153127
- O'Connor, P. A., Morsanyi, K., & McCormack, T. (2018). Young children's non-numerical ordering ability at the start of formal education longitudinally predicts their symbolic number skills and academic achievement in math. *Developmental Science*. doi:10.1111/desc.12645
- Passolunghi, M. C., & Siegel, L. S. (2001). Short-term memory, working memory, and inhibitory control in children with difficulties in arithmetic problem solving. *Journal of Experimental Child Psychology*, 80, 44–57. doi:10.1006/jecp.2000.2626
- Passolunghi, M. C., & Siegel, L. S. (2004). Working memory and access to numerical information in children with disability in mathematics. *Journal of Experimental Child Psychology*, 88, 348–367. doi:10.1016/j.jecp.2004.04.002
- Piazza, M., Facoetti, A., Trussardi, A. N., Berteletti, I., Conte, S., Lucangeli, D., ... Zorzi, M. (2010). Developmental trajectory of number acuity reveals a severe impairment in developmental dyscalculia. *Cognition*, 116, 33–41. doi:10.1016/j.cognition.2010.03.012
- Prado, J., Chadha, A., & Booth, J. R. (2011). The brain network for deductive reasoning: A quantitative meta-analysis of 28 neuroimaging studies. *Journal of Cognitive Neuroscience*, 23, 3483–3497. doi:10.1162/jocn_a_00063
- Prado, J., Van Der Henst, J. B., & Noveck, I. A. (2008). Spatial associations in relational reasoning: Evidence for a SNARC-like effect. *Quarterly Journal of Experimental Psychology*, 61, 1143–1150. doi:10.1080/17470210801954777
- Restle, F. (1970). Speed of adding and comparing numbers. *Journal of Experimental Psychology*, 83, 274–278. doi:10.1037/h0028573
- Richland, L. E., Morrison, R. G., & Holyoak, K. J. (2006). Children's development of analogical reasoning: Insights from scene analogy problems. *Journal of Experimental Child Psychology*, 94, 249–273. doi:10.1016/j.jecp.2006.02.002
- Richland, L. E., Zur, O., & Holyoak, K. J. (2007). Cognitive supports for analogies in the mathematics classroom. *Science*, 316, 1128–1129. doi:10.1126/science.1142103
- Rittle-Johnson, B., Siegler, R. S., & Alibali, M. W. (2001). Developing conceptual understanding and procedural skill in mathematics: An iterative process. *Journal of Educational Psychology*, 93, 346–362. doi:10.1037/0022-0663.93.2.346
- Rittle-Johnson, B., & Star, J. R. (2007). Does comparing solution methods facilitate conceptual and procedural knowledge? An experimental study on learning to solve equations. *Journal of Educational Psychology*, 99, 561–574. doi:10.1037/0022-0663.99.3.561
- Rittle-Johnson, B., & Star, J. R. (2011). The power of comparison in learning and instruction: Learning outcomes supported by different types of comparisons. In J. P. Mestre & B. H. Ross (Eds.), *Psychology of learning and motivation* (pp. 199–225). Oxford: Academic Press.
- Rousselle, L., & Noël, M. P. (2007). Basic numerical skills in children with mathematics learning disabilities: A comparison of symbolic vs non-symbolic number magnitude processing. *Cognition*, 102, 361–395. doi:10.1016/j.cognition.2006.01.005
- Rubinsten, O., & Henik, A. (2009). Developmental dyscalculia: Heterogeneity might not mean different mechanisms. *Trends in Cognitive Sciences*, 13, 92–99. doi:10.1016/j.tics.2008.11.002
- Rubinsten, O., & Sury, D. (2011). Processing ordinality and quantity: The case of developmental dyscalculia. *PLoS ONE*, 6, e24079. doi:10.1371/journal.pone.0024079
- Rumelhart, D. E., & Norman, D. A. (1981). Analogical processes in learning. In J. R. Anderson (Ed.), *Cognitive skills and their acquisition* (pp. 335–359). Hillsdale, NJ: Erlbaum.
- Sak, U. (2008). Test of the three-mathematical minds (M3) for the identification of mathematically gifted students. *Roeper Review*, 31, 53–67. doi:10.1080/02783190802527372
- Sasanguie, D., Lyons, I. M., De Smedt, B., & Reynvoet, B. (2017). Unpacking symbolic number comparison and its relation with arithmetic in adults. *Cognition*, 165, 26–38. doi:10.1016/j.cognition.2017.04.007
- Sasanguie, D., & Vos, H. (2018). About why there is a shift from cardinal to ordinal processing in the association with arithmetic between first and second grade. *Developmental Science*. doi:10.1111/desc.12653
- Schwartz, F., Epinat-Duclos, J., Léone, J., Poisson, A., & Prado, J. (2018). Impaired neural processing of transitive relations in children with math learning difficulty. *NeuroImage: Clinical*, 20, 1255–1265. doi:10.1016/j.nicl.2018.10.020

- Skagerlund, K., & Träff, U. (2014). Development of magnitude processing in children with developmental dyscalculia: Space, time, and number. *Frontiers in Psychology*, 5, 675. doi:10.3389/fpsyg.2014.00675
- Swanson, H. L. (2011). Working memory, attention, and mathematical problem solving: A longitudinal study of elementary school children. *Journal of Educational Psychology*, 103, 821–837. doi:10.1037/a0025114
- Szűcs, D., Devine, A., Soltész, F., Nobes, A., & Gabriel, F. (2013). Developmental dyscalculia is related to visuo-spatial memory and inhibition impairment. *Cortex*, 49, 2674–2688. doi:10.1016/j.cortex.2013.06.007
- van Dijck, J. P., Abrahamse, E. L., Majerus, S., & Fias, W. (2013). Spatial attention interacts with serial-order retrieval from verbal working memory. *Psychological Science*, 24, 1854–1859. doi:10.1177/0956797613479610
- Van Dooren, W., De Bock, D., Depaepe, F., Janssens, D., & Verschaffel, L. (2003). The illusion of linearity: Expanding the evidence towards probabilistic reasoning. *Educational Studies in Mathematics*, 53, 113–138. doi:10.1023/A:1025516816886
- Vandierendonck, A., & De Vooght, G. (1997). Working memory constraints on linear reasoning with spatial and temporal contents. *The Quarterly Journal of Experimental Psychology Section A*, 50, 803–820. doi:10.1080/027249897391892
- Vendetti, M. S., Matlen, B. J., Richland, L. E., & Bunge, S. A. (2015). Analogical reasoning in the classroom: Insights from cognitive science. *Mind, Brain, and Education*, 9, 100–106. doi:10.1111/mbe.12080
- Vogel, S. E., Remark, A., & Ansari, D. (2015). Differential processing of symbolic numerical magnitude and order in first-grade children. *Journal of Experimental Child Psychology*, 129, 26–39. doi:10.1016/j.jecp.2014.07.010
- von Aster, M. G., & Shalev, R. S. (2007). Number development and developmental dyscalculia. *Developmental Medicine and Child Neurology*, 49, 868–873. doi:10.1111/j.1469-8749.2007.00868.x
- Vos, H., Sasanguie, D., Gevers, W., & Reynvoet, B. (2017). The role of general and number-specific order processing in adults' arithmetic performance. *Journal of Cognitive Psychology*, 29, 469–482. doi:10.1080/20445911.2017.1282490
- Waltz, J. A., Knowlton, B. J., Holyoak, K. J., Boone, K. B., Mishkin, F. S., de Menezes Santos, M., ... Miller, B. L. (1999). A system for relational reasoning in human prefrontal cortex. *Psychological Science*, 10, 119–125. doi:10.1111/1467-9280.00118
- Waltz, J. A., Lau, A., Grewal, S. K., & Holyoak, K. J. (2000). The role of working memory in analogical mapping. *Memory & Cognition*, 28, 1205–1212. doi:10.3758/BF03211821
- Witzel, B. S. (2005). Using CRA to teach algebra to students with math difficulties in inclusive settings. *Learning Disabilities: A Contemporary Journal*, 3, 49–60.
- Wong, T. T. Y. (2018). Is conditional reasoning related to mathematical problem solving? *Developmental Science*. doi:10.1111/desc.12644

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INTERPERSONAL RELATIONSHIPS AND STUDENTS WITH AUTISM SPECTRUM DISORDER

Perspectives from Theory of Mind and Neuroscience

Robyn M. Gillies

Children and adolescents with autism spectrum disorder (ASD) are well known to have difficulties communicating at an interpersonal level with others. In schools, this can present a challenge for teachers where learning is very dependent on the relationships they can build with students and students can build with each other. The difficulties these children and adolescents encounter include recognizing social cues such as those derived from eye contact, gestures, smiles, and similar ways of communicating nonverbally, as well as those obtained from interacting verbally with others such as being able to engage in reciprocal interactions, understanding others' perspectives, and recognizing others' emotional states. Other difficulties that have been well documented include restrictive and repetitive patterns of behavior, fixated interests, and difficulties adjusting to changes in routines. These patterns of behavior are characteristic of children with ASD, a neurodevelopmental disorder that emerges in early childhood and can have varying effects on how children function in their environment (DSM-5; American Psychiatric Association, 2013). The term "spectrum" is used because the way in which this disorder is manifested depends on the severity of the autistic condition, the child's developmental level, and the child's chronological age.

The current definition of ASD includes disorders previously referred to as "early infantile autism, childhood autism, Kanner's autism, high-functioning autism, pervasive developmental disorder not otherwise specified, childhood disintegrative disorder, and Asperger's disorder" (DSM-5, 299.00 [F84.0], American Psychiatric Association, 2013). The severity of the condition is based upon impairments in social communication and restrictive and repetitive patterns of behavior, with the level of severity ranging from Level 1 (requiring support) through to Level 3 (requiring very substantial support). An individual requiring Level 1 support for social communication would demonstrate difficulties engaging in reciprocal conversations and making

friends, whereas Level 3 support would be characterized by an individual having severe deficits in verbal and nonverbal communication skills, making it difficult for this individual to be able to communicate basic needs and wants. Similarly, Level 1 support for restrictive and repetitive behaviors would include difficulties transitioning from one activity to another and problems with organizing and planning, whereas Level 3 would be characterized by extreme difficulty or distress in coping with change to routines (DSM-5, 299.00 [F84.0], American Psychiatric Association, 2013).

The four core diagnostic features of ASD include: (a) persistent impairment in social communication and social interaction (b) and restrictive, repetitive patterns of behavior, interests, or activities, with (c) these features emerging early in the child's development and (d) noticeable by the limits or impairments in everyday functioning (DSM-5, 299.00, American Psychiatric Association, 2013). Although these diagnostic features appear to be quite straightforward, the manifestations are often dependent on the age of the individual, cognitive ability, and language ability. For example, individuals with impairments in social communication and interaction often have significant language deficits that affect their abilities to communicate with others, comprehend speech, and engage in reciprocal interactions where they learn to share thoughts and feelings. Other impairments include difficulties in developing, maintaining, and understanding relationships that are judged against norms for age, gender, and culture. These impairments are often evident in young children with ASD who do not engage in shared social play or imaginary or pretend play.

The impairment of social imagination, Wing, Gould, and Gillberg (2011) argue, is a feature that should also be included, because individuals with ASD often exhibit a "decreased capacity to think about and predict the consequences of one's own actions for oneself and for other people" (p. 769). In fact, Wing, Gould, and Gillberg maintain that it is this lack or impairment of social instinct, present from early in the child's development, that essentially underpins all autistic conditions and should be considered as a core diagnostic feature rather than the current one of repetitive behavior patterns.

NEUROSCIENTIFIC PERSPECTIVES

The Wing et al. (2011) view (and others like it), however, is contentious, because ASDs are a heterogeneous group of neurodevelopmental disorders underpinned by a complex interaction of genetic and environmental factors (Donovan & Basson, 2017; Pua, Bowden, & Seal, 2017). In fact, Ecker (2017) proposes that recent developments in neurobiology reveal that a combination of specific cognitive skills underlies the social instinct in individuals with ASD. For example,

many of the neural structures that have been reported as atypical in ASD overlap with the set of brain-regions that are integral to the so called "social" and "emotional" brain which encompasses a set of brain regions involved in wider aspects of social cognition and emotional processing.

(p. 21)

Certainly, there is agreement that ASD is a complex neurodevelopmental disorder with differences in brain anatomy and brain connectivity, making it difficult to investigate and characterize the neurobiological underpinnings of this disorder (Donovan

& Basson, 2017; Ecker et al., 2010), with Pua et al. (2017) arguing that, “the search for definitive neuroimaging markers remains obscured by inconsistent or incomplete findings” (p. 28). However, Donovan and Basson note that there are well-validated studies that do report on the neuroanatomical differences between normal and abnormal brain development in children with ASD. For example, it is well established that the amygdala, a group of nuclei in the anterior medial temporal lobe, plays an important role in emotional processing, including fear, pleasure, and aggression, facial and emotional recognition, enhancement of memory for emotionally significant events, and prediction of reward values (Schumann & Amaral, 2006).

In a follow-up study, Schumann, Barnes, Lord, and Courchesne (2009) measured the amygdala volumes on magnetic resonance imaging scans of 89 toddlers at 1–5 years of age and found that those children who later received a confirmed autism diagnosis (32 boys and 9 girls) had a significantly larger right and left amygdala compared with typically developing children of the same age. Furthermore, the authors found that amygdala size in children with ASD correlated with the severity of their social and communication impairments as measured on the Autism Diagnostic Interview and the Vineland Scale.

Similar results were obtained by Mosconi et al. (2009) who used magnetic imaging to examine the amygdala volume of 55 autistic children and 33 control children between 18 and 35 months (2 years) of age, followed up at 42–59 months (4 years) of age; they found that amygdala enlargement was observed in children with autism at both 2 and 4 years of age. The authors concluded that amygdala volume was associated with joint attention ability such that children with autism reflected diminished social orienting behavior and reduced tendency to coordinate eye contact. When this occurs, children with ASD engage in fewer social experiences leading to a cascade of developmental effects such as disrupted cognitive, communication, and social growth opportunities.

In a meta-analysis of 24 data sets comprising 496 participants with ASD, Via, Radua, Cardoner, Happe, and Mataix-Cols (2011) found that there were no differences in overall gray matter volume between participants with ASD and healthy controls. However, participants with ASD were found to have robust decreases in gray matter volume in the bilateral amygdala-hippocampus complex (a region of the brain involved in the interaction of emotion and memory; Phelps, 2004; Smith, Stephan, Rugg, & Dolan, 2006) and in the medial parietal regions (a region of the brain involved in integration of information, episodic memory, and mental imagery strategies), which are implicated in the mirror-neuron system believed to underlie empathy and social insight. Via et al. concluded that the results of this meta-analysis confirm the crucial involvement of structures linked to social cognition in ASD.

In a review of more recent developments in brain imaging research, Buckner, Andrews-Hanna, and Schacter (2008) have pointed to a default network within the brain that is cognitively involved when individuals are focused on internal tasks rather than external ones. Such internal tasks would include the retrieval of personal memory experiences, picturing the future, and trying to understand others’ perspectives. Although research on the default network is still in an early stage, Buckner et al. suggest that it is best understood as a series of multiple interacting subsystems that are hypothesized to involve anatomically connected and interacting areas of the brain. Two interacting subsystems that Buckner et al. highlight involve the medial

temporal subsystem, which stores previous memories and associations that are the building blocks of mental simulations, and the medial prefrontal system, which enables the flexible use of this information during the production of personally relevant mental simulations. In individuals with ASD, Buckner et al. propose that there may be a developmental disruption in the default network that may lead to individuals with ASD having a mind that is “environmentally focused” (p. 26) but absent to the thoughts of others, contributing to difficulties interacting with others in social situations. Buckner et al. also note that the amygdala is known to contribute to social cognition and interacts within regions in the default network as well, further confounding the difficulties children with ASD may have in processing socially relevant information. Caution, though, must be exercised when drawing conclusions about the default network being disrupted in children with ASD, as Buckner et al. note such disruptions are only hypothesized and have not yet been identified.

In summary, recent research (Ecker, 2017; Donovan & Basson, 2017; Schumann et al., 2009; Via et al., 2011)) highlights the key role the amygdala plays in emotional processing, including facial and emotional recognition and memory enhancement for emotionally significant events. Children with ASD have been shown to have an enlarged amygdala volume, which has been associated with attention difficulties reflecting diminished social orienting behavior and reduced eye contact with others, often leading to fewer social experiences that affect cognitive and communicative interactions and opportunities. These patterns of behavior emerge in early childhood and have been characterized as a lack of understanding of not only one’s mind, but also the minds of others, or what is commonly referred to as a theory of mind (ToM; for a related discussion see Byrnes & Eaton, Chapter 27, this volume).

PSYCHO-THEORETICAL PERSPECTIVES: THEORY OF MIND

Difficulties in understanding one’s own mind and others’ minds represent an underlying cognitive characteristic of individuals with ASD. The term theory of mind was first coined by Premack and Woodruff (1978) in a study in which they investigated whether chimpanzees are able to attribute mental states to themselves and others—states such as purpose or intentions, beliefs, knowledge, doubt, guessing, pretending, and so on. In this study, the authors showed an adult chimpanzee a series of videos of a human actor struggling with a variety of problems with which the chimpanzee would have been familiar. After each video, the chimpanzee was presented with a series of photos, with one presenting the solution to the problem. The authors argued that the chimpanzee’s consistent choice of the correct photo indicated that the animal recognized the videotape as representing a problem, understood the actor’s purpose in trying to resolve the problem, and chose photos compatible with that purpose.

Baron-Cohen, Leslie, and Frith (1985) were the first to test the notion of ToM in children with autism. Noting that children with autism exhibit a profound impairment in understanding and coping with the social environment, the authors set out to test the thesis that it is the difficulties that these children experience in being able to have a ToM or know and understand what others know, want, feel, or believe that are the distinguishing feature in children with autism. Moreover, the authors argued that it was not possible for children with autism to develop a ToM if they were unable

to form second-order representations such as engaging in pretend play. The ability to engage in pretend play emerges in the second year of childhood in normally developing children, and it is an early cognitive manifestation of the ability to understand mental states in others or to develop a ToM (Leslie, 1987).

Using a model of meta-representational development to predict a cognitive deficit that could help to explain a crucial component of the social impairment in children with autism, Baron-Cohen et al. (1985) compared the performances of three cohorts of children—high-functioning children with autism (mean age = 11.11 years) with an intelligence quotient (IQ) in the average and borderline range, a group of children with Down syndrome (mean age = 10.11 years) with an IQ in the average to moderate range, and a group of “normally” developing children (mean age = 4.5 years). Using Wimmer and Perner’s (1983) story paradigm in which a protagonist (puppet) puts an object in a specific location (x), but, while the protagonist is away, the object is moved to another location (y), with the targeted child required to predict where the puppet would look for the object on his/her return. As the transfer occurred when the puppet was away, the children had to assume that he/she would look in location x where he/she had placed it, rather than in location y , its current position. In predicting the correct answer, the children demonstrated that they were aware of different mental perspectives or different beliefs others may hold.

Using a similar false-belief scenario, Baron-Cohen et al. (1985) arranged for the children to be presented with two dolls (Sally and Anne) and to predict where Sally would look for a marble that she placed in a box before she left the room. After Sally left the room, the children watched as Anne transferred the marble to another location that was hidden from Sally. If the children pointed to the original location of the marble (rather than the new one), they passed the belief question by demonstrating that they now understood the doll’s false belief. In contrast, if they pointed to the marble’s current location, they demonstrated that they had failed to take into account the doll’s false belief. However, the conclusions were only warranted if the children could correctly answer two control questions: *Where is the marble really?* (reality question) and *Where was the marble in the beginning?* (memory question).

The results showed that all children completed the reality and memory questions correctly, and 86% of the children with Down syndrome and 85% of the normally developing children passed the belief question. However, in contrast, 80% of the children with autism failed the belief question on both trials, pointing to where the marble really was rather than where Sally, the doll, would look for it. Baron-Cohen et al. (1985) concluded that the failure shown by the children with autism constituted a specific deficit that cannot be attributed to general effects of intellectual level, as the more severely impaired Down syndrome children performed close to ceiling on the false-belief task. Rather, Baron-Cohen et al. argued that the study “demonstrated a cognitive deficit that is largely independent of general intellectual level and has the potential to explain both lack of pretend play and social impairment by virtue of a circumscribed cognitive failure” (p. 44). Because children with autism fail to attribute beliefs to others, they are at a distinct disadvantage when having to predict the behavior of other people. In a classroom setting, children are expected to be able to understand the behaviors of others and communicate their intentions based on their understandings of those behaviors.

In a review of ToM and autism, Baron-Cohen (2001) noted that, although difficulty in understanding others' minds is a core cognitive feature of individuals with autism, weak central coherence and executive dysfunction are also characteristic of autism spectrum conditions. In the former, individuals with autism are known to have difficulties integrating information from different contexts, but are superior at specific-detail perception. In the latter, individuals with autism have been shown to have difficulties on such tasks as regulating their behaviors and managing their attention. These difficulties manifest themselves in relation to understanding that different people can have different thoughts about the same situation (i.e., first-order belief tasks), recognizing mental state words (i.e., think, know, dream, hope, wish, imagine), using different mental state words in their spontaneous speech, and engaging in pretend play. Other first-order belief tasks that individuals with autism generally find difficult include understanding more complex causes of emotion, intentions, deception, metaphor, sarcasm, jokes, and irony, as well as humor and the pragmatics of language such as turn-taking and listening appropriately to a speaker. This is in spite of the fact that most normally developing children can pass these tasks at age 4 years. Interestingly, although some children with autism do eventually pass these first-order belief tasks when tested, Baron-Cohen reported that none were able to do it at the right mental age.

Failure to be able to understand and pass first-order false-belief tasks leads to delays in passing second-order false-belief tasks. Second-order belief tasks involve considering embedded mental states such as "what Dan thinks that Erin thinks." Whereas Baron-Cohen (2001) noted that most first-order false-belief tasks correspond to a mental age of 4 years, second-order false belief tasks correspond to a mental age of 6 years. Again, if some individuals with autism do manage to pass these second-order tasks, they do so in their teenage years or later, and not at the age of 6 years, when most normally developing children would be able to do so. In short, Baron-Cohen (2001) argues that individuals with autism do have mentalizing difficulties or difficulties in being able to understand how others may think, behave, or feel, which is very clearly different to normally developing individuals and individuals who may be intellectually impaired.

Given the difficulties children with ASD have with being able to attribute subjective mental states to themselves and others, Begeer et al. (2011) conducted a randomized controlled study to determine if a 16-week ToM training intervention in children (8–13 years) with ASD and normal IQs ($N = 40$) was effective in helping these children learn those ToM skills associated with understanding the thoughts and feelings of others, the use of imagination and humor, and the attribution of different mental states to others. The results showed that the children who participated in the intervention obtained significantly higher scores on their ability to reason about beliefs and false beliefs (first-order belief tasks) than the controls. However, no significant differences were recorded between the intervention and control conditions on the precursors to ToM skills such as perception and imitation, emotion recognition, pretense, and physical-reality distinction. Furthermore, the second-order skills such as reasoning and understanding humor remained unchanged. Follow-up information from the parents of the children involved in the intervention reported that their children's social skills did not improve, nor did their self-reported empathic skills. In short, Begeer et al. suggested that, despite the effects of the intervention on children's

ability to reason about beliefs and false beliefs, the study does not offer strong evidence for the effectiveness of a ToM intervention. The results led Begeer et al. to suggest that more sensitive measures of ToM skills may be needed to identify subtle changes in children's skills, rather than the broad categories of behavior currently tapped by many ToM measures. Additionally, because children with ASD have difficulties generalizing skills across settings, one solution the authors suggest may be to focus on those children with ASD who demonstrate better generalization skills or, alternatively, design specific programs that train children to generalize behaviors rather than focus on the development of conceptual understanding, currently the focus of many ToM training interventions.

In classroom situations where children with autism do experience difficulties understanding how others think, behave, or feel, the results of the Begeer et al. (2011) study have implications for how teachers plan and structure activities and experiences to enable these children to learn how to understand and communicate effectively with their peers. This topic will be discussed in depth in a later section on social skills training.

Integrating the Key Perspectives: Developments in the Neuroscience of Theory of Mind

Given the difficulties that children with autism generally have in being able to mentalize others' states, questions have been raised as to whether these difficulties can be attributed to domain-specific or domain-general mechanisms for reasoning about others' thoughts, intentions, and feelings, with studies in neuroscience emerging that are beginning to shed light on this dilemma.

In a review of a number of papers in a special issue of *Social Neuroscience* (2006), Saxe and Baron-Cohen (2006) highlight arguments proposed for both domain-specific and domain-general mechanisms. For example, in the case of domain-specific mechanisms, they argue that the clearest evidence has come from studies of children with autism who have consistently shown delays or deficits in passing false-belief tasks, which they believe is not a general meta-representational problem (i.e., an understanding of representational relationships between the representation and the referent) but a domain-specific one, as it relates to representing mental states or attitudes in others.

In arguing against a domain-specific mechanism, Stone and Gerrans (2006) maintain that the performance of children with autism on ToM tests can be explained more parsimoniously by the deficits they have, not in meta-representation, but in lower-level, domain-specific mechanisms for processing social information. They argue that, without the proper input from these lower-level mechanisms, such as difficulties with face recognition, facial expression, processing of gaze direction, and joint attention, children with autism will have ToM impairment. Furthermore, they suggest that meta-representation in autism is intact because individuals with autism generally demonstrate capacities for both meta-representation and recursion (i.e., reasoning about others' thoughts and thoughts about thoughts), but often experience difficulties with inferring what someone is feeling or processing social information. Stone and Gerrans further argue that there are two routes to deficits in ToM tasks, which can be explained by deficits either in low-level input (e.g., representations of gaze, joint

attention) or in higher-level, domain-general mechanisms such as executive function, meta-representation, and recursion.

Perner and Aichhorn (2006) also investigated domain-specificity by examining whether regions of the brain that are activated by false-belief stories but not by false-photo stories (i.e., representations of nonmental external objects) are specific to processing perspective differences of mental states (false beliefs, different visual perspectives) or whether they are also associated with processing perspective differences created by nonmental objects (e.g., false-direction signs). Using four different types of vignette that tested participants' responses to the false-belief task, the false-direction sign, the false photo, and a control task (change over time), MRI scans were conducted on 19 volunteers (19–34 years) to determine what regions of the brain were activated with the different tasks. The results showed that the right temporoparietal junction (TPJ-R) is specifically associated with processing mental states such as belief, whereas, in contrast, the left temporoparietal junction (TPJ-L) was responsive to visual perspectives such as those differences created by signs or signals.

Interestingly, although Saxe, Schulz, and Jiang (2006) found that the TPJ-R is associated with belief attribution, they also noted that belief attribution recruits brain regions associated with domain-general attention, response selection, and inhibitory control, suggesting that both domain-general and domain-specific cognitive resources are involved in the development of ToM in adults.

Others who have investigated regions of the brain that are activated during ToM tasks, particularly those involving explicit false-belief tasks, include Sabbagh, Bowman, Evraire, and Ito (2009), who collected baseline electroencephalogram (EEG) data from 29 4-year-old children while they completed batteries of representational theory-of-mind (RTM) tasks and executive functioning tasks (EFs). Results showed that individual differences in EEG alpha activity localized to the dorsal medial prefrontal cortex (dMPFC) and the TPJ-R and were positively associated with children's RTM performance. These results held and could not be accounted for by relations with children's age, or their relations with EF. Although Sabbagh et al. found other areas of the brain (e.g., cuneus, posterior inferior temporal lobe, and the precentral gyrus) were associated with RTM performance, their influence was mediated through their common associations with the dMPFC and the TPJ-R. These findings led the authors to suggest that functional maturation of the dMPFC and the TPJ-R may be critical neural correlates of preschoolers' explicit ToM development.

Others who have looked at developmental changes in regions of the brain associated with ToM include Saxe, Whitfield-Gabrieli, Scholz, and Pelphrey (2009) and Gweon, Dodell-Feder, Bedny, and Saxe (2012). In the first study, Saxe et al. scanned the brains of 13 normally developing children (aged 6–10 years) to gauge their responses to a series of short stories consisting of physical facts, characters' appearance and social relationships, and characters' mental states. The results showed that, although the children recruited the same ToM regions as adults for mental state content in comparison with the physical state stories, the response to the social state condition decreased significantly with age, whereas the response to the mental state content remained high (the response to the physical control stories remained low). The authors argued that, although ToM brain regions are involved in thinking about mental states in children at 6 years of age, the TPJ-R becomes more specialized for processing mental state content in later childhood.

In the second study, Gweon et al. (2012) used fMRI to investigate brain regions associated with ToM in children ($n = 20$; 5–11 years) and adults ($n = 8$) and found that, although the ToM network was actively engaged during ToM tasks in both adults and children, developmental changes were evident in these regions' functional profiles between children and adults and also within children. Gweon et al. found that ToM brain regions respond more selectively to mental state content with age, such that children (as a group) showed lower selectivity for mental state information than adults in the bilateral TPJ and PC, but not the MPFC. In short, both Saxe et al. (2009) and Gweon et al. (2012) found that regions of the brain associated with ToM respond more selectively to processing mental state content with age. Furthermore, they found that the extent to which the RTPJ responded more selectively to mental state content was correlated with behavioral performance on the ToM behavioral battery. Richardson and Saxe (2016) argue that these studies support the notion that there is conceptual change in ToM after 5 years of age, and that behavioral change is related to changes in selectivity within ToM brain regions. Moreover, these studies, Richardson and Saxe note, contribute to a better understanding of how and when children learn to understand the minds of others, and this is critically important if programs are to be developed and targeted to help them to understand how others may think, behave, or feel in different social contexts. At this point in time, these neuroimaging studies, Richardson and Saxe argue, are just beginning to provide unique understandings that are helping to inform developmental hypotheses of how children with autism begin to understand the minds of others, understandings that will be critically important for developing programs that will promote sociality and academic well-being.

SOCIAL SKILLS TRAINING FOR CHILDREN AND ADOLESCENTS WITH ASD

Given the difficulties that children and adolescents with ASD generally have in understanding the mental states of others, a number of social skills training programs have been developed to help these children and adolescents respond appropriately to others in small-group or classroom-based settings. Although the focus of these social skills training programs has been on helping children and adolescents communicate with others, respond appropriately to social situations, and cooperate to attain mutual goals during school-based activities, the effectiveness of these programs is equivocal, possibly because many published studies were qualitative reviews with a lack of a quantitative metric to evaluate the effect of treatment and generalizability.

One of the first studies to address these concerns was a meta-analysis of 55 single-subject design studies that evaluated the effectiveness of school-based social skills interventions for children and adolescents, conducted by Bellini, Peters, Benner, and Hopf (2007). Social skills were defined as interpersonal behaviors that students would be expected to demonstrate when interacting with their peers in classroom settings, social interaction such as social behavior, conversation, cooperation, social communication, social response, play, eye contact, and reciprocity. This meta-analysis also sought to identify participant, setting, and procedural features that led to the most effective intervention outcomes and to compare the intervention, maintenance, and generalization effects of the studies with outcomes of similar studies involving social skills interventions for children with ASD. The results showed that school-based

social skills interventions are minimally effective for children with ASD; social skills interventions produced low treatment effects and low generalization effects across participants, settings, and play stimuli. These results are similar to the Begeer et al. (2011) randomized controlled trial. Specifically, despite improvements children with ASD showed in their ability to reason about beliefs and false beliefs in comparison with controls, the ToM training did not improve skills that are regarded as forerunners to ToM (e.g., perceptions and imitation, emotion recognition) or their ability to reason and understand humor, social skills, or their empathic skills—skills that are critically important for being able to interact successfully with others.

Interestingly, Bellini et al. (2007) did find that students who participated in social skills programs in their classrooms were more likely to engage with the targeted skills and to use those skills in other settings. This led the authors to suggest that teachers should focus on selecting social skills interventions that can be implemented in naturalistic settings such as classrooms, rather than pull-out situations. Additional suggestions included ensuring that training is implemented more intensely and frequently, specifically targeting skill deficits, and systematic implementation of the program needs to ensure the strategies that are taught can be evaluated. Identifying those social skills programs with strong evidence-based practices that have consistently demonstrated positive outcomes for youth with ASD is the focus of a review by Otero, Schatz, Merrill, and Bellini (2015). In this review, social skills training refers to instruction that facilitates the performance or acquisition of social skills. It may include group or individual instruction to teach youth with ASD appropriate ways to interact with peers and adults. Typically, social skills are taught in small groups of five to eight participants, with a teacher or other adult facilitating the interaction. Skills that tend to be emphasized include basic conversational skills, nonverbal communication, emotional regulation, and skills needed to initiate, respond to, and maintain social interaction. Strategies identified as being used in social skills interventions included: (a) cognitive behavioral interventions (CBIs), (b) modelling, (c) naturalistic interventions, (d) pivotal response training (PRT), (e) self-management, (f) social narratives, and (g) technology-aided instruction and video-modelling. Furthermore, Otero et al. maintain that, as long as these interventions are administered with fidelity and match each child's skill level, the results can be positive, helping students with ASD to build appropriate social and interpersonal relationships with their peers in school and in community settings.

Evidence-Based Social Skills Interventions

In a review of programs that have consistently demonstrated positive outcomes for children and youth with ASD, Otero et al. (2015) identified the following social skills interventions that include strong evidence-based practice. These interventions are reviewed and discussed in the context of current developments in research.

Cognitive Behavior Interventions

CBI or cognitive behavioral therapy (CBT) emerged from the work of Albert Ellis on rational emotive behavior therapy; he proposed that individuals are born to think both rationally and irrationally (Corey, 2013), and that individuals need to learn how

to dispute or manage their irrational thinking if they are to reduce the emotional disturbance that these thoughts can create. CBI is used mainly with youth with ASD who experience irrational ideas or thinking associated with anxiety or fear, or who have difficulty controlling their anger or aggressive behavior. In CBI, individuals are taught to identify these irrational thoughts and associated feelings and to use strategies to express their behavior in more appropriate ways. Many of the strategies are similar to those used in behavioral therapy, except that individuals are taught how to control their thinking by identifying adverse situations and implementing plans or strategies to manage them, such as accurately describing how to respond to a social interaction with another student in a classroom. Such strategies may include self-instruction and behavioral rehearsal to monitor and manage behavior, which require individuals to have well-developed language skills.

In a literature review of 10 studies focused on youth with Asperger's syndrome and high-functioning autism, Cappadocia and Weiss (2011) compared three types of social skills training. These types included traditional social skills training groups (i.e., provide instruction and practice in social skills), social skills training groups with cognitive behavioral instruction, and social skills training with an additional parent component. They found all groups improved in their social skills from pre- to post-test as measured by a combination of observations of cooperative behaviors demonstrated with peers, self-reports by youth with ASD, and pre- and post-reports of social competence by parents or carers. An examination of the role of CBI indicated that it was difficult to identify specific strategies that were unique to the groups, as all groups used elements of CBI in their skills training. Furthermore, the authors proposed that it may have been the extensive period of intervention (i.e., length of time) or the intensity of the intervention (i.e., every day for 6 weeks) that also contributed to the consistent social skills improvements across these three groups.

Olsson, Rautio, Asztalos, Stoetzer, and Bolte (2016) reported on the perspectives of youth with ASD, aged 9–17 years, who participated in a social skills group training program called KONTAKT (delivered in psychiatric child and adolescent outpatient units in Sweden), which is based on the principles of CBT, observational learning, and behavioral activation. The program emphasized skills that underpin interpersonal relationships and communication with others, such as learning to initiate social overtures and conversational skills, understanding social rules and relationships, identifying and interpreting verbal and nonverbal social signals, and managing conflicts and coping strategies. The purpose of the study was to report on the experiences and opinions about social skills group training of high- and low-group responders, identified by their responses to the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005). Six high responders and five low- to non-responders to social group training and one parent for each child or adolescent were interviewed. Interestingly, there were few differences between the high and low responders, with both groups reporting that they were better at making contact/talking with others, reading emotions, thinking about the consequences, and engaging in more social situations as a consequence of the program (although high responders provided more details about the positive changes they had experienced). Parent responses of both high and low responders were similar to those of their children, with parents indicating they were satisfied with the purpose and structure of the sessions, the time involved, as well as the group size, which helped contribute to group cohesion and a good atmosphere.

Another empirically supported social skills program for youth with ASD is the Program for Education and Enrichment of Relational Skills (PEERS), developed at the UCLA Semel Institute for Neuroscience and Human Behavior (Laugeson & Park, 2014). PEERS utilizes the principles of CBT to teach the skills necessary for making and keeping friends and managing peer conflict and rejection, in both school and out-of-school settings. Instruction occurs in a variety of formats, from groups to individual one-on-one settings. In each context, an instructor teaches adolescent skills that foster awareness and evaluation of their thoughts, feelings, and behaviors, as well as the rules and steps involved in developing appropriate social responses to different situations. For example, through the CBT strategy of didactic instruction with specifically identified steps, adolescents are taught how to gain peer entry to a social situation by: (1) watching and listening, (2) identifying the topic under discussion, (3) waiting for a pause in the conversation, (4) moving closer, and (5) joining the discussion by saying something on the topic. Other CBT strategies that the instructor may utilize include Socratic questioning to challenge participants to consider alternative perspectives or ideas, social problem-solving, behavioral rehearsal, performance feedback with social coaching, homework assignments, and parent involvement in treatment to help consolidate skill development.

Laugeson, Ellingsen, Sanderson, Tucci, and Bates (2014) examined changes in social function for adolescents with high-functioning ASD following the implementation of a school-based, teacher-facilitated PEERS program. Seventy-three middle school students with ASD, along with their parents and teachers, participated in the study. Participants were assigned to the PEERS treatment condition or an alternative social skills curriculum. Results demonstrated that those adolescents who participated in the PEERS treatment condition significantly improved in social functioning in the areas of teacher-reported social responsiveness, social communication, social motivation, and social awareness, with a trend towards improved social cognition. The adolescents reported significant improvements in social skills knowledge and frequency of contact with their peers. Parent reports indicated a decrease in anxiety as measured on the Social Anxiety Scale. The authors suggested that the use of CBT techniques in teaching social skills to adolescents with ASD is effective and advisable.

The long-term effects of CBT on social impairment in adolescents with ASD were examined by Maddox, Miyazaki, and White (2017) during a randomized control trial and a 1-year follow-up for 25 adolescents (12–17 years) with ASD and anxiety (anxiety is a comorbid condition affecting approximately 40% of adolescents with ASD). Participants were randomly allocated to the treatment condition ($n = 13$) or the waitlist condition ($n = 12$). The treatment program involved 12–13 individual CBT sessions during which the participants worked with a therapist to explore how cognitions contribute to anxious feelings and avoidance behaviors and how these feelings and behaviors contribute to irrational or faulty thinking. Each session lasted about 1 hour, with parents joining at the end of each session for approximately 15 minutes. Parent participation was critical as they acted as coaches between sessions to help with the homework skills participants had committed to practice. Seven group sessions were also included, enabling the adolescents to discuss and practice such social skills as talking to peers, following a conversation, and entering a group. The results showed that social impairment as measured on the SRS (Constantino, & Gruber, 2005) had decreased during treatment and at the 3-month follow-up time point, although

it increased somewhat between the 3-month follow-up and the 1-year time points. However, compared with pretreatment scores on the SRS, scores were significantly lower at the 3-month and 1-year follow-up time points with large effect sizes, attesting to the effect of the intervention. White, Schry, Miyazaki, Ollendick, and Scahill (2015) also reported on a similar pattern of long-term reduction in anxiety for their sample of 22 adolescents (12–17 years) with ASD and one or more anxiety disorders, with participants demonstrating a reduction in anxiety during the year following treatment. In sum, Maddox, Miyazaki, and White noted that these findings on improvement in social skills add to the growing literature supporting CBT for adolescents with ASD and anxiety (for a related discussion, see Wigfield and Ponnock, Chapter 17, this volume).

Modelling

Modelling, which involves the demonstration of a skill, does not usually occur in isolation but is one of many skills incorporated in different social skills training programs where it is reinforced until eventually it is part of a repertoire of skills the learner has acquired. For example, modelling was used extensively in the PEERS program (Laugeson, Ellingsen, Sanderson, Tucci, & Bates, 2014), where adolescents received instruction on how to enter conversations, deal with electronic communication, develop friendship networks, use humor appropriately, manage teasing and bullying, resolve arguments with friends, and change reputations, including long-term strategies for altering bad reputations. These skills were modelled and practiced in situ and followed up with homework assignments, supervised by the parents.

Other forms of modelling include peer-mediated modelling and video-modelling, two of the most common forms of social skills training for children with ASD. In peer-mediated modelling, peers are usually normally developing children who are taught social skills interactions such as sharing, helping, prompting, instructing, or praising by the teacher before applying those skills when interacting with children with ASD, usually in natural classroom-based activities. On the other hand, video-modelling involves children with ASD watching a video to observe a particular behavior and then mimicking the social behavior in the video. Videos have the potential to engage children's interest and are regarded as a natural way for children to learn skills (video-modelling will be discussed in more depth in the section on Technology-Aided Instruction and Video-Modelling).

Wang, Cui, and Parrila (2011) reported on a meta-analysis of single-case research that examined the effectiveness of peer-mediated and video-modelling social skills interventions for children with ASD. The study used hierarchical linear modelling to examine the outcomes across multiple single-case studies, a clear advantage in being able to quantify the outcomes of single-case study research, which in the past has relied on visual analysis of the outcome graphs, a method that can be highly subjective. The focus for inclusion in the meta-analysis was (a) at least half or more of the participants were children with ASD, (b) the study provided a social skills intervention, and (c) the study used a single-case study design. Of the 14 studies included in the meta-analysis, 9 were identified that adopted a peer-mediated intervention, and 5 studies adopted a video-modelling intervention. The results showed that peer-mediated and video-monitoring interventions are equally effective in improving the

social behavior of children with ASD, although younger children tended to gain more from the intervention than older children. The results of this meta-analysis led the authors to recommend both approaches as evidence-based practices for social skills training for children with ASD.

Naturalistic Interventions

Naturalistic interventions refer to those social skills interventions that occur in the child's natural environment. Behavior therapy techniques are used to identify and capitalize on those routines that occur in the child's natural environment that may assist in reinforcing social interaction with others (Lane et al., 2016). For example, a teacher may help to validate a child's attempt to interact with others by publicly acknowledging the child's behavior with comments such as: "I really liked the way Tim came in, looked at Maria and said *hello*." Other situations may involve children working in small groups on a collaborative group project, participating in role-plays, or even arranging school desks so the subject child is seated close to socially skilled and friendly peers. Naturalistic interventions are not implemented as the sole strategy for helping children with ASD to interact socially with others. Rather, this approach is implemented in conjunction with such behavioral techniques as reinforcing and prompting to encourage social interaction and attention.

Success with any intervention, White (2014) argues, is dependent on the implementation of practices that promote social skills acquisition and improved skills performance by youth with ASD. These practices include: (a) structured activities so there is a high level of routine, (b) intensive training experience, (c) an atmosphere of acceptance and nurturing, (d) peer involvement, and (e) practice environments that resemble as closely as possible those in which the skills will be used.

Although working with peers is one of the most widely used methods to improve social skills in children and adolescents with ASD, Gates, Kang, and Lerner (2017) cautioned that the group social skills interventions examined in their meta-analysis ($n = 19$ studies) were only modestly effective with children and adolescents with ASD (age range = 5.3–20.42 years) in comparison with nontreatment or waitlist controls. Moreover, most of the change was attributed to self-reported changes by the participants in social knowledge rather than changes in their perceived social behavior. Parents also reported modest improvements in social competence relative to controls, whereas there were no significant differences in social competence between the intervention and control groups reported by the teachers. The authors suggested that the common approach to didactically teaching social skills in small group settings may not provide enough opportunities for participants to practice these skills in social situations to ensure more robust gains in the targeted skills across different contexts.

Pivotal Response Training

PRT is a naturalistic intervention strategy that is based on the principles of applied behavior analysis. This strategy uses the child's existing interests, routines, and settings to target the acquisition of specific skills by providing systematic reinforcement for every attempt that the child makes to produce the desired behavior (Otero et al., 2015). Wong et al. (2015), in a review of evidence-based practices that have been used

with children, youth, and young adults with ASD, identified PRT as an evidence-based practice that has been used successfully with students with ASD to respond appropriately to different social situations. PRT interventions can be implemented by researchers/clinicians, parents, teachers, and peers, and Otero et al. noted that generalizability of skills is enhanced when different implementers are involved in the target intervention.

Brock, Dueker, and Barczak (2017) tested the efficacy of practitioner-implemented, peer-mediated PRT with 11 elementary and middle school students with ASD, aged 8–12 years. Participants were randomly assigned to a treatment ($n = 5$) or control ($n = 6$) group. Adult facilitators (assigned to the treatment group) identified peers who could be used to help implement the intervention (e.g., students who had interacted positively with students with ASD in the past) and taught them strategies they would need to use to engage the attention of the student with ASD whom they had agreed to “buddy with.” These strategies included: (a) ensuring that their buddy looked at them, (b) inviting their buddy to play with them, (c) showing and explaining how to play, (d) praising their buddy, and (e) teaching their buddy to take turns when they play. The facilitator described and modelled each strategy so peers could practice them, with the facilitator providing constructive feedback. The intervention was implemented for 5 weeks during recess time. The results showed that the children in the treatment group engaged in significantly more total interactions with their peer buddies than students in the control group. There were also significantly more interactions from target students to their buddies and from buddies to their targeted students than from peers in the control group. Brock et al. suggested that these findings demonstrate that school staff can facilitate peer-implemented PRT that improves the social outcomes for students with ASD.

Others who have implemented PRT to increase opportunities for school-aged children with ASD to ask questions include Verschuur, Huskens, Verhoeven, and Didden (2017). In this study, the authors trained 14 staff members to implement PRT with children attending an in-patient treatment facility. All the staff, except one, had a bachelor’s degree and, on average, 5.8 years of experience working with children with ASD. No staff members had experience with PRT prior to this study. The children ranged in age from 7 to 13 years and were either receiving treatment for severe autism symptoms, psychiatric comorbidity, or maladaptive behaviors, or their parents were unable to cope with their behaviors at home. The study aimed to investigate (a) the effectiveness of PRT staff training, (b) the effectiveness of PRT in self-initiated questions by children with ASD, (c) the generalization of these skills to group situations, and (d) maintenance of these skills over time. The results showed that PRT resulted in significant increases in both staff member-created opportunities and child-initiated questions. However, generalization of creating opportunities to group situations was limited. Post-intervention and follow-up data indicated that most staff members maintained their skills over time. Furthermore, 8 of the 14 children initiated significantly more questions as a result of the intervention. However, only a minority of the children maintained these skills over time. Collateral changes in language, pragmatic and adaptive skills, and maladaptive behaviors did not occur, leading the authors to suggest that further research is necessary to investigate training procedures that promote generalized, consistent, and continuous implementation of PRT by staff across situations with a focus on fidelity of implementation.

Mrachko and Kaczmarek (2017) reviewed seven studies in which paraprofessionals were taught to implement social communication interventions for young children with ASD. The majority of the studies utilized a naturalistic behavioral intervention based on child choice, natural reinforcement, prompting, and responsiveness to the child. Two of the studies taught PRT, and two other studies taught the natural language paradigm, an intervention similar to PRT. All studies showed an improvement in paraprofessional behavior for implementing the social communication intervention with fidelity, with five reporting corresponding improvements in child outcomes. Four of the studies provided definitive evidence of the effectiveness of paraprofessional training, with feedback (in written, graphical, video, or verbal forms) being the only training component used across all studies in conjunction with one other component (e.g., fidelity of implementation). However, researchers training professionals on PRT demonstrated the most evidence of effectiveness of training and child outcomes. This led the authors to recommend that further research is needed on teaching paraprofessionals to facilitate child spontaneous communication using PRT and other naturalistic behavioral interventions.

Duifhuis et al. (2017) investigated the effects of PRT in comparison with treatment as usual (TAU) in children with ASDs (aged 3–8 years). Parents of the children in the PRT group ($n = 11$) participated in 20 PRT training sessions of 45 minutes duration each over a 5-month period. Each session was tailored to the individual child's needs and targeted skills such as developing social directedness (pointing, giving, sharing, grabbing the hand, joint attention), using one or two words to communicate, asking for help or an object, asking “who, what, where” questions, making comments, responding to multiple cues, and demonstrating self-management. The goal of PRT is to teach children to respond to the many learning opportunities and social interactions that occur in their natural environment and to increase their motivation to communicate. Parents of the children in the TAU group ($n = 13$) received psycho-education and parent mediation therapy ranging from low-frequency sessions with a psychologist to intensive parent training that involved home visits by the therapist, twice a week for 20 weeks. The results showed a significantly positive treatment effect for PRT on autism symptoms, with slight improvements in the PRT group on social directedness and social affect and a deterioration in the TAU group. The authors suggested that PRT challenges children to improve their communication skills rather than accepting them, whereas TAU is more specifically focused on teaching the social environment how to cope with children with ASD, perhaps leading to low-frequency reinforcement of targeted skills.

Self-Management

Self-management, Otero et al. (2015) maintain, refers to strategies used to teach children how to identify, record, and manage their behaviors across different settings. Rafferty (2010) identifies five types of self-management intervention as follows:

1. Self-monitoring—teaching students to observe their own behaviors and record whether or not they are engaging in the targeted behaviors;
2. Goal setting—instructing students how to set behavior targets or goals;
3. Self-evaluation—teaching students to assess their behaviors against a set of standards;

4. Self-instruction—teaching students how to use self-statements to direct their behavior;
5. Strategy instruction—teaching students a series of steps to follow to complete a task.

Self-management interventions can be used to help students manage a range of social and academic behaviors, although students are usually only taught to focus on one behavior at a time. For children with ASD who experience social communication problems, the focus may be on learning how to initiate an interaction with a peer, attend to a speaker who is talking, or seek help when it is needed.

A meta-analysis by Carr (2016) examined the effectiveness of self-management interventions in reducing challenging behaviors for children and youth with ASD. Twelve single-subject research design studies (27 participants, 4–18 years) that specifically targeted a reduction in challenging behaviors, as well as studies that focused on skill acquisition and described improvements in challenging behaviors as a collateral effect of the intervention, were included in the meta-analysis. The types of challenging behavior targeted in these studies included a decrease in inappropriate vocalizations, tantrums, and aggressive behavior, and an increase in social skills such as social initiation and interaction, and appropriate play behaviors. The majority of the interventions were conducted in the home and/or the school environment, with the remainder in the community, clinic, or hospital setting.

The results showed that self-management interventions are effective at reducing challenging behaviors in children and youth with ASD. Specific components of the interventions that were particularly effective were discrimination training, where the participants were taught to identify appropriate targeted behaviors and non-instances of the targeted behaviors, enabling them to make valid judgements of their behaviors. The interventions also included self-monitoring, self-recording, and reinforcement, which Carr (2016) suggested were significant features of the self-management interventions that contributed to their effectiveness. These findings led the author to suggest that self-management in small group-based social skills development programs may assist students with ASD to maintain general education placement.

Social Narratives

Social narratives include a variety of interventions designed to introduce and teach appropriate behavior to children, adolescents, or young adults and may include written stories, performances, pictures, and songs. Social narratives are used to illustrate situations, skills, or concepts, using a series of statements that describe situations, feelings, and responses of others, and appropriate actions to deal with the situations depicted in the narratives (Otero et al., 2015).

Reynhout and Carter (2006) reviewed the empirical research on social stories, including a descriptive review and single-subject meta-analysis of studies that utilized social stories to target changes in challenging behaviors, social and communication skills, and on-task behaviors, primarily in school environments for students with disabilities. The authors noted that, because the body of research on social stories was relatively small, only 11 peer-reviewed journal articles and five dissertations met the criteria for inclusion in this review and meta-analysis. All 16 studies involved a child

or children with autism or Asperger's syndrome (60 boys and 17 girls, aged 3–15 years), with the studies addressing disruptive and challenging behaviors, difficulties with social communication and interaction, and off-task behavior. In all studies, social stories were the medium used to effect change.

Gray and Garand (1993) proposed that social stories should contain the following types of short, direct sentence or statement that students with ASD could understand and follow. To be considered a social story, the text needed to contain the following sentences or statements: (1) descriptive statements that indicate what people do in a specific situation and why; (2) directive statements that focus on what a student should do to be successful in a particular situation; (3) perspective-taking statements that describe other people's reactions to a situation; (4) cooperative statements that describe what others will do to help; (5) affirmative statements that acknowledge and validate the common values of a culture; and (6) control statements that are written or developed by the student that provide strategies for using the appropriate behaviors. Although nine studies reported an appropriate reduction in target behaviors and eight studies indicated that there had been an appropriate increase in targeted behaviors, effect sizes could only be calculated on three studies, limiting the conclusions that could be drawn on treatment effects of the social stories interventions (Reynhout & Carter, 2006).

The social validity of social stories for supporting the behavioral and communicative functioning of children with ASD was investigated by Hutchins and Prelock (2013). Twenty children, aged 4–12 years, participated in a multiple baseline design across behaviors, with a 6-week follow-up. The effects of the behavior stories (to reduce problem behaviors) and communication stories (to facilitate communication), as assessed by parental perceptions of their child's functioning, were evaluated and compared. Using daily parental ratings, behavior stories were considered to be effective for 11 of the 17 stories (65%), and communication stories (to facilitate communication) were deemed to be effective for 10 of the 19 stories (53%), with great variability in effect size for both. The results also indicated variability in performance across specific story targets. The authors argue that interventions using social stories to address behavioral and communicative functioning can yield socially valid outcomes across a range of child characteristics and intervention targets, including helping children with ASD to build interpersonal relationships with their peers at school.

Technology-Aided Instruction and Video-Modelling

Technology-aided instruction and video-modelling have been merged into the one topic because of the overlap of these technologies in much of the recent research. Technology-aided instruction and video-modelling have become very popular as mediums for teaching social skills to children and adolescents with ASD, possibly because these technologies are highly motivational and have the capacity to engage attention. Shepley, Lane, and Shepley (2016) used video presentations of specific actions to teach three preschool-aged children with ASD and related social-communication delays to label actions. In addition, the teacher augmented the video presentations with additional discussions and assessed generalization to novel stimuli. The results showed that all three participants were able to label the action represented in the video, and two of the children learned to generalize their responses to novel situations (i.e., novel videos and novel pictures of photographs) without additional direct instruction.

Spriggs, Gast, and Knight (2016) used video-modelling and observational learning to teach students (8–11 years) appropriate recreation and leisure skills—in this case, access to video games. Students viewed the video model in a one-on-one situation with their teacher before demonstrating the skills they had learned to others who had not seen the video modelling. The results indicated that all students learned the steps necessary to access the different video games, and all students acquired some of the steps necessary to access different video games by observing their peers performing the steps. The authors concluded that video-modelling was effective in teaching students with ASD to play different video games. Although the focus was on teaching appropriate recreation and leisure skills, the authors suggested that, provided students had the prerequisite skills (e.g., were able to manage a computer mouse) and the video games were developmentally appropriate, they could be used to teach different classroom behaviors.

Video-modelling has also been used by mothers of children with ASD to teach social skills. Acar, Tekin-Iftar, and Yikmis (2017) reported on a study where three mothers of children with ASD were taught how to write a social story that targeted behaviors that their child needed to learn and how to develop and implement a video intervention based on the targeted behaviors. The results showed that all mothers learned how to develop social stories and implement a video intervention with 100% accuracy and with high treatment integrity. The results also showed that both interventions were effective in teaching social skills to children with ASD, and that mothers and children could maintain and generalize their acquired skills to other contexts.

SUMMARY AND FUTURE DIRECTIONS

This chapter has discussed the difficulties children and adolescents with ASD have in communicating at an interpersonal level with others. These difficulties arise because successful communication involves recognizing social cues, such as eye contact, gestures, and smiles, as well as understanding others' perspectives and emotional states and being able to communicate these understandings through reciprocal interactions. Other difficulties that children and adolescents with ASD may exhibit include restricted and repetitive patterns of behavior, fixated interests, and difficulties adjusting to changes in routines. These behaviors have been attributed to the neuroanatomical differences between normal and abnormal brain development in children with ASD (Donovan & Basson, 2017; see Byrnes & Eaton, Chapter 27, this volume). These differences, for example, have been found to occur in the size and volume of the amygdala (a group of nuclei in the brain that plays a role in processing emotions; Mosconi et al., 2009; Schumann et al., 2009); structural abnormalities have been found to be implicated in difficulties with social cognition and ToM processes (Via et al., 2011).

Difficulties in being able to understand one's own mind and others' minds are an underlying characteristic of individuals with ASD, leading to difficulties in integrating information from different contexts, regulating behaviors, and managing attention (Baron-Cohen, 2001). In classroom situations, these children and adolescents will often be overwhelmed by the complexity of the learning environment, potentially leading to an escalation of frustration, anger, and failure to thrive, both emotionally and academically.

Given the difficulties children and adolescents with ASD generally have in understanding the mental states of others, a number of social skills training programs have been developed to help them communicate appropriately with others in small-group or classroom-based contexts. Otero et al. (2015) reviewed those social skills programs that have strong evidence-based practices that have demonstrated positive outcomes for youth with ASD. These included: (a) cognitive behavioral interventions, (b) modelling or demonstrating behaviors, (c) naturalistic interventions, (d) pivotal response training, (e) self-management, (f) social narratives, and (g) technology-guided instruction and video-modelling.

Integrating research on those social skills interventions that have a strong evidence base (Otero et al., 2015) with the neuroscientific evidence that has been able to attribute difficulties in processing social information to specific regions of the brain (Gweon et al., 2012; Sabbagh et al., 2009) or identify how the brain responds more selectively to processing mental state content with age (Richardson & Saxe, 2016) will be critically important in helping children and adolescents with ASD understand the minds of others and communicate more effectively at an interpersonal level. At this point in time, there is still a disconnect between studies that have a strong evidence base of successful practices and neuroscientific studies that focus on identifying the anatomical regions in the brain associated with social cognition and the developmental changes that occur in these regions (Gweon et al., 2012; Richardson & Saxe, 2016). However, this disconnect is likely to be bridged as more neuroscientific studies are published that reveal how and when children learn to understand the minds of others, including how others think, behave, and feel in different contexts.

Current research using randomized controlled trials does indicate that school-based social skills interventions are minimally effective, producing low effects for treatment and generalization for children and adolescents with ASD (Bellini et al., 2007). Begeer et al. (2011), in a 16-week randomized control trial designed to gauge the effectiveness of a ToM intervention, also found that the intervention was only effective in helping participants learn those skills associated with understanding the thoughts and feelings of others. No significant differences were found between the participants and the controls across a variety of skills that are clearly very important in the ability to interact with peers in class settings, such as perception and imitation, recognition of emotion, pretense, and understanding of humor. Likewise, Olsson et al. (2017) and Dekker et al. (2018) conducted randomized controlled trials to investigate the effectiveness of different social skills training interventions and reported only moderate and inconsistent effects.

Given that ASD is a complex neurodevelopmental disorder that manifests itself in different ways (Donovan & Basson, 2017; Ecker et al., 2010), it would be reasonable to assume that children and adolescents with ASD may respond differently to different social skills programs and would thus require interventions to target specific behaviors that can potentially be taught in naturalistic classroom settings rather than pull-out situations (Bellini et al., 2007). Additionally, training programs need to be implemented systematically and with intensity, leading Begeer et al. (2011) to recommend that, because many social skills measures focus on broad categories of behavior, consideration should be given to developing more sensitive measures that will identify subtle changes in student behaviors that are often not detected on current measures.

CONCLUSION

Children and adolescents with ASD are known to have difficulties communicating with others at an interpersonal level. In schools, this can present a challenge for teachers where learning is very dependent on the relationships they can build with students and that students can build with each other. This chapter overviewed the difficulties children and adolescents with ASD experience in understanding not only their own mind, but also the minds of others, commonly referred to as theory of mind. Also discussed were recent developments in neuroscience that may help to explain the difficulties these children and adolescents experience, including the hypothesized role of the brain's default network that is believed to be active when individuals work on tasks that are internally focused, accounting in part for the difficulties with connecting socially to others. Finally, those social skill programs that employ strong evidence-based practices were reviewed and discussed in the context of current research in randomized control trials. Findings indicate that such interventions are only minimally effective, highlighting a clear need for more research on how to support the development of interpersonal relationships for individuals with ASD.

REFERENCES

- Acar, C., Tekin-Iftar, E., & Yikmis, A. (2017). Effects of mother-delivered social stories and video modelling in teaching social skills to children with autistic spectrum disorders. *The Journal of Special Education*, 50, 215–226.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5*. Washington, DC: Author.
- Baron-Cohen, S. (2001). Theory of mind and autism: A review. *Special Issue of the International Review of Mental Retardation*, 23, 169.
- Baron-Cohen, S., Leslie, A., & Frith, U. (1985). Does the autistic child have a theory of mind? *Cognition*, 21, 37–46.
- Beger, S., Gevers, C., Clifford, P., Verhoeve, M., Kat, K., Hoddenbach, E., & Boer, F. (2011). Theory of mind training in children with autism: A randomized controlled trial. *Journal of Autism and Developmental Disorders*, 41, 997–1006.
- Bellini, S., Peters, J., Benner, L., & Hopf, A. (2007). A meta-analysis of school-based social skills interventions for children with autism spectrum disorders. *Remedial and Special Education*, 28, 153–162.
- Brock, M., Dueker, S., & Barczak, M. (2017). Brief report: Improving social outcomes for students with autism at recess through peer-mediated pivotal response training. *Journal of Autism and Developmental Disorders*. doi:10.1007/s10803-017-3435-3
- Buckner, R. L., Andrews-Hanna, J. R., & Schacter, D. L. (2008). The brain's default network: Anatomy, function, and relevance to disease. *Annals of the New York Academy of Sciences*, 1124, 1–38.
- Cappadocia, M. C., & Weiss, J. (2011). Review of social skills training groups for youth with Asperger syndrome and high functioning autism. *Research in Autism Spectrum Disorders*, 5, 70–80.
- Carr, M. (2016). Self-management of challenging behaviours associated with autistic spectrum disorder: A meta-analysis. *Australian Psychologist*, 51, 316–333.
- Constantino, J. N., & Gruber, C. P. (2005). *Social Responsiveness Scale (SRS)*. Los Angeles, CA: Western Psychological Services.
- Corey, G. (2013). *Theory and practice of counselling and psychotherapy* (9th ed.). Belmont, CA: Brooks/Cole.
- Dekker, V., Nauta, M., Timmerman, M., Mulder, E., van der Veen-Mulders, L., van Den Hoofdakker, B., ... Bildt, A. (2018). Social skills group training in children with autism spectrum disorder: A randomized controlled trial. *European Child & Adolescent Psychiatry*. doi:10.1007/s00787-018-1205-1
- Donovan, A., & Basson, M. (2017). The neuroanatomy of autism—A developmental perspective. *Journal of Anatomy*, 230, 4–15.

- Duifhuis, E., Den Boer, J., Doornbos, A., Buitelaar, J., Oosterling, L., & Klip, H. (2017). The effect of pivotal response treatment in children with autism spectrum disorders: A non-randomised study with a blinded outcome measure. *Journal of Autism and Developmental Disorders*, 47, 231–242.
- Ecker, C. (2017). The neuroanatomy of autistic spectrum disorder: An overview of structural neuroimaging findings and their translatability to the clinical setting. *Autism*, 21, 18–28.
- Ecker, C., Marquand, A., Mourao-Miranda, J., Johnson, P., Daly, E., Brammer, M., ... Murphy, D. (2010). Describing the brain in autism in five dimensions-magnetic resonance imaging-assisted diagnosis of autism spectrum disorder using a multiparameter classification approach. *The Journal of Neuroscience*, 30, 10612–10623.
- Gates, J., Kang, E., & Lerner, M. (2017). Efficacy of group social skills interventions for youth with autism spectrum disorder: A systematic review and meta-analysis. *Clinical Psychology Review*, 52, 164–181.
- Gray, C., & Garand, J. (1993). Social stories: Improving responses of students with autism with accurate social information. *Focus on Autistic Behavior*, 8, 1–10.
- Gweon, H., Dodell-Feder, D., Bedny, M., & Saxe, R. (2012). Theory of mind performance in children with functional specialization of a brain region for thinking about thoughts. *Child Development*, 83, 1853–1868.
- Hutchins, T., & Prelock, P. (2013). The social validity of social stories for supporting behavioural and communicative functioning of children with autism spectrum disorder. *International Journal of Speech-Language Pathology*, 15, 383–395.
- Lane, J., Ledford, J., Shepley, C., Mataras, T., Ayres, K., & Davis, A. (2016). A brief coaching intervention for teaching naturalistic strategies to parents. *Journal of Early Intervention*, 38, 135–150.
- Laugeson, E., Ellingsen, R., Sanderson, J., Tucci, L., & Bates, S. (2014). The ABC's of teaching social skills to adolescents with autism spectrum disorder in the classroom: The UCLA PEERS program. *Journal of Autism and Developmental Disorders*, 44, 2244–2256.
- Laugeson, E., & Park, M. (2014). Using a CBT approach to teach social skills to adolescents with autism spectrum disorder and other social challenges: The PEERS method. *Journal of Rational-Emotive and Cognitive Behavior Therapy*, 32, 84–97.
- Leslie, A. (1987). Pretense and representation: The origins of theory of mind. *Psychological Review*, 94, 412–426.
- Maddox, B., Miyazaki, Y., & White, S. (2017). Long-term effects of CBT on social impairment in adolescents with ASD. *Journal of Autism Developmental Disorders*, 47, 3872–3882.
- Mosconi, M., Cody-Hazlett, H., Poe, M., Gerig, G., Gimpel-Smith, R., & Piven, J. (2009). Longitudinal study of amygdala volume and joint attention in 2- to 4-year-old children with autism. *Archives in General Psychiatry*, 66, 509–516.
- Mrachko, A., & Kaczmarek, L. (2017). Examining para professional interventions to increase social communication for young children with ASD. *Topics in Early Childhood Special Education*, 37, 4–15.
- Olsson, N., Flygare, O., Coco, C., Gorling, A., Rade, A., Chen, Q., ... Bolte, S. (2017). Social skills training for children and adolescents with autism spectrum disorder: A randomized controlled trial. *Journal of the American Academy of Child & Adolescent Psychiatry*, 56, 585–592.
- Olsson, N., Rautio, D., Asztalos, J., Stoetzer, U., & Bolte, S. (2016). Social skills group training in high-functioning autism: A qualitative responder study. *Autism*, 20, 995–1010.
- Otero, T., Schatz, R., Merrill, A., & Bellini, S. (2015). Social skills training for youth with autism: A follow-up. *Child and Adolescent Psychiatric Clinics of North America*, 24(1), 99–115.
- Perner, J., & Aichhorn, M. (2006). Thinking of mental and other representations: The roles of left and right temporo-parietal junction. *Social Neuroscience*, 1(3–4), 245–258.
- Phelps, E. (2004). Human emotion and memory: Interactions of the amygdala and hippocampal complex. *Current Opinion in Neurobiology*, 14, 198–202.
- Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *The Behavioral and Brain Sciences*, 4, 515–526.
- Pua, E., Bowden, S., & Seal, M. (2017). Autism spectrum disorders: Neuroimaging findings from systematic reviews. *Research in Autism Spectrum Disorders*, 43, 28–33.
- Rafferty, L. (2010). Step-by-step: Teaching students to self-monitor. *Teaching Exceptional Children*, 43, 50–58.
- Reynhout, G., & Carter, M. (2006). Social stories for children with disabilities. *Journal of Autism and Developmental Disorders*, 36, 445–469.
- Richardson, H., & Saxe, R. (2016). Using MRI to study developmental change in theory of mind. In J. Sommerville & J. Decety (Eds.), *Social cognition: Development across the lifespan* (pp. 210–237). New York: Routledge.

- Sabbagh, M., Bowman, L., Evraire, L., & Ito, J. (2009). Neurodevelopmental correlates of theory of mind in preschool children. *Child Development*, 80, 1147–1162.
- Saxe, R., & Baron-Cohen, S. (2006). Editorial: The neuroscience of theory of mind. *Social Neuroscience*, 1(3–4), i–ix.
- Saxe, R., Schulz, L., & Jiang, Y. (2006). Reading minds versus following rules: Dissociating theory of mind and executive control in the brain. *Social Neuroscience*, 1(3–4), 284–298.
- Saxe, R., Whitfield-Gabrieli, S., Scholz, J., & Pelphrey, K. (2009). Brain regions for perceiving and reasoning about other people in school-aged children. *Child Development*, 80, 1197–1209.
- Schumann, C., & Amaral, D. (2006). Stereological analysis of amygdala neuron number in autism. *The Journal of Neuroscience*, 26, 7674–7679.
- Schumann, C., Barnes, C., Lord, C., & Courchesne, E. (2009). Amygdala enlargement in toddlers with autism related to severity of social and communication impairments. *Biological Psychiatry*, 66, 942–949.
- Shepley, C., Lane, J., & Shepley, S. (2016). Teaching young children with social- communication delays to label actions using videos and language expansion models: A pilot study. *Focus on Autism and Other Developmental Disabilities*, 31, 243–253.
- Smith, A., Stephan, K., Rugg, M., & Dolan, R. (2006). Task and content modulate amygdala- hippocampal connectivity in emotional retrieval. *Neuron*, 49, 631–638.
- Spriggs, A., Gast, D., & Knight, V. (2016). Video modelling and observational learning to teach gaming access to students with ASD. *Journal of Autism and Developmental Disorders*, 46, 2845–2858.
- Stone, V., & Gerrans, P. (2006). What's domain-specific about theory of mind? *Social Neuroscience*, 1(3–4), 309–319.
- Verschuur, R., Huskens, B., Verhoeven, L., & Didden, R. (2017). Increasing opportunities for question-asking in school-aged children with autism spectrum disorder: Effectiveness of staff training in pivotal response treatment. *Journal of Autism and Developmental Disorders*, 47, 490–505.
- Via, E., Radua, J., Cardoner, N., Happe, F., & Mataix-Cols, D. (2011). Meta-analysis of gray matter abnormalities in autism spectrum disorder. *Archives of General Psychiatry*, 68, 409–418.
- Wang, S., Cui, Y., & Parrila, R. (2011). Examining the effectiveness of peer-mediated and video-modeling social skills interventions for children with autism spectrum disorders: A meta-analysis in single case research using HLM. *Research in Autism Spectrum Disorders*, 5, 562–569.
- White, S. (2014). *Social skills training for children with asperger syndrome and high functioning autism*. New York: Guilford Press.
- White, S., Schry, A., Miyazaki, Y., Ollendick, T., & Scahill, L. (2015). Effects of verbal ability and severity of autism on anxiety in adolescents with ASD: One-year follow-up after cognitive behavioural therapy. *Journal of Clinical Child and Adolescent Psychology*, 44, 839–845.
- Wimmer, H., & Perner, J. (1983). Beliefs about Beliefs: Representation and Constraining Function of Wrong Beliefs in Young Children's Understanding of Deception. *Cognition*, 13, 103–128. [http://dx.doi.org/10.1016/0010-0277\(83\)90004-5](http://dx.doi.org/10.1016/0010-0277(83)90004-5)
- Wing, L., Gould, J., & Gillberg, C. (2011). Autism spectrum disorders in the DSM-V: Better or worse than the DSM-IV? *Research in Developmental Disabilities*, 32, 768–773.
- Wong, C., Odom, S., Hume, K., Cox, A., Fettig, A., Kucharczyk, S., ... Schultz, T. (2015). Evidence-based practices for children, youth, and young adults with autism spectrum disorder: A comprehensive review. *Journal of Autism and Developmental Disorders*, 45, 1951–1966.

23

STUDENT ENGAGEMENT AND LEARNING

Attention, Behavioral, and Emotional Difficulties in School

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Data from the World Health Organization (WHO, 2017) indicate that globally, 10–20% of children and adolescents experience mental disorders. In addition, half of all mental disorders manifest before age 14, and three-fourths do so by the mid-20s. Left untreated, mental disorders impact children's development, educational attainment, and productive citizenry (WHO, 2017). Regardless of the classification or diagnostic system that is used, a large number of children and adolescents have attentional, emotional, and/or behavioral difficulties that interfere with their achievement and performance in school. Such school-related problems frequently have far-reaching consequences, including associations with high school dropout (e.g., McFarland, Cui, & Stark, 2018) and post-secondary enrollment and persistence (e.g., Sanford et al., 2011).¹ The purpose of this chapter is to review the literature on student engagement for students with special needs, specifically students with attention difficulties, behavioral and emotional problems, and learning disabilities. The research highlights the importance of motivation and engagement for all students, including those who are placed at increased risk for poor outcomes owing to these difficulties.

In order to examine the literature on student engagement and school-related difficulties, one must also consider the educational categorizations used to identify those who qualify or may benefit from additional services or special education. In the US, for example, federal education law delineates separate educational classifications, not medical or psychiatric diagnostic criteria (e.g., International Statistical Classification of Diseases and Related Health Problems [ICD-10], *Diagnostic and Statistical Manual of Mental Disorders* [DSM-5]), to be used for qualification and provision of school-related services. To receive services, students must both (a) meet criteria for one of the 13 recognized disability categories and (b) demonstrate an educational need for services (Individuals with Disabilities Education Act [IDEA], 2004). In addition, the educational disability must not be due to lack of instruction, limited

English proficiency, economic disadvantage, and so forth. It is conceivable that a child or adolescent may meet criteria for a medical or psychiatric disorder and not qualify to receive special education services in school; however, students with significant attentional, emotional, and/or behavioral issues that impair their functioning sufficiently to meet medical or psychiatric diagnostic criteria will also demonstrate an educational need. Furthermore, psychiatric/medical disorders in childhood and adolescence frequently manifest as difficulty at school, such as chronic absenteeism and school refusal, behavioral incidents resulting in disciplinary actions and suspensions, and coursework failure (American Psychiatric Association [APA], 2013; WHO, 2016).

In the US, the largest categories for the provision of school-based special education services are specific learning disability (SLD, 39.2%), speech or language impairment (17.6%), other health impairment (OHI, 14.4%; where students with attention-deficit/hyperactivity disorder [ADHD] are served), autism (8.6%), intellectual disability (7.0%), and emotional disturbance (ED, 5.9%; which includes those with internalizing problems, such as anxiety or depression, and externalizing behavior, such as aggression toward others; U.S. Department of Education, Office of Special Education and Rehabilitative Services, Office of Special Education Programs., 2016a). Attention, emotional, and/or behavioral difficulties are frequently present across high-incidence disability categories (Friend & Bursuck, 2012) and are associated with poorer educational outcomes. For example, in 2013–2014, 66.1% of students ages 14–21 who exited special education graduated with a regular high school diploma; 18.5% of these students dropped out (U.S. Department of Education, Office of Special Education and Rehabilitative Services, Office of Special Education Programs., 2016a). For comparison, the overall U.S. graduation rate during that same time was 82% (McFarland et al., 2018). Another study found that adults with psychiatric disorders account for 14.2% of high school dropouts and 4.7% of college dropouts, with 7.2 million people in the US terminating their education owing to early-onset psychiatric disorders (Kessler, Foster, Saunders, & Stang, 1995).

As the construct of student engagement has evolved in recent years, it is increasingly recognized that engagement is relevant for all students and levels of schooling, elementary through college (Christenson, Reschly, & Wylie, 2012a). There are vast differences in students' engagement, and outcomes, across years. Longitudinal studies suggest that there are multiple trajectories of student engagement, and that students with low and unstable levels of engagement are less likely to graduate high school on-time (Janosz, Archambault, Morizot, & Pagani, 2008; Wylie & Hodgen, 2012) or pursue postsecondary education (Lawson & Masyn, 2015; O'Donnell, Lovelace, Reschly, & Appleton, 2019). Furthermore, students characterized with poor engagement are also more likely to exhibit learning and behavior problems, have less positive relationships with teachers, achieve worse grades, participate in fewer extracurricular activities, and experience higher rates of bullying behavior, risky health behaviors, burnout, and mental health problems (Archambault & Dupéré, 2017; Li & Lerner, 2011; Salmela-Aro, Moeller, Schneider, Spicer, & Lavonen, 2016; Wang & Peck, 2013; Wylie & Hodgen, 2012). Unfortunately, students with special needs generally report lower engagement than their average-achieving peers (Lovelace, Reschly, Appleton, & Lutz, 2014; Reschly & Christenson, 2006). In addition, the cumulative effect of risk factors on developmental outcomes (Appleyard, Egeland, van Dulmen, & Sroufe, 2005)

suggests that students who are in special education and identify as racial minorities, from low socioeconomic backgrounds, and so on, are especially susceptible to poorer academic and social-emotional outcomes.

Although engagement is an important construct to consider for all students, the roots of engagement lie in dropout theory (Finn, 1989; Reschly & Christenson, 2012), an important connection in that engagement is thought to be critical for students at greatest risk for poor outcomes (Reschly & Christenson, 2006). In addition to the many and varied associations between indicators of engagement and both proximal and distal student outcomes, a compelling reason for the burgeoning interest in student engagement is that students' engagement is alterable, or amenable, to the effects of intervention (Christenson et al., 2008). Thus, unlike many status or demographic variables associated with student outcomes, such as race-ethnicity or socioeconomic status (SES), student engagement indicators (e.g., attendance, homework completion, extracurricular participation, behavior) are sensitive to effects of intervention and influenced by contexts: families, schools, peers, and communities (Reschly & Christenson, 2012; Reschly, Pohl, Christenson, & Appleton, 2017). Thus, students' engagement is a feasible target of intervention efforts across demographic, socioeconomic, and other risk conditions. For example, Reschly and Christenson (2006) found that, after controlling for achievement, grade retention, and SES, student engagement variables were significant predictors of school dropout and completion for students with SLD and ED and those without disabilities. Similarly, among a group of students selected owing to demographic risk (i.e., minority students from low-income backgrounds), student engagement variables differentiated those who were successful school completers, unsuccessful school completers, and dropouts (Finn & Rock, 1997). Across risk conditions, engagement is thought to be a protective factor that promotes resilience (Finn & Zimmer, 2012; Skinner & Pitzer, 2012).

This chapter begins with a summary of major theories of motivation and engagement. Next, studies of student engagement for students with attention, behavioral, emotional, and learning difficulties in educational environments are organized by types of engagement, which are described in greater detail in the next section. We conclude with implications for practitioners and future directions for practice.

THEORIES OF MOTIVATION AND ENGAGEMENT

As a broad, integrative construct, it follows that student engagement draws from several theoretical perspectives and literatures. Arguably, the two greatest influences on the engagement construct are from theories of motivation and high school dropout and completion.

Self-Determination Theory

Self-determination theory (SDT) posits that people are motivated by extrinsic and intrinsic factors that fall along a regulation continuum from nonself-determined to self-determined (Deci & Ryan, 1985; Ryan & Deci, 2000). Although amotivation is associated with incompetence, a lack of control, and nonregulation, intrinsic motivation arises from within and is associated with greater interest, enjoyment, and

intrinsic regulation. Within extrinsic motivation, regulation may be driven by external factors (external regulation), somewhat external factors (introjected regulation), somewhat internal factors (identified regulation), or internal factors (integrated regulation), indicating that external motivation may vary depending on a person's level of autonomy or choice (Ryan, 1995; Ryan & Connell, 1989). Motivation becomes more intrinsic, and regulation becomes more internalized, as three basic psychological needs are met: autonomy (locus of control), belonging (relatedness), and competence (Ryan & Deci, 2000). These needs must be satisfied to promote well-being, and external environments can either support or thwart these needs. For example, providing more choice can increase feelings of autonomy, or providing positive performance feedback can improve feelings of competence (see Wehmeyer & Shogren, Chapter 12, this volume).

Participation-Identification Model

In seminal work on dropout theory and intervention, Finn (1989; Finn & Zimmer 2012) described the processes of both engagement and disengagement/withdrawal that lead to high school graduation and dropout, respectively. Engagement is defined primarily in terms of behavioral participation and emotional connection, termed identification. For most students, the cycle works as follows: students attend and participate at school, which leads to school success, and, in turn, the student identifies with school (i.e., an emotional connection), which further facilitates their ongoing participation. Many students arrive at school with the behaviors and attitudes needed to successfully participate, thus triggering this engagement–participation–identification cycle. Others, however, may not have the requisite behaviors or skills to be successful. Furthermore, the requirements of schooling change with age (e.g., successful participation requires more within and outside of school in fourth grade than it did in kindergarten), with more responsibility and greater opportunities for involvement (e.g., extracurricular activities, leadership and governance). For students who do not have the requisite skills and behaviors to be successful at the commencement of schooling or who do not demonstrate the increased and varied forms of participation required to be successful, the cycle becomes one of disengagement, little success, and emotional withdrawal that culminates in eventual drop out.

This theory highlighted the developmental processes of engagement, and disengagement, across levels of schooling. Scholars recognize that engagement and withdrawal may differ in intensity or kind across ages (Balfanz & Byrnes, 2019; Reschly, Appleton, & Pohl, 2014). It also provides a theoretical basis for understanding the possible link between the long-term effects of intensive, high-quality early childhood programs, such as the Perry Preschool (Schweinhart et al., 2005) and the Chicago Parent Child Projects (Reynolds, 1999, 2001), on outcomes such as grade retention, special education placement, and high school dropout and graduation. One way in which these programs may facilitate better outcomes for students is through the enhancement of the participation–success–identification cycle wherein programs such as these prepare students to be successful (attitudes, behaviors, skills) upon entry to school, thereby setting them up for greater success in their participation–success–identification cycle (Reschly & Christenson, 2012).

An Integrative Model

There is a broad consensus regarding the multidimensional nature of engagement as including students' cognition, emotion, and behavior, which allows for a richer, more accurate/sophisticated view of students' school experiences (Fredricks, Blumenfeld, & Paris, 2004). Furthermore, most conceptualizations of student engagement view it as an alterable variable that serves as a mediator between important contexts – families, schools, peers, and communities – and students' proximal (e.g., grades, emotion regulation, relationship skills) and distal (e.g., high school graduation, college attendance, and persistence) outcomes, thereby underscoring the developmental processes of engagement and disengagement across years. Contexts may either support or diminish students' engagement at school and with learning and are relevant to inform and as targets of interventions (Reschly & Christenson, 2012, 2019).

It has been noted that student engagement is a relatively new construct, first appearing in the literature in the 1980s (Reschly & Christenson, 2012). Furthermore, the view that it is a meta-construct relevant for all students has evolved even more recently (i.e., Fredricks et al., 2004). Thus, despite agreement on broad dimensions, developmental processes, and the mediating role of engagement between important contexts and outcomes, there are several points that lack consensus among engagement scholars. Some engagement models add social (Finn & Zimmer, 2012; Wang, Fredricks, Ye, Hofkens, & Linn, 2017) or academic engagement (Appleton, Christenson, Kim, & Reschly, 2006; Reschly & Christenson, 2012), and, even among those endorsing three dimensions, scholars often differ in how they operationalize and measure the dimensions. For example, perceived relevance of schoolwork is variously classified as affective engagement (Finn, 2006) and cognitive engagement (Appleton et al., 2006; Reschly & Christenson, 2012). This lack of clarity across scholars can make it difficult to generalize results across studies and has added caution to translating these results into recommendations for practice (Reschly & Christenson, 2012).

Another variation across scholars is whether engagement is measured on a single continuum varying from low to high or whether there are separate continua of engagement and disaffection (Reschly & Christenson, 2012). Furthermore, the distinctions between motivation and engagement also vary. Motivational researchers, for example, tend to describe engagement as the action or outcome of motivation (Reeve, 2012; Skinner & Pitzer, 2012), whereas others argue that much of the motivational research is subsumed by the engagement meta-construct, primarily as what is termed cognitive engagement (Fredricks et al., 2004; Reschly & Christenson, 2012). Despite these scholarly debates, from a practical perspective, virtually all scholars and educators agree that motivation and engagement are of vital importance (Martin, 2007; Reschly & Christenson, 2012), and that both require the satisfaction of the fundamental human needs for autonomy, belonging, and competence (Reschly et al., 2017).

In this chapter, we use the widely agreed upon three dimensions or subtypes of engagement: cognitive, affective, and behavioral (Fredricks et al., 2004), with the specific addition of academic engagement from Christenson and colleagues' model of student engagement (Appleton et al., 2006; Reschly & Christenson, 2012). We argued for academic engagement being bifurcated from behavioral engagement in order to

provide a clearer link to intervention strategies (Appleton et al., 2006; Reschly et al., 2014; Reschly & Christenson, 2012). For the purposes of this chapter, affective engagement is comprised of emotional experiences at school and with learning, which we operationalize in terms of identification and belonging, as well as connections to others (peer, teacher, and family support; Appleton et al., 2006; Reschly et al., 2017). Behavioral engagement refers to school-related conduct (e.g., office referrals, detention, suspensions), attendance, and participation and involvement in school-related activities (e.g., extracurriculars) and learning (Fredricks et al., 2004; Reschly et al., 2017). Academic engagement includes time on task, credit accrual, homework completion rate and accuracy, and grades or GPA (Reschly et al., 2014, 2017). Finally, cognitive engagement may be thought of as students' investment, relevance, and self-regulation of learning (Fredricks et al., 2004; Reschly et al., 2017). Although these dimensions or subtypes of engagement are described separately, scholars recognize that the dimensions are interrelated (Fredricks et al., 2004; Reschly & Christenson, 2012). Thus, efforts to address one type, such as an intervention that targets students' relationships with teachers, may also affect their behavioral and academic engagement (Reschly et al., 2014).

AFFECTIVE ENGAGEMENT

Definition and Overview

Affective engagement – students' emotional experiences at school and while learning (Reschly et al., 2017) – is shaped over time in response to academic achievement and connections with peers and teachers (Voelkl, 2012). Furthermore, student perceptions of support in the classroom promote participation in class and, thus, academic achievement (Voelkl, 1995). Poor classroom management, unfair disciplinary practices, and larger school sizes, however, are associated with lower school connectedness, whereas there is a positive association between higher grades, lower absences, and greater extracurricular participation and school connectedness (McNeely, Nonnemaker, & Blum, 2002). In addition, students with poorer relationships with teachers and lower feelings of school connectedness in elementary school had greater self- and teacher-reported social and emotional difficulties (Murray & Greenberg, 2000).

In meta-analyses of teacher–student relationships, student engagement, and achievement (Roorda, Jak, Zee, Oort, & Koomen, 2017; Roorda, Koomen, Spilt, & Oort, 2011), there was a medium-to-large association between relationships and engagement and a small-to-medium association between relationships and achievement. Although teacher–student relationships had larger effects on student engagement than on achievement, the association between relationships and student achievement was partially mediated by student engagement. Additionally, teacher–student relationships had a stronger effect on secondary grades overall, but negative relationships had a stronger effect in the primary grades. As for peer relationships, students who are subjected to frequent and continuous peer victimization are more likely to experience lower school engagement, poorer academic self-perceptions, and lower academic achievement (Ladd, Ettekal, & Kochenderfer-Ladd, 2017).

Students with Attention, Learning, Behavioral, and Emotional Difficulties

Although feelings of belongingness are a basic need for all students, students with special needs appear to be at greater risk for lower school connectedness. In a study comparing students with disabilities (including ED, SLD, mild intellectual disability, and OHI) with students without disabilities, students with disabilities experienced overall greater dissatisfaction with teacher relationships, lower school connectedness, and greater perceptions of school danger (Murray & Greenberg, 2001). In a later study examining students with ED, SLD, mild intellectual disability, and OHI, Murray and Greenberg (2006) found that teacher alienation uniquely contributed to conduct and externalizing problems, and peer alienation contributed to conduct problems, delinquency, anxiety, and depression. They also identified that school connectedness significantly contributed to self-ratings of school competence. Students with disabilities are also at greater risk of peer victimization than children without disabilities (Bear, Mantz, Glutting, Yang, & Boyer, 2015). Students with SLD had higher ratings of perceived school danger in one study (Murray & Greenberg, 2001), but other research suggests that students with SLD do not differ from students without disabilities in terms of feelings of school connectedness (Hagborg, 1998; Svetaz, Ireland, & Blum, 2000). This may be attributable to the availability of resource rooms and close relationships with special education teachers. School connectedness is also a protective factor for adolescents with SLD from emotional distress, suicide attempts, and involvement in violence (Svetaz et al., 2000). However, when faced with academic and interpersonal stressors, students with SLD seek help from significantly fewer peers compared with students without learning disabilities (Geisthardt & Munsch, 1996).

When looking at specific groups of special needs students, those with ED are particularly susceptible to low feelings of school connectedness and poorer peer and teacher relationships. Murray and Greenberg (2001) determined that students with ED experienced poorer affiliation with teachers, greater dissatisfaction with teachers, and poorer bonds with school than students without disabilities. In addition, a study comparing children with social phobia to normal peers found that 75% of children with social phobia reported having few or no friends, and 50% reported that they did not like school (Beidel, Turner, & Morris, 1999). In Bear et al.'s (2015) study of peer victimization, children with ED were the most at-risk disability category and were at a 64–1,306% greater risk of experiencing bullying across different criteria and measures than students without disabilities (for a related discussion, see Cassady & Thomas, Chapter 3, this volume).

As for students with ADHD, Rogers and Tannock (2013) had teachers rate their students' ADHD symptoms to form high-symptom and low-symptom groups. They found that the students with greater ADHD symptoms perceived classrooms as more controlling. This group also reported more feelings of incompetence and more negative student-teacher relationships than the low-symptom group (for related discussions, see, in this volume, Martin, Chapter 16; Schunk & DiBenedetto, Chapter 11). Children with ADHD are also at greater risk for experiencing bullying compared with students without disabilities, which may be attributed to their increased likelihood of social skills deficits and externalizing problems (Bear et al., 2015). In a study by Bear et al. (2015), the prevalence of peer victimization for students served under OHI was 30%.

COGNITIVE ENGAGEMENT

Definition and Overview

Cognitive engagement, or students' investment, relevance, and self-regulation of learning (Fredricks et al., 2004; Reschly et al., 2017), is significantly related to students' learning and academic success. Students who are cognitively engaged in learning have a sense of self-efficacy for learning in that they focus their attention, set goals, and evaluate their progress (Schunk & Mullen, 2012). One study found that achievement outcomes are directly influenced by high school students' cognitive strategy use and feelings of self-efficacy (Greene, Miller, Crowson, Duke, & Akey, 2004), which were, in turn, shaped by students' preference for mastery goals (i.e., the desire to extend effort to master tasks and gain competence; Anderman & Patrick, 2012) and perceived instrumentality of classroom tasks. Mega, Ronconi, and De Beni (2014) also identified that students' positive emotions had a positive relationship with students' cognitive engagement, in that positive emotions were associated with better organization of study time, personalization of study materials, and metacognition strategy use during exams.

Literature concerning cognitive engagement often relates to self-regulated learning, which Zimmerman (2002) opined to be the cycle between forethought, volitional control/performance, and self-reflection. Within this conceptualization, forethought refers to goal-setting, strategic planning, self-efficacy beliefs, goal orientation, and intrinsic investment. Volitional control/performance is defined as attention-focusing, self-instruction/imagery, and self-monitoring. Finally, self-reflection refers to self-evaluation, attributions, self-reactions, and adaptivity. Research shows that the quantity and quality of self-regulations strategies are related to academic achievement (Zimmerman & Martinez-Pons, 1986), and that self-regulation strategies can be taught to increase motivation and achievement (Schunk & Zimmerman, 1998) for all students.

Students with Attention, Learning, Behavioral, and Emotional Difficulties

There is little research directly examining the broader construct of cognitive engagement for students with disabilities; however, academic difficulties experienced by students with disabilities may reflect a lack of developed self-regulation strategies. As explored below, evidence suggests that, when directly taught self-regulation strategies, students with disabilities improve their academic achievement (for a related discussion, see Perry, Mazabel, & Yee, Chapter 13, this volume). According to one study, students with SLD are more likely to have low academic self-efficacy, believe that intelligence is fixed, prefer performance over learning goals, and are more likely to interpret that effort is indicative of low ability than students without disabilities (Baird, Scott, Dearing, & Hamill, 2009). Graham and Berman (2012) further noted that students with SLD often lack behaviors that support self-regulation related to critical thinking and self-awareness skills. Fortunately, multiple studies indicate that students with SLD can successfully learn self-regulation strategies and improve their academic outcomes. In a study by De La Paz (1999), students with learning disabilities and students without disabilities were both taught self-regulation strategies for plan-

ning and writing, including setting process and content goals. All students improved in essay length and quality pre- to post-test. Other studies have also found that setting revision goals to add information (Graham, MacArthur, & Schwartz, 1995), setting product and process goals, providing strategies for note-taking, and evaluating goals (Graham, MacArthur, Schwartz, & Page-Voth, 1992) improved writing quality for students with SLD (for a related discussion, see Graham & Harris, Chapter 20, this volume). In one study examining self-regulation and reading, students with learning disabilities developed long-lasting improvements in reading comprehension by using story structures to analyze and remember stories, setting goals, and learning self-instruction strategies (Johnson, Graham, & Harris, 1997). In a review of seven studies, Montague (2008) concluded that teaching students with SLD mathematics problem-solving self-regulation strategies resulted in improvements to their mathematics achievement.

For students with emotional-behavioral disorders, Mooney and colleagues (2005) conducted a meta-analysis of the effects of self-regulation strategies for academic skills. Overall, learning self-monitoring, self-evaluation, self-instruction, and multi-component strategies were all found to improve academic skills for students with ED. Most studies included in these analyses focused on mathematics calculation skills. In another meta-analysis, Losinski, Cuenca-Carlino, Zablocki, and Teagarden (2014) examined the effect of self-regulated strategy instruction on the writing skills of students with ED. Results showed that self-regulation strategy interventions resulted in large effect sizes for essay elements, essay quality, and word count. In one of the studies examined (Cuenca-Sanchez, Mastropieri, Scruggs, & Kidd, 2012), self-regulation strategy development was used as the intervention, which emphasizes the development of background knowledge, discussion of the strategy, modeling of the strategy, memorization, collaborative support, and independent practice through goal-setting, self-instruction, self-monitoring, and self-reinforcement. Students with ED who received the intervention demonstrated improved performance in writing persuasive essays as measured by word count, number of sentences and paragraphs, transition words, essay parts, and overall quality pre- to post-test.

Self-regulation strategies may be particularly effective tools to improve the cognitive engagement of students with ADHD, as the disorder is characterized by executive functioning and motivational dysfunction (Barkley, 1997), which may contribute to self-regulation difficulties. Martin (2012) found that both ADHD and non-ADHD high school students demonstrated positive academic and behavioral engagement effects when utilizing personal best goals, defined as “specific, challenging, competitively self-referenced targets towards which students strive” (p. 91; for a related discussion see Martin, Chapter 16, this volume). In addition, self-regulation interventions such as self-monitoring, self-monitoring plus reinforcement, self-management, and self-reinforcement increased on-task behavior, academic accuracy, and productivity and reduced off-task behavior for students with ADHD (Reid, Trout, & Scharztz, 2005). Within this study, self-monitoring involved observing and recording students’ own behavior (related to attention or performance), whereas self-management referred to monitoring, rating, and comparing their behavior with a pre-determined standard. Reid and Lienemann (2006) found that a self-regulation strategy development intervention improved the number of story parts, length of stories, and story quality

for three students with ADHD. Another study found that both self-monitoring of attention and self-monitoring of performance increased on-task and spelling studying behaviors in students with ADHD (Harris, Friedlander, Saddler, Frizzelle, & Graham, 2005).

BEHAVIORAL ENGAGEMENT

Definition and Overview

Research on behavioral engagement can be divided into studies examining disciplinary incidents, attendance, and extracurricular participation. For all students, harsh discipline practices (e.g., expulsion for minor or first-time infractions) are associated with lower feelings of school connectedness (McNeely et al., 2002). In a longitudinal analysis of ninth-grade students, disciplinary incidents in general were related to course failure and absenteeism, and out-of-school suspension (OSS) was significantly and negatively related to on-time high school graduation and post-secondary enrollment and persistence (Balfanz, Byrnes, & Fox, 2014). Noltmeyer, Ward, and Mcloughlin (2015) also found that OSS and in-school suspensions were negatively related to academic achievement, and OSS in particular was significantly related to high school dropout.

Regarding attendance, research shows significant relationships between attendance and achievement for all students (Roby, 2003). Poor attendance, misbehavior, and course failure in sixth grade can identify 60% of students who will not graduate high school (Balfanz, Herzog, & Mac Iver, 2007). In addition, absenteeism in earlier grades predicts absenteeism in later grades, and higher rates of absenteeism are associated with lower scores on standardized assessments (Buehler, Tapogna, & Chang, 2012). Studies also suggest that high rates of absences most significantly impact low SES students (Buehler et al., 2012; Ready, 2010).

As for extracurricular participation, involvement in extracurricular activities is associated with improved psychological well-being, on-time high school graduation, reduced rates of delinquency, and academic adjustment and achievement (Feldman & Matjasko, 2005; Feldman Farb & Matjasko, 2012; Fredricks, 2012). Generally, studies suggest small relationships between weekly extracurricular participation and better emotional and behavioral adjustment and social competence (Howie, Lukacs, Pastor, Reuben, & Mendola, 2010). A study conducted by Denault and Déry (2015) found that greater extracurricular participation predicted better social skills, and better social skills predicted fewer conduct problems, suggesting an indirect link between extracurricular participation and problem behavior.

Students with Attention, Learning, Behavioral, and Emotional Difficulties

Data from the 2013–2014 Civil Rights Data Collection (U.S. Department of Education, 2016b) indicated that students with disabilities from kindergarten through 12th grade are disproportionately suspended and are twice as likely to receive one or more OSS than students without disabilities (12% compared with 5%, respectively). Greater disproportionality of suspensions occurs for male students with disabilities who are American Indian/Alaska Native, Hawaiian or Pacific Islander, black, or multiracial

compared than for white male students with disabilities. Similarly, Balfanz et al. (2014) conducted a longitudinal analysis of ninth-graders and found that students who identified as black, students from low SES backgrounds, and students in special education experienced disproportionately more suspensions than other groups of students. In a study comparing the suspensions and expulsions of students with emotional-behavioral disorders, learning disabilities, and ADHD, higher rates were found for the ED and ADHD groups (Achilles, McLaughlin, & Croninger, 2007). Additionally, all of the groups were associated with older age, male gender, low SES, multiple school changes, urban schooling, and parents with low school satisfaction.

According to the U.S. Department of Education (2016b), students with disabilities are 1.5 times more likely to be chronically absent in elementary school than their non-disabled peers, and 1.4 times more likely in high school. Chronic absenteeism refers to missing 10% or more of days in the school year. In a study based in New York, students with disabilities were 65.6% more likely to be chronically absent than students without disabilities (Gottfried, Stiefel, Schwartz, & Hopkins, 2017). Among students with disabilities, students with ED had the highest rates of absence, followed by low-incidence disabilities, students served under OHI, SLD, and speech impairment.

Although there is a lack of studies examining EDs and extracurricular activity participation, there is research investigating the relationship between internalizing and externalizing behaviors and extracurricular activities. Involvement in a structured physical activity program in Canada resulted in improvements to students' social problems, thought problems, and attention problems based on parent-report, and anxiety-depression problems and social problems based on teacher-report (Verret, Guay, Berthiaume, Gardiner, & Béliveau, 2012). Another study investigated the relationship and directionality between activity involvement and internalizing and externalizing problems in the US and found no significant relationship for externalizing behaviors (Bohnert, Kane, & Garber, 2008). However, high activity participation in 10th grade predicted lower internalizing problems in 11th grade, and more internalizing problems in 11th grade predicted less participation in 12th grade. In a sample of Finnish children, researchers examined the relationship between different types of extracurricular activities and social-emotional behavior (Metsäpelto & Pulkkinen, 2012). Results indicated that: participation in arts and music was related to higher adaptive behavior, academic achievement, and working skills (e.g., persistence, concentration); involvement in performing arts was associated with working skills; and participation in academic clubs was related to academic achievement and reduced internalizing problems. Driessens (2015) also explored social-emotional and behavioral differences based on the type of activity in a sample of British adolescents. Participation in sports was associated with reduced anxiety and depression symptoms, whereas adolescents involved in expressive and religious activities reported higher levels of internalizing problems. The researcher further concluded that, generally, extracurricular participation buffered the impact of bullying, lack of parental involvement, and poor student-parent relationships on the presence of disruptive behavior problems.

Moreover, there are some studies on extracurricular participation rates of students with various high-incidence disabilities, with most studies being conducted outside of the US. One recent study from Turkey indicates that, for students with SLD, there

is a correlation between sports participation and increased social skills, resulting in reduced feelings of loneliness (Yılmaz, Kırımoğlu, & Soyer, 2018). As for ED, Wagner (1995) found that 37.3% of students with ED participated in clubs or social groups at school compared with 42.6% of students with other disabilities and more than 50% of students without disabilities. Shimoni, Engel-Yeger, and Tirosh (2010) compared the extracurricular activities of boys with ADHD with those of boys without ADHD in a sample from Israel. Findings indicated that the two groups participated in a similar number of activities, with the ADHD group participating in more formal activities (i.e., structured activities with a formal coach or tutor). Interestingly, the ADHD group also reported less enjoyment of formal activities, and they were less involved in social, skill-based, and self-improvement activities. Boys with and without ADHD had similar participation rates in physical and recreational activities (i.e., unstructured activities).

ACADEMIC ENGAGEMENT

Definition and Overview

There is general agreement that student engagement includes cognitive, emotional, and behavioral dimensions (e.g., Fredricks et al., 2004). Based on their intervention work with Check & Connect, Christenson and colleagues separated academic engagement from behavioral engagement in an effort to better link subtypes to interventions (Appleton et al., 2006; Reschly et al., 2014; Reschly & Christenson, 2012). Academic engagement is often conceptualized as credits earned towards high school graduation, time on-task (e.g., completing classwork, participating in discussions and group work, and responding to questions asked by the teacher), and homework completion, as these indicators have a direct relationship with academic achievement.

A lack of academic engagement and achievement is associated with high school dropout and a lack of school connectedness for all students (Finn, 1989; Finn & Rock, 1997). Moreover, failing to graduate on time from high school is associated with a decreased enrollment in postsecondary school and fewer job opportunities (U.S. Department of Labor, 2018). A meta-analysis of homework effects (Cooper, Robinson, & Patall, 2006) found consistent evidence for the positive influence of homework on academic achievement, with stronger relationships for secondary students and when using student report. Although the amount of homework assigned and academic achievement do not appear to be related, there is a positive association between homework completion and academic achievement (Cooper, Lindsay, Nye, & Greathouse, 1998).

Students with Attention, Learning, Behavioral, and Emotional Difficulties

The academic difficulties of students with disabilities are well documented. Data from the 2013–2014 Civil Rights Data Collection (U.S. Department of Education, Office for Civil Rights, 2016b) suggest that there is a participation gap in high-level mathematics and science courses and unequal access to accelerated courses/gifted and talented education programs between students with disabilities and those without. For example, students with disabilities served under IDEA represented 12% of students in

schools with gifted and talented education programs, but represented 3% of gifted and talented education students (U.S. Department of Education, Office for Civil Rights., 2016b). In addition, students with disabilities are less likely to enroll in advanced placement courses, with fewer than 2% of special education students served under IDEA enrolled in at least one advanced placement course (U.S. Department of Education, Office for Civil Rights., 2016b). Students with disabilities are also more likely to be retained compared with students without disabilities, with about 22% of special education students being held back in high school (U.S. Department of Education, Office for Civil Rights., 2016b).

Looking within special education categories, data from the National Longitudinal Transition Study of Special Education Students indicated that students with ED exhibited the lowest GPAs of all special education categories across grade levels, with three-fourths of students with ED failing at least one course in high school (Wagner, 1995). A literature review by Trout and colleagues (2003) revealed that 91% of reviewed studies reported that students with ED were academically below grade level compared with their peers across reading, writing, and math subject areas. In reviewing 23 comparison studies with students with ED and other special education categories, those with ED performed academically more poorly than peers without disabilities, but they performed similarly to students with SLD in writing and mathematics and to students with ADHD in reading, writing, and mathematics. Another study comparing male high school students with ADHD and students without ADHD found that students with ADHD demonstrated lower academic performance, were less likely to take advanced courses, and failed more courses than students without disabilities (Kent et al., 2011).

One study examining the academic engagement of students with SLD found that these students were less likely to interact with teachers, other peers, and classroom activities than students without SLD (McIntosh, Vaughn, Schumm, Haager, & Lee, 1993). Students with SLD were also less likely to ask for help, answer questions out loud, and engage in discussions compared with students without disabilities. Examining ED students' time on task, a study by Wagner and colleagues (2006) found that students with ED participated in class at similar rates to other students but were more likely to receive individual instruction and less likely to respond orally to questions and to work independently. Students with ADHD across grade levels appear to struggle with classroom participation and staying on task. Classroom observations of first- through fourth-grade students found that students with ADHD were less academically engaged and more off task (Vile Junod, DuPaul, Jitendra, Volpe, & Cleary, 2006). Specifically, students with ADHD demonstrated lower rates of passive academic engagement (passively attending to assigned material: listening, silently reading), but exhibited similar rates of active academic engagement (actively engaging with academic tasks: writing, reading aloud).

In a study comparing students with learning disorders, behavior disorders, and nondisabled students, both learning and behavior disorder groups had significantly more homework problems according to the Homework Problem Checklist than the nondisabled group, based on both parent- and teacher-report (Epstein, Polloway, Foley, & Patton, 1993). The researchers noted that common items endorsed for the special education groups included problems with procrastination, daydreaming,

distractions, and needing reminders or an adult in the room to complete homework. Additionally, the ED group had more homework completion problems than the SLD group, but this difference was not statistically significant. Another study by the same group of researchers examined the homework difficulties of students with learning disorders and nondisabled students and found that students with SLD had 2.5 times more difficulties with homework, experienced more motivation and distraction problems, complained more, avoided homework, and took longer to complete homework (Polloway, Foley, & Epstein, 1992). When specifically comparing students with behavior disorder with those without on the Homework Problem Checklist, students with ED demonstrated significantly more problems, especially related to relying on external support, attention deficits, and organizational deficits (Epstein, Foley, & Polloway, 1995). Another study found that students with emotional-behavioral disorders struggle with completing homework-related tasks such as using a planner, remembering materials, time management, and paying attention in class (Cancio, West, & Young, 2004).

The Homework Problem Checklist has also been used to study students with ADHD, with research suggesting that this population similarly struggles with homework completion. In one study, students with ADHD rated significantly higher for homework problems than a nonclinical sample, including problems with paying attention, working efficiently, working independently, productivity, knowledge of due assignments, completing homework, and turning in homework (Power, Werba, Watkins, Angelucci, & Eiraldi, 2006). Another study examining a diverse sample of children with ADHD found that homework problems were greater for students in higher grades, and that students with comorbid ADHD and learning disabilities had more homework problems than students with ADHD alone (Langberg et al., 2010). In addition, this study found that inattentive symptoms were highly correlated with homework problems, whereas hyperactivity and impulsivity had low-to-moderate correlations with homework problems. In another study, the best predictors for the school grades of middle school students with ADHD were parent-rated homework materials management skills and teacher-rated memory and materials management skills (Langberg et al., 2011).

SUMMARY

There are numerous studies that provide evidence of the difficulties that students with learning, attention, behavioral, and/or emotional problems also experience with their affective, cognitive, behavioral, and academic engagement. These results also highlight the similarities in school difficulties across high-incidence disabilities. Although more recent work underscores the importance of student engagement for all youth (Christenson, Reschly, & Wylie, 2012b), the roots of engagement are in dropout theory and intervention – that is, highlighting the importance of this construct for those who are at the greatest risk for poor educational outcomes. Results of studies examining the engagement of students with high-incidence disabilities and psychiatric disorders accentuate the concepts of engagement and risk and the link to intervention for youth experiencing these difficulties. In the next section, we discuss implications for school-based practitioners.

IMPLICATIONS FOR PRACTITIONERS

Student engagement has been described as a meta-construct because it brings together previously isolated areas of research (e.g., belonging, extracurricular participation) into one conceptual model. This characterization recognizes the complex interplay between students' emotions, cognitions, and behavior, thereby allowing for a richer depiction of students' school experiences (Fredricks et al., 2004). This broad conceptualization of student engagement has implications for both assessment and intervention practices for students, including those with learning, behavioral, and emotional difficulties.

Assessment

Student engagement resonates with educators and scholars alike because of the wide-ranging connections to important proximal and distal outcomes of interest and because of the inherent amenability of engagement to intervention efforts (Christenson et al., 2012a; Reschly et al., 2014). Collecting, interpreting, and monitoring students' engagement are imperative to inform such intervention decisions as determining who may benefit, which interventions should be considered and at what level (i.e., school or district-wide, classroom, small/targeted groups, or individuals), and whether intervention efforts are effective.

Schools regularly collect some forms of engagement data (e.g., absences and tardies; credits earned; homework completion rate; compliance with school behavior guidelines in terms of detentions, suspensions, and expulsions), whereas other indicators of student engagement require additional data collection efforts (Reschly & Christenson, 2012). Student self-report, experience sampling, teacher ratings, interviews, and observational methodologies have all been used to assess various aspects of student engagement (Fredricks & McColskey, 2012). Student self-report is arguably the most frequently used method of collecting information about students' engagement and supplementing the data already available in school data systems. Student self-report measures are popular owing to practicality, ease of administration, relatively low cost, and possibility of following many students across several years (Fredricks & McColskey, 2012). Some have even argued that self-report is required for subtypes of student engagement that are higher inference and less easily observed (i.e., cognitive and affective engagement; Appleton et al., 2006; Christenson et al., 2008; Reschly & Christenson, 2012). Cautions regarding self-report surveys include whether students answer honestly and these measures' tendency to be focused on general, or global, engagement rather than specific strategies, tasks, or situations (Fredricks & McColskey, 2012).

The desire to measure student engagement in a comprehensive way – that is, including behavioral, affective, and cognitive subtypes – requires several decisions to translate this desire into action, including the determination of respondent (i.e., teacher, student), selection of instruments, timing and frequency of data collection, and how the data will be compiled and used by educators. As noted previously, some indicators of engagement are readily and easily tracked in many school data systems (Reschly et al., 2014; Reschly & Christenson, 2012) and, therefore, may be updated

daily or weekly, such as attendance, disciplinary incidents, and homework completion, whereas other indicators, particularly those garnered from observations or surveys, may be collected less frequently owing to concerns over cost and time or limitations of the measures themselves. For example, few, if any, engagement surveys are designed to be given on a daily, weekly, or even monthly basis; thus, a biannual or triannual schedule for survey data is much more likely (e.g., Appleton, 2012). Furthermore, the selection of a survey instrument should be guided by considerations of costs and time to administer and score the survey, as well as weighing the psychometric evidence for use with students of various ages and other demographic characteristics, as well as cultures. Properties of an instrument normed and extensively researched in one country or culture, or with specific populations, do not necessarily transfer to other cultures, languages, or groups. However, in addition to limitations in the measures themselves, it may also be that some indicators of engagement are sensitive to small changes in performance (e.g., attendance, homework completion), whereas students' cognition and emotions tend to be more stable and slower to change, with naturally occurring variations in contexts thought to affect student engagement (i.e., home, school, peers, and community) or the introduction of other interventions. Giving weight to this possibility is the time needed to develop or improve relationships or perhaps learn new self-regulation strategies.

Students with Attention, Learning, Behavioral, and Emotional Difficulties

Given its origins in the dropout literature, engagement is especially relevant for those who are at risk for poor educational outcomes, including those with attendance, behavior, or learning problems. The type of engagement data collected or how they may be used does not typically vary for these students. For example, indicators of engagement, such as attendance, behavioral incidents, extracurricular participation, homework completion, feelings of belonging, and so forth, are predictive of short- and long-term outcomes, regardless of whether students have been diagnosed with behavior, attention, emotional, or learning difficulties, are from lower-SES backgrounds, or experience other forms of risk (e.g., friends who dropped out, English learner status). However, some modifications may be necessary, depending on the nature of students' difficulties (e.g., those with reading difficulties may benefit from having survey questions read aloud). Students with more severe difficulties or those with low-incidence disabilities, such as moderate-to-profound intellectual disability, are largely absent from the engagement and school completion literatures.

Linking Assessment to Intervention

Arguably, the purpose of assessment is to inform instruction or intervention (Christenson & Ysseldyke, 1989). Unfortunately, much has been written about the difficulty educators, psychologists, and researchers have in linking assessment to interventions for school-age youth (Reschly & Chaffin, 2015; VanDerHeyden & Burns, 2018; Ysseldyke & Christenson, 2002), either owing to limitations of the type of data that are collected (e.g., variables that are not amenable to intervention, narrow targets for intervention; Christenson & Anderson, 2002; Christenson & Ysseldyke, 1989; Sheridan & Gutkin, 2000) or the limitations of assessment that is conducted for the

purpose of classification (Reschly, 2008). For example, a student's IQ score or percentile rank on a broad achievement test does little to describe specific deficits the student may have (e.g., sight words, specific mathematics skills, function of a disruptive behavior) and does not link well to specific intervention strategies or programs. In theory, student engagement data are ideal for the purpose of linking assessment to intervention: engagement resonates with educators, is linked to important outcomes, and is amenable to changes in contexts or more formal interventions (Reschly et al., 2014; Reschly & Christenson, 2012; Reschly et al., 2017).

In a practical sense, educators may struggle to collect and interpret comprehensive student engagement information. The growing prevalence of early warning systems (Department of Education, 2016c) may alleviate some of the difficulty of translating engagement into a practical, user-friendly format, provided higher-inference (i.e., cognitive and affective) subtypes are also included (Reschly & Christenson, 2019). However, caution is warranted in that we must do better than merely using students' engagement data to make better predictions about who will drop out of school or the likelihood of a student attending and persisting in college. The key, then, is taking this information about students' engagement and risk and linking it to intervention efforts (Reschly & Christenson, 2019). This information can be further differentiated to determine if whole-school or classroom-based interventions may be warranted (e.g., large numbers of students who are chronically absent, classrooms with rates of academic engagement below 80% of observations) and those students who may need more intensive, individualized support for their engagement and academic progress (Reschly et al., 2014, 2017). For example, as described by Reschly et al. (2014; 2017), when student survey responses indicate low levels of cognitive engagement, interventionists may examine what is done at the classroom level to promote a mastery goal orientation (e.g., Anderman & Patrick, 2012), work with families to deliver messages of motivational support (e.g., talking with their children about school, having high expectations), or consider a self-regulation program such as self-regulation strategy development, an instructional intervention that has been used with students with and without disabilities to improve academic skills, including modeling, goal-setting, and self-monitoring (Institute of Education Sciences, 2017). If student responses indicate low levels of belonging or lack of participation in school clubs, sports, or activities, educators may work to address barriers to participation (e.g., transportation) and link students' interests to offerings (Reschly et al., 2014).

Intervention

The study of student engagement is a relatively recent phenomenon; thus, efforts to measure the construct and design effective interventions understandably are even more recent developments. However, engagement draws broadly from several well-researched subconstructs, such as those related to school belonging, extracurricular participation, attendance, students' perceptions of family support, and so on. Among interventions to address high school dropout, arguably the most advanced arena for student engagement interventions, definitive statements regarding what works, for whom, and under what conditions cannot be made (cf. Reschly et al., 2014, 2017; Rumberger et al., 2017). There are two main implications of the status of this work. First, there are promising engagement interventions, and students with attention,

behavioral, emotional, and learning difficulties are frequently included or targeted specifically for these efforts (e.g., HOPS was designed for students with ADHD; Langberg et al., 2011; Check & Connect was first implemented with students identified as EBD; Sinclair, Christenson, Evelo, & Hurley, 1998). Interventions have been described by subtype (cognitive, affective, behavioral) and level (i.e., whole group, targeted; Christenson et al., 2008; Reschly et al., 2014, 2017), and new, promising engagement interventions have been piloted (Wang & Amemiya, 2019). In sum, there are empirically supported student engagement interventions that may be used in schools. The second implication is that, because this is a relatively new area, it is imperative that schools ensure the treatment integrity of the interventions as implemented in their settings and evaluate the effectiveness of these interventions with their students (Reschly & Christenson, 2012; Reschly et al., 2017).

IMPLICATIONS FOR RESEARCHERS AND FUTURE RESEARCH

As the previously reviewed studies suggest, students with special needs are at risk of lower engagement and academic achievement than their typically functioning peers, and more research on student engagement is needed for this population. Although there is wide agreement that engagement is multidimensional and involves aspects of emotion, cognition, and behavior (Fredricks et al., 2004), there are a range of definitions among scholars and, thus, differences in methods of engagement measurement (Christenson et al., 2012a; Reschly & Christenson, 2012). Specifically examining the literature of students with special needs and their engagement, most studies examine components of engagement subtypes rather than measuring a specific engagement subtype (e.g., assessing self-regulation strategies versus cognitive engagement). Our review suggests that there are a lack of studies examining the meta-construct of engagement or multiple subtypes of engagement for students with special needs.

Considerations for the measurement of student engagement in future studies include the data source that is used (e.g., school data; teacher-, parent-, or student-report) and how engagement measures function across groups (Fredricks & McColskey, 2012), including those with attention, learning, and behavior difficulties. Future research could examine the universality of engagement measures of various subgroups of students, including those with learning, behavior, and attention difficulties (Christenson et al., 2012a). As other scholars have discussed, it is unclear how universal the student engagement construct is across cultures, and the importance of social contexts may vary in different cultural contexts (Reschly & Christenson, 2012; Wylie & Hodgen, 2012).

There are also developmental differences in students' engagement (Fredricks & McColskey, 2012). A common finding in the engagement and motivation literatures is declining engagement and motivation as students progress from elementary to middle school and middle school to high school (e.g., Lovelace et al., 2014; National Research Council, 2004; Wigfield & Eccles, 2000). Furthermore, the relative importance of various indicators may change with age (Fredricks & McColskey, 2012). For example, younger students have fewer opportunities for extracurricular participation and lower rates of suspension and expulsion from school. On the other hand, students may not develop some of the self-regulation skills that are often conceptualized as part of cognitive engagement until they are older (Fredricks & McColskey, 2012). Research

with the Student Engagement Instrument appears to support this idea, with changes in the number of factors and items from early elementary school through college (Appleton et al., 2006; Carter, Reschly, Lovelace, Appleton, & Thompson, 2012; Grier-Reed, Appleton, Rodriguez, Ganuza, & Reschly, 2012; Waldrop, Reschly, Fraysier, & Appleton, 2019; Wright, Reschly, Hyson, & Appleton, 2019). Regarding students with special needs, more research is needed that examines the relationship between the development of engagement in relation to behavioral, attention, and learning difficulties and academic outcomes (Rogers & Tannock, 2013). Other researchers have described the need for studies that examine differences in the engagement of special needs students across grades (Langberg et al., 2011; Losinski et al., 2014) and gender (Rogers & Tannock, 2013).

Longitudinal studies of student engagement have identified multiple profiles and trajectories of engagement across the general student population; although most students demonstrate stable and high levels of engagement, there is variability in the stability and level of engagement for a significant minority of students (Archambault & Dupéré, 2017; Janosz et al., 2008; Li & Lerner, 2011; O'Donnell et al., 2019; Wylie & Hodgen, 2012). Moreover, students with higher and more consistent engagement trajectories experience better academic outcomes related to on-time high school graduation (Janosz et al., 2008; Wylie & Hodgen, 2012) and postsecondary enrollment (Lawson & Masyn, 2015) and persistence (O'Donnell et al., 2019). Although it seems likely that students with behavioral, emotional, and learning needs would be more likely to demonstrate unstable and lower levels of engagement, further research is necessary to determine developmental trajectories of engagement for this population.

Given their potential to improve the academic and social-emotional functioning of all students, more engagement interventions are needed (Christenson et al., 2012a; Fredricks, Reschly, & Christenson, 2019). As research on interventions for improving student engagement is relatively recent in the literature, future studies need to examine what interventions work, how they work, how much intervention is necessary, and when intervention needs to begin to be the most effective (Reschly & Christenson, 2012). Along with these issues, future research may identify if certain interventions are more or less effective for special needs student populations.

CONCLUSION

Student engagement is a unifying construct that draws broadly from several domains, including students' motivation, their participation in class and school, behavior, attendance, emotions while learning, connections to others in the school environment, self-regulation, and perceived value of education. Across many years and studies, these indicators of student engagement have been found to be associated with current variables of interest, such as achievement and emotional well-being, as well as long-term outcomes such as graduating from high school on time and post-secondary attendance and persistence. Unlike so many other variables that predict students' outcomes (e.g., SES), student engagement is amenable to intervention and, thus, a growing focus of school-based interventions. The purpose of this chapter was to examine the affective, cognitive, behavioral, and academic engagement of students with attention, learning, and behavior difficulties. The studies reviewed indicated the difficulty these students have in terms of their engagement at school and with learning and

underscored the need for support and intervention. For practice, we recommended the regular collection and examination of student engagement data, including the need for student self-report, and the importance of linking these data to interventions for youth showing signs of disengagement from school. Engagement-based interventions are growing, and a number of promising strategies and programs have been identified. These interventions may be categorized by type of engagement (e.g., cognitive, behavioral) addressed, as well as whether the intervention is intended for universal use (i.e., whole school, whole classroom) or more targeted efforts (i.e., small groups, individuals). Implications for research were also discussed, such as: the range of definitions and methods of measurement in the field, which may hamper efforts to further theory and draw conclusions for practice; the need to examine student engagement across cultures and with specific populations of students, including those with learning, behavior and attention difficulties; the importance of considering how student engagement may change across development; and further development and examination of student engagement interventions to answer questions regarding the timing of intervention, how much is required, and how the intervention works in general, as well as for students with special needs.

NOTE

- 1 Post-secondary attendance for general population was 62% compared with 55% for all disabilities and 56.6%, 44.9%, and 60.9%, respectively, for students identified with OHI (where ADHD students are frequently served), ED, and learning disability.

REFERENCES

- Achilles, G. M., McLaughlin, M. J., & Croninger, R. G. (2007). Sociocultural correlates of disciplinary exclusion among students with emotional, behavioral, and learning disabilities in the seals national dataset. *Journal of Emotional and Behavioral Disorders, 15*, 33–45. doi:10.1177/10634266070150010401
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.
- Anderman, E. M., & Patrick, H. (2012). Achievement goal theory, conceptualization of ability/intelligence, and classroom climate. In S. L. Christenson, A. L. Reschly, C. Wylie, S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 173–191). New York: Springer. doi:10.1007/978-1-4614-2018-7_8
- Appleton, J. J. (2012). Systems consultation: Developing the assessment-to-intervention link with the student engagement instrument. In S. L. Christenson, A. L. Reschly, C. Wylie, S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 725–741). New York: Springer. doi:10.1007/978-1-4614-2018-7_35
- Appleton, J. J., Christenson, S. L., Kim, D., & Reschly, A. L. (2006). Measuring cognitive and psychological engagement: Validation of the student engagement instrument. *Journal of School Psychology, 44*, 427–445. doi:10.1016/j.jsp.2006.04.002
- Appleyard, K., Egeland, B., van Dulmen, M. H., & Sroufe, L. A. (2005). When more is not better: The role of cumulative risk in child behavior outcomes. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 46*, 235–245. doi:10.1111/j.1469-7610.2004.00351.x
- Archambault, I., & Dupéré, V. (2017). Joint trajectories of behavioral, affective, and cognitive engagement in elementary school. *The Journal of Educational Research, 110*, 188–198. doi:10.1080/00220671.2015.1060931
- Baird, G. L., Scott, W. D., Dearing, E., & Hamill, S. K. (2009). Cognitive self-regulation in youth with and without learning disabilities: Academic self-efficacy, theories of intelligence, learning vs. performance goal preferences, and effort attributions. *Journal of Social and Clinical Psychology, 28*, 881–908. doi:10.1521/jscp.2009.28.7.881

- Balfanz, R., & Byrnes, V. (2019). Early warning indicators and intervention systems: State of the field. In J. Fredricks, A. Reschly, & S. Christenson (Eds.), *Handbook of student engagement interventions: Working with disengaged youth* (pp. 45–55). New York: Elsevier.
- Balfanz, R., Byrnes, V., & Fox, J. (2014). Sent home and put off-track: The antecedents, disproportionalities, and consequences of being suspended in the ninth grade. *Journal of Applied Research on Children: Informing Policy for Children at Risk*, 5(2), 1–19. Retrieved from: <https://digitalcommons.library.tmc.edu/childrenatrisk/vol5/iss2/13>
- Balfanz, R., Herzog, L., & Mac Iver, D. J. (2007). Preventing student disengagement and keeping students on the graduation path in urban middle-grades schools: Early identification and effective interventions. *Educational Psychologist*, 42, 223–235. doi:10.1080/00461520701621079
- Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin*, 121(1), 65–94. doi:10.1037/0033-2909
- Bear, G. G., Mantz, L. S., Glutting, J. J., Yang, C., & Boyer, D. E. (2015). Differences in bullying victimization between students with and without disabilities. *School Psychology Review*, 44, 98–116. doi:10.17105/SPR44-1.98-116
- Beidel, D. C., Turner, S. M., & Morris, T. L. (1999). Psychopathology of childhood social phobia. *Journal of the American Academy of Child and Adolescent Psychiatry*, 38, 643–650. doi:10.1097/00004583-199906000-00010
- Bohnert, A. M., Kane, P., & Garber, J. (2008). Organized activity participation and internalizing and externalizing symptoms: Reciprocal relations during adolescence. *Journal of Youth and Adolescence*, 37, 239–250. doi:10.1007/s10964-007-9195-1
- Buehler, M. H., Tapogna, J., & Chang, H. N. (2012). *Why being in school matters: Chronic absenteeism in Oregon public schools*. *Attendance Works*, June 2012.
- Cancio, E. J., West, R. P., & Young, R. K. (2004). Improving mathematics homework completion and accuracy of students with EBD through self-management and parent participation. *Journal of Emotional and Behavioral Disorders*, 12, 9–22. doi:10.1177/10634266040120010201
- Carter, C., Reschly, A. L., Lovelace, M. D., Appleton, J. J., & Thompson, D. (2012). Measuring student engagement among elementary students: Pilot of the elementary student engagement instrument. *School Psychology Quarterly*, 27, 61–73. doi:10.1037/a0029229
- Christenson, S. L., & Anderson, A. R. (2002). Commentary: The centrality of the learning context for students' academic enabler skills. *School Psychology Review*, 31, 378–393.
- Christenson, S. L., Reschly, A. L., Appleton, J. J., Berman, S., Spanjers, D., & Varro, P. (2008). Best practices in fostering student engagement. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology* (5th ed., pp. 1099–1120). Bethesda, MD: National Association of School Psychologists.
- Christenson, S. L., Reschly, A. L., & Pohl, A. (2012a). Epilogue. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 813–817). New York: Springer.
- Christenson, S. L., Reschly, A. L., & Wylie, C. (2012b). *Handbook of research on student engagement*. New York: Springer.
- Christenson, S. L., & Ysseldyke, J. E. (1989). Assessing student performance: An important change is needed. *Journal of School Psychology*, 27, 409–425. doi:10.1016/0022-4405(89)90017-4
- Cooper, H., Lindsay, J. J., Nye, B., & Greathouse, S. (1998). Relationships among attitudes about homework, amount of homework assigned and completed, and student achievement. *Journal of Educational Psychology*, 90, 70–83. doi:10.1037//0022-0663.90.1.70
- Cooper, H., Robinson, J. C., & Patall, E. A. (2006). Does homework improve academic achievement? A synthesis of research, 1987–2003. *Review of Educational Research*, 76, 1–62. doi:10.3102/00346543076001001
- Cuenca-Sanchez, Y., Mastropieri, M. A., Scruggs, T. E., & Kidd, J. K. (2012). Teaching students with emotional and behavioral disorders to self-advocate through persuasive writing. *Exceptionality*, 20, 71–93. doi:10.1080/09362835.2012.669291
- De La Paz, S. (1999). Self-regulated strategy instruction in regular education settings: Improving outcomes for students with and without learning disabilities. *Learning Disabilities Research & Practice*, 14, 92–106. doi:10.1207/sldrp1402_3
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum. doi:10.1007/978-1-4899-2271-7
- Denault, A. S., & Déry, M. (2015). Participation in organized activities and conduct problems in elementary school: The mediating effect of social skills. *Journal of Emotional and Behavioral Disorders*, 23, 167–179. doi:10.1177/1063426614543950

- Driessens, C. (2015). Extracurricular activity participation moderates impact of family and school factors on adolescents' disruptive behavioural problems. *BMC Public Health*, 15, 1–13. doi:10.1186/s12889-015-2464-0
- Epstein, M. H., Foley, R. M., & Polloway, E. A. (1995). Homework problems: A comparison of students identified as behaviorally disorders with nonhandicapped students. *Preventing School Failure: Alternative Education for Children and Youth*, 40(1), 14–18. doi:10.1080/1045988X.1995.9944645
- Epstein, M. H., Polloway, E. A., Foley, R. A., & Patton, J. R. (1993). Homework: A comparison of teachers' and parents' perceptions of the problems experienced by students identified as having behavioral disorders, learning disabilities, or no disabilities. *Remedial & Special Education*, 14, 40–50. doi:10.1177/074193259301400507
- Feldman, A. F., & Matjasko, J. L. (2005). Profiles and portfolios of adolescent school-based extracurricular activity participation. *Journal of Adolescence*, 30, 313–332. doi:10.1016/j.adolescence.2006.03.004
- Feldman Farb, A., & Matjasko, J. L. (2012). Recent advances in research on school-based extracurricular activities and adolescent development. *Developmental Review*, 32, 1–48. doi:10.1016/j.dr.2011.10.001
- Finn, J. D. (1989). Withdrawing from school. *Review of Educational Research*, 59, 117–142. doi:10.3102/00346543059002117
- Finn, J. D. (2006). *The adult lives of at-risk students: The roles of attainment and engagement in high school* (NCES2006-328). Washington, DC: U.S. Department of Education, National Center for Education Statistics.
- Finn, J. D., & Rock, D. A. (1997). Academic success among students at-risk for school failure. *Journal of Applied Psychology*, 82, 221–234. doi:10.1037/0021-9010.82.2.221
- Finn, J. D., & Zimmer, K. (2012). Student engagement: What is it? Why does it matter? In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 97–131). New York: Springer. doi:10.1007/978-1-4614-2018-7_5
- Fredricks, J. A. (2012). Extracurricular participation and academic outcomes: Testing the over-scheduling hypothesis. *Journal of Youth and Adolescence*, 41, 295–306. doi:10.1007/s10964-011-9704-0
- Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). Student engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, 74, 59–109. doi:10.3102/00346543074001059
- Fredricks, J. A., & McColskey, W. (2012). The measurement of student engagement: A comparative analysis of various methods and student self-report instruments. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 763–782). New York: Springer. doi:10.1007/978-1-4614-2018-7_37
- Fredricks, J. A., Reschly, A. L., & Christenson, S. L. (Eds.). (2019). *Handbook of student engagement interventions: Working with disengaged youth*. New York: Elsevier.
- Friend, M., & Bursuck, W. D. (2012). *Including students with special needs: A practical guide for classroom teachers* (6th ed.). Upper Saddle River, NJ: Pearson Education.
- Geisthardt, C., & Munsch, J. (1996). Coping with school stress: A comparison of adolescents with and without learning disabilities. *Journal of Learning Disabilities*, 29, 287–296. doi:10.1177/002221949602900307
- Gottfried, M., Stiefel, L., Schwartz, A. E., & Hopkins, B. *Showing up: Disparities in chronic absenteeism between students with and without disabilities*. Institute for Education and Social Policy Working Paper #03-17 June 2017.
- Graham, L., & Berman, J. (2012). Self-regulation and learning disabilities. *Special Education Perspectives*, 21, 42–52. Retrieved from: www.researchgate.net/publication/236890580
- Graham, S., MacArthur, C., & Schwartz, S. (1995). Effects of goal setting and procedural facilitation on the revising behavior and writing performance of students with writing and learning problems. *Journal of Educational Psychology*, 87, 230–240. doi:10.1037/0022-0663.87.2.230
- Graham, S., MacArthur, C., Schwartz, S., & Page-Voth, V. (1992). Improving the compositions of students with learning disabilities using a strategy involving product and process goal setting. *Exceptional Children*, 58, 322–334. doi:10.1177/001440299205800405
- Green, B. A., Miller, R. B., Crowson, H. M., Duke, B. L., & Akey, K. L. (2004). Predicting high school students' cognitive engagement and achievement: Contributions of classroom perceptions and motivation. *Contemporary Educational Psychology*, 29, 462–482. doi:10.1016/j.cedpsych.2004.01.006
- Grier-Reed, T., Appleton, J. J., Rodriguez, M., Ganuza, Z., & Reschly, A. L. (2012). Exploring the Student Engagement Instrument and career perceptions with college students. *Journal of Educational and Developmental Psychology*, 2, 85–96. doi:10.5539/jedp.v2n2p85
- Hagborg, W. J. (1998). School membership among students with learning disabilities and nondisabled students in a semirural high school. *Psychology in the Schools*, 35, 183–188. doi:10.1002/(SICI)1520-6807(199804)35:2<183::AID-PITS10>3.0.CO;2-8

- Harris, K. R., Friedlander, B. D., Saddler, B., Frizzelle, R., & Graham, S. (2005). Self-monitoring of attention versus self-monitoring of academic performance: Effects among students with ADHD in the general education classroom. *Journal of Special Education, 39*, 145–156. doi:10.1177/00224669050390030201
- Howie, L. D., Lukacs, S. L., Pastor, P. N., Reuben, C. A., & Mendola, P. (2010). Participation in activities outside of school hours in relation to problem behavior and social skills in middle childhood. *Journal of School Health, 80*, 119–125. doi:10.1111/j.1746-1561.2009.00475.x
- Individuals with Disabilities Education Act. (2004). 20 U.S.C. § 1400.
- Institute of Education Sciences. (2017). WWC intervention report: Self-regulated strategy development. *What Works Clearinghouse*, Institute of Education Sciences, U.S. Department of Education, Washington, D.C. Retrieved from: https://ies.ed.gov/ncee/wwc/Docs/InterventionReports/wwc_srsd_111417.pdf
- Janosz, M., Archambault, I., Morizot, J., & Pagani, L. (2008). School engagement trajectories and their differential predictive relations to dropout. *Journal of Social Issues, 64*, 21–40. doi:10.1111/j.1540-4560.2008.00546.x
- Johnson, L., Graham, S., & Harris, K. R. (1997). The effects of goal setting and self-instruction on learning a reading comprehension strategy: A student of students with learning disabilities. *Journal of Learning Disabilities, 30*, 80–91. doi:10.1177/002221949703000107
- Kent, K. M., Pelham, W. E., Molina, B. S. G., Sibley, M. H., Waschbusch, D. A., Yu, J., & Karch, K. M. (2011). The academic experience of male high school students with ADHD. *Journal of Abnormal Child Psychology, 39*, 451–462. doi:10.1007/s10802-010-9472-4
- Kessler, R. C., Foster, C. L., Saunders, W. B., & Stang, P. E. (1995). Social consequences of psychiatric disorders, I: Educational attainment. *The American Journal of Psychiatry, 152*, 1026–1032. doi:10.1176/ajp.152.7.1026
- Ladd, G. W., Ettekal, L., & Kochenderfer-Ladd, B. (2017). Peer victimization trajectories from kindergarten through high school: Differential pathways for children's school engagement and achievement? *Journal of Educational Psychology, 109*, 826–841. doi:10.1037/edu0000177
- Langberg, J. M., Arnold, L. E., Flowers, A. M., Altaye, M., Epstein, J. N., & Molina, B. S. G. (2010). Assessing homework performance problems in children with ADHD: Validation of a parent-report measure and evaluation of homework performance patterns. *School Mental Health, 2*, 3–12. doi:10.1007/s12310-009-9021-x
- Langberg, J. M., Epstein, J. N., Girio, E. L., Becker, S. P., Vaughn, A. J., & Altaye, M. (2011). Materials, organization, planning, and homework completion in middle school students with ADHD: Impact on academic performance. *School Mental Health, 3*, 93–101. doi:10.1007/s12310-011-9052-y
- Lawson, M. A., & Masyn, K. E. (2015). Analyzing profiles, predictors, and consequences of student engagement dispositions. *Journal of School Psychology, 53*, 63–86. doi:10.1016/j.jsp.2014.11.004
- Li, Y., & Lerner, R. M. (2011). Trajectories of school engagement during adolescence: Implications for grades, depression, delinquency, and substance use. *Developmental Psychology, 47*, 233–247. doi:10.1037/a0021307
- Losinski, M., Cuenca-Carlino, Y., Zablocki, M., & Teagarden, J. (2014). Examining the efficacy of self-regulated strategy development for students with emotional or behavioral disorders: A meta-analysis. *Behavioral Disorders, 40*, 52–67. doi:10.17988/0198-7429-40.1.52
- Lovelace, M. D., Reschly, A. L., Appleton, J. J., & Lutz, M. E. (2014). Concurrent and predictive validity of the Student Engagement Instrument. *Journal of Psychoeducational Assessment, 32*, 509–520. doi:10.1177/0734282914527548
- Martin, A. J. (2007). Examining a multidimensional model of student motivation and engagement using a construct validation approach. *British Journal of Educational Psychology, 77*, 413–440. doi:10.1348/000709906x118036
- Martin, A. J. (2012). The role of personal best (PB) goals in the achievement and behavioral engagement of students with ADHD and students without ADHD. *Contemporary Educational Psychology, 37*, 91–105. doi:10.1016/j.cedpsych.2012.01.002
- McFarland, J., Cui, J., & Stark, P. (2018). Trends in high school dropout and completion rates in the United States: 2014 (NCES 2018-117). *U.S. Department of Education*. Washington, DC: National Center for Education Statistics. Retrieved February 28, 2018 from: <http://nces.ed.gov/pubsearch>
- McIntosh, R., Vaughn, S., Schumm, J. S., Haager, D., & Lee, O. (1993). Observations of students with learning disabilities in general education classrooms. *Exceptional Children, 60*, 249–261. doi:10.1177/001440299406000306
- McNeely, C. A., Nonnemaker, J. M., & Blum, R. W. (2002). Promoting school connectedness: Evidence from the national longitudinal study of adolescent health. *The Journal of School Health, 72*, 138–146. doi:10.1111/j.1746-1561.2002.tb06533.x
- Mega, C., Ronconi, L., & De Beni, R. (2014). What makes a good student? How emotions, self-regulated learning, and motivation contribute to academic achievement. *Journal of Educational Psychology, 106*, 121–131. doi:10.1037/a0033546

- Metsäpelto, R.-L., & Pulkkinen, L. (2012). Socioemotional behavior and school achievement in relation to extra-curricular activity participation in middle childhood. *Scandinavian Journal of Educational Research*, 56, 167–182. doi:10.1080/00313831.2011.581681
- Montague, M. (2008). Self-regulation strategies to improve mathematical problem solving for students with learning disabilities. *Learning Disability Quarterly*, 31(1), 37–44. doi:10.2307/30035524
- Mooney, P., Ryan, J. B., Uhing, B. M., Reid, R., & Epstein, M. H. (2005). A review of self-management interventions targeting academic outcomes for students with emotional and behavioral disorders. *Journal of Behavioral Education*, 14, 203–221. doi:10.1007/s10864-005-6298-1
- Murray, C., & Greenberg, M. T. (2000). Children's relationship with teachers and bonds with school: An investigation of patterns and correlates in middle childhood. *Journal of School Psychology*, 38, 423–445. doi:10.1016/s0022-4405(00)00034-0
- Murray, C., & Greenberg, M. T. (2001). Relationships with teachers and bonds with school: Social emotional adjustment correlates for children with and without disabilities. *Psychology in the Schools*, 38, 25–41. doi:10.1002/1520-6807(200101)38:1<25::AID-PITS4>3.0.CO;2-C
- Murray, C., & Greenberg, M. T. (2006). Examining the importance of social relationships and social contexts in the lives of children with high-incidence disabilities. *The Journal of Special Education*, 39, 220–233. doi:10.1177/00224669060390040301
- National Research Council and the Institute of Medicine. (2004). *Engaging schools: Fostering high school students' motivation to learn*. Committee on Increasing High School Students' Engagement and Motivation to Learn. Board on Children, Youth, and Families, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.
- Noltemeyer, A. L., Ward, R. M., & McLoughlin, C. (2015). Relationship between school suspension and student outcomes: A meta-analysis. *School Psychology Review*, 44, 224–240. doi:10.17105/spr-14-0008.1
- O'Donnell, K. C., Lovelace, M. D., Reschly, A. L., & Appleton, J. J. (2019). Longitudinal trajectories of student engagement: Predicting high school graduation and college attendance. Manuscript under review.
- Pollaway, E. A., Foley, R. M., & Epstein, M. H. (1992). A comparison of the homework problems of students with learning disabilities and nonhandicapped students. *Learning Disabilities Research & Practice*, 7, 203–209. Retrieved from: <https://psycnet.apa.org/record/1993-15513-001>
- Power, T. J., Werba, B. E., Watkins, M. W., Angelucci, J. G., & Eiraldi, R. B. (2006). Patterns of parent-reported homework problems among ADHD-referred and non-referred children. *School Psychology Quarterly*, 41, 13–33. doi:10.1521/scpq.2006.21.1.13
- Ready, D. D. (2010). Socioeconomic disadvantage, school attendance, and early cognitive development: The differential effects of school exposure. *Sociology of Education*, 83, 271–286. doi:10.1177/0038040710383520
- Reeve, J. (2012). A self-determination theory perspective on student engagement. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 149–172). New York: Springer. doi:10.1007/978-1-4614-2018-7_7
- Reid, R., & Lienemann, T. O. (2006). Self-regulated strategy development for written expression with students with attention deficit/hyperactivity disorder. *Exceptional Children*, 73, 53–68. doi:10.1177/001440290607300103
- Reid, R., Trout, A. L., & Schartz, M. (2005). Self-regulation interventions for children with attention deficit/hyperactivity disorder. *Exceptional Children*, 71, 361–377. Retrieved from: <https://psycnet.apa.org/record/2005-06917-001>
- Reschly, A. L., Appleton, J. J., & Pohl, A. (2014). Best practices in fostering student engagement. In A. Thomas & P. Harrison (Eds.), *Best practices in school psychology* (6th ed., pp. 37–50). Bethesda, MD: National Association of School Psychologists.
- Reschly, A. L., & Chaffin, M. C. (2015). Contextual influences and response to intervention. In S. R. Jimerson, M. K. Burns, & A. M. VanDerHeyden (Eds.), *Handbook of response to intervention: The science and practice of multi tiered systems of support* (2nd ed., pp. 441–453). New York: Springer. doi:10.1007/978-1-4899-7568-3_26
- Reschly, A. L., & Christenson, S. L. (2006). Prediction of dropout among students with mild disabilities: A case for the inclusion of student engagement variables. *Remedial and Special Education*, 27, 276–292. doi:10.1177/07419325060270050301
- Reschly, A. L., & Christenson, S. L. (2012). Jingle, jangle, and conceptual haziness: Evolution and future directions of the engagement construct. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 3–19). New York: Springer. doi:10.1007/978-1-4614-2018-7_1
- Reschly, A. L., & Christenson, S. L. (2019). *Lowering the high school dropout rate: Lessons from the research*. (PDK Primer #2). Arlington, VA: Phi Delta Kappa.

- Reschly, A. L., Pohl, A., Christenson, S. L., & Appleton, J. J. (2017). Engaging adolescents in secondary schools. In B. Schultz, J. Harrison, & S. Evans (Eds.), *School mental health services for adolescents* (pp. 45–77). New York: Oxford University Press. doi:10.1093/med-psych/9780199352517.003.0003
- Reschly, D. J. (2008). Paradigm shift and beyond. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology* (5th ed., pp. 3–15). Bethesda, MD: National Association of School Psychologists.
- Reynolds, A. J. (1999). *The Chicago longitudinal study: A study of children in the Chicago public schools*. Retrieved October 3, 2006 from: www.waisman.wisc.edu/cls/CLSWEB.PDF
- Reynolds, A. J. (2001). *Press release: Long-term effects of CPC program*. Retrieved October 3, 2006 from: www.waisman.wisc.edu/cls/PRESS01.PDF
- Roby, D. E. (2003). Research on school attendance and student achievement: A study of Ohio schools. *Educational Research Quarterly*, 28, 4–15. Retrieved from: <https://eric.ed.gov/?id=EJ714746>
- Rogers, M., & Tannock, R. (2013). Are classrooms meeting the basic psychological needs of children with ADHD symptoms? A self-determination theory perspective. *Journal of Attention Disorders*, 22, 1354–1360. doi:10.1177/1087054713508926
- Roorda, D. L., Jak, S., Zee, M., Oort, F. J., & Koomen, H. M. Y. (2017). Affective teacher–student relationships and students’ engagement and achievement: A meta-analytic update and test of the mediating role of engagement. *School Psychology Review*, 46, 239–261. doi:10.17105/SPR-2017-0035.V46-3
- Roorda, D. L., Koomen, H. M. Y., Spilt, J. L., & Oort, F. J. (2011). The influence of affective teacher–student relationships on students’ school engagement and achievement: A meta-analytic approach. *Review of Educational Research*, 81, 493–529. doi:10.3102/0034654311421793
- Rumberger, R., Addis, H., Allensworth, E., Balfanz, R., Bruch, J., Dillon, E., ... Tuttle, C. (2017). *Preventing dropout in secondary schools (NCEE 2017-4028)*. Washington, DC: National Center for Education and Regional Assistance (NCEE), Institute of Education Sciences, U.S. Department of Education. <https://whatworks.ed.gov>
- Ryan, R. M. (1995). Psychological needs and the facilitation of integrative processes. *Journal of Personality*, 63, 397–427. doi:10.1111/j.1467-6494.1995.tb00501.x
- Ryan, R. M., & Connell, J. P. (1989). Perceived locus of causality and internalization: Examining reasons for acting in two domains. *Journal of Personality and Social Psychology*, 57, 749–761. doi:10.1037/0022-3514.57.5.749
- Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology*, 25, 54–67. doi:10.1006/ceps.1999.1020
- Salmela-Aro, K., Moeller, J., Schneider, B., Spicer, J., & Lavonen, J. (2016). Integrating the light and dark sides of student engagement using person-oriented and situation-specific approaches. *Learning and Instruction*, 43, 61–70. doi:10.1016/j.learninstruc.2016.01.001
- Sanford, C., Newman, L., Wagner, M., Cameto, R., Knokey, A.-M., & Shaver, D. (2011). *The post-high school outcomes of young adults with disabilities up to 6 years after high school. Key findings from the National Longitudinal Transition Study-2 (NLTS2)*. (NCSE 2011-3004). Menlo Park, CA: SRI International.
- Schunk, D. H., & Mullen, C. A. (2012). Self-efficacy as an engaged learner. In S. L. Christenson, A. L. Reschly, C. Wylie, S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 219–235). New York: Springer. doi:10.1007/978-1-4614-2018-7_10
- Schunk, D. H., & Zimmerman, B. J. (Eds.). (1998). *Self-regulated learning: From teaching to self-reflective practice*. New York: Guilford Press.
- Schweinhart, L. J., Montie, J., Xiang, Z., Barnett, W. S., Belfield, C. R., & Nores, M. (2005). *The high/scope perry preschool study through age 40: summary, conclusions and frequently asked questions*. Ypsilanti, MI: High/Scope Press. http://nieer.org/wp-content/uploads/2014/09/specialsummary_rev2011_02_2.pdf
- Sheridan, S., & Gutkin, T. (2000). The ecology of school psychology: Examining and changing our paradigm in the 21st century. *School Psychology Review*, 29, 485–502. Retrieved from: <https://psycnet.apa.org/record/2000-14347-001>
- Shimoni, M., Engel-Yeger, B., & Tirosh, E. (2010). Participation in leisure activities among boys with attention deficit hyperactivity disorder. *Research in Developmental Disabilities*, 31, 1234–1239. doi:10.1016/j.ridd.2010.07.022
- Sinclair, M. F., Christenson, S. L., Evelo, D. L., & Hurley, C. M. (1998). Dropout prevention for youth with disabilities: Efficacy of a sustained school engagement procedure. *Exceptional Children*, 65, 7–21. doi:10.1177/001440299806500101
- Skinner, E. A., & Pitzer, J. R. (2012). Developmental dynamics of student engagement, coping, and everyday resilience. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 21–44). New York: Springer. doi:10.1007/978-1-4614-2018-7_2

- Svetaz, M. V., Ireland, M., & Blum, R. (2000). Adolescents with learning disabilities: Risk and protective factors associated with emotional well-being: Findings from the national longitudinal study of adolescent health. *The Journal of Adolescent Health, 27*, 340–348. doi:10.1016/s1054-139x(00)00170-1
- Trout, A. L., Nordness, P. D., Pierce, C. D., & Epstein, M. H. (2003). Research on the academic status of children with emotional and behavioral disorders: A review of the literature from 1961 to 2000. *Journal of Emotional and Behavioral Disorders, 11*, 198–210. doi:10.1177/10634266030110040201
- U.S. Department of Education, Office for Civil Rights. (2016b). *2013-2014 Civil rights data collection: A first look*. Washington, DC: Author.
- U.S. Department of Education, Office of Planning, Evaluation, and Policy Development. (2016c). *Issue brief: Early warning systems*. Washington, DC: Author.
- U.S. Department of Education, Office of Special Education and Rehabilitative Services, Office of Special Education Programs. (2016a). *38th Annual Report to Congress on the implementation of the Individuals with Disabilities Education Act*. Washington, DC: Author.
- U.S. Department of Labor, Bureau of Labor Statistics. (2018). *Economic news release, college enrollment and work activity of recent high school and college graduates – 2017*. Retrieved from: www.bls.gov/news.release/hsgc.nr0.htm
- VanDerHeyden, A., & Burns, M. (2018). Improving decision making in school psychology: Making a difference in the lives of students, not just a prediction about their lives. *School Psychology Review, 47*, 385–395. doi:10.17105/SPR-2018-0042.V47-4
- Verret, C., Guay, M. C., Berthiaume, C., Gardiner, P., & Béliveau, L. (2012). A physical activity program improves behavior and cognitive functions in children with ADHD: An exploratory study. *Journal of Attention Disorders, 16*, 71–80. doi:10.1177/1087054710379735
- Vile Junod, R. E., DuPaul, G. J., Jitendra, A. K., Volpe, R. J., & Cleary, K. S. (2006). Classroom observations of students with and without ADHD: Differences across types of engagement. *Journal of School Psychology, 44*, 87–104. doi:10.1016/j.jsp.2005.12.004
- Voelkl, K. E. (1995). School warmth, student participation, and achievement. *Journal of Experimental Education, 63*, 127–138. doi:10.1080/00220973.1995.9943817
- Voelkl, K. E. (2012). School identification. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 193–218). New York: Springer. doi:10.1007/978-1-4614-2018-7_9
- Wagner, M. M., Friend, M., Bursuck, W. D., Kutash, K., Duchnowski, A. J., Sumi, W. C., & Epstein, M. H. (2006). Educating students with emotional disturbances: A national perspective on school programs and services. *Journal of Emotional and Behavioral Disorders, 14*, 12–30. doi:10.1177/10634266060140010201
- Wagner, M. N. (1995). Outcomes for youths with serious emotional disturbance in secondary school and early adulthood. *The Future of Children, 5*, 90–112. doi:10.2307/1602359
- Waldrop, D., Reschly, A. L., Fraysier, K., & Appleton, J. J. (2019). Measuring the engagement of college students: Administration format, structure, and validity of the student engagement instrument-college. *Measurement and Evaluation in Counseling and Development, 52*, 90–107. doi:10.1080/07481756.2018.1497429
- Wang, M. T., & Amemiya, J. (2019). Changing beliefs to be engaged in school: Using integrated mindset interventions to promote student engagement during school transitions. In J. Fredricks, A. Reschly, & S. Christenson (Eds.), *Handbook of student engagement interventions: Working with disengaged youth* (pp. 169–182). New York: Elsevier.
- Wang, M.-T., Fredricks, J., Ye, F., Hofkens, T., & Linn, J. S. (2017). Conceptualization and assessment of adolescents' engagement and disengagement in school. *European Journal of Psychological Assessment, 1*–15. doi:10.1027/1015-5759/a000431
- Wang, M. T., & Peck, S. (2013). Adolescent educational success and mental health vary across school engagement profiles. *Developmental Psychology, 49*, 1266–1276. doi:10.1037/a0030028
- Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology, 25*, 68–81. doi:10.1006/ceps.1999.1015
- World Health Organization (2016). *International statistical classification of diseases and related health problems 10th revision*. Retrieved February 2, 2018 from: <http://apps.who.int/classifications/icd10/browse/2016/en>
- World Health Organization. (2017). *Child and adolescent mental health*. Retrieved January 16, 2018 from: www.who.int/mental_health/maternal-child/child_adolescent/en/
- Wright, A., Reschly, A. L., Hyson, D., & Appleton, J. J. (2019). *Measuring student engagement in early elementary school*. Presentation at the Annual Meeting of the National Association of School Psychologists, Atlanta, GA.

- Wylie, C., & Hodgen, E. (2012). Trajectories and patterns of student engagement: Evidence from a longitudinal study. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 585–599). New York: Springer. doi:10.1007/978-1-4614-2018-7_28
- Yılmaz, A., Kırımoğlu, H., & Soyer, F. (2018). Comparison of loneliness and social skill levels of children with specific learning disabilities in terms of participation in sports. *Education Sciences*, 8, 37. doi:10.3390/educsci8010037
- Ysseldyke, J. E., & Christenson, S. L. (2002). *FAAB: Functional assessment of academic behavior: creating successful learning environments*. Longmont, CO: Sopris West.
- Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice*, 41, 64–70. doi:10.1207/s15430421tip4102_2
- Zimmerman, B. J., & Martinez-Pons, M. (1986). Development of a structured interview for assessing students' use of self-regulated learning strategies. *American Educational Research Journal*, 23, 614–628. doi:10.2307/1163093

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EXAMINING ACADEMIC SELF-CONCEPTS AND THE BIG-FISH-LITTLE-POND EFFECT IN RELATION TO INCLUSIVE AND SEGREGATED CLASSROOM ENVIRONMENTS FOR STUDENTS WITH MILD INTELLECTUAL DISABILITIES

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With positive academic self-concepts posited as key drivers of educational achievement, understanding the structure and enhancement of academic self-concepts has preoccupied the field of educational psychology for the past six decades. The current research investigating academic self-concepts is largely predicated on theories of social comparison (Festinger, 1954) such as the big-fish-little-pond effect (BFLPE; Marsh, 1987). The BFLPE suggests that the formation of an individual's academic self-concept is impacted by the academic performance of their peers. Specifically, being a high achiever (i.e., big fish) in a group of averagely lower academic achievers (i.e., little pond) enhances the individual's academic self-concept, as opposed to being a high achiever in a group of averagely higher academic achievers. This theory positions the classroom environment as a key determinant of academic self-concepts. Substantive and methodological advances within self-concept theory and research have been achieved mostly through examining the academic self-concepts of students who have been assigned to different educational "ponds" – namely, students who are identified as high achievers or gifted and talented, where they are allocated to special classes or schools separate from others of lower abilities. Ironically, students with disabilities, such as mild intellectual disabilities, experience significant educational disadvantages and, thus, are likely to benefit the most from advances in psycho-educational developmental theory and, more specifically, research into academic self-concepts. Students with mild intellectual disabilities are readily able to report their self-concepts and are educated in a range of classroom environments, including special schools (schooled with other students with mild intellectual disabilities at a separate institution), special

classes (schooled in a separate class with other students with mild intellectual disabilities, but where the class is located within a regular school), and inclusive classes (schooled in a regular class in a regular school with peers of different abilities). Yet, students with mild intellectual disabilities remain an under-researched group in terms of understanding the impact of the BFLPE on academic self-concepts when these students are educated in various classroom environments.

This chapter seeks, first, to identify the importance of academic self-concepts to psycho-educational development and review the key theories within the academic self-concept literature, in particular the BFLPE, which highlights the impact of classroom environment upon the formation of one's academic self-concepts. The historical and recent research into the academic self-concepts of students with mild intellectual disabilities and the impact of classroom environments, via the BFLPE, will be critiqued. Importantly, methodological weaknesses limiting the research with students with mild intellectual disabilities are identified. Finally, the chapter provides recommendations for future practice and research to cultivate a more robust empirical base on which to generate best practice to support the psycho-educational development of students with mild intellectual disabilities.

THE IMPORTANCE OF ACADEMIC SELF-CONCEPT TO STUDENTS' PSYCHO-EDUCATIONAL DEVELOPMENT

The attainment of a positive self-concept, and related self-perceptions, is often espoused in educational policy across the developed world. Indeed, the learning framework posited by the OECD Education 2030 Project identifies that the goal of education is to not only foster knowledge and skill acquisition, but also develop every student as a whole person and cultivate positive individual well-being (OECD, 2018). The theoretical and empirical investigation into students' self-concepts, and associated self-perceptions, has garnered much attention internationally over the past 60 years, resulting in methodological and substantive advances that support the psycho-educational development of children and adolescents (for related discussions, see, in this volume, Schunk & DiBenedetto, Chapter 11; Wigfield & Ponnock, Chapter 17).

So, what is self-concept, and why is it so important? Self-concept is a term used to describe the perceptions that people hold of themselves, with these perceptions largely constructed through experiences and one's interpretation of these experiences (Shavelson, Hubner, & Stanton, 1976). Early theories proposed that self-concept was a unidimensional construct whereby people considered their perceptions of self in global terms. Shavelson et al. (1976), however, presented a hierarchical and multidimensional model of self-concept that receives widespread endorsement in the empirical literature (e.g., Marsh & Craven, 2006). Within this model, the apex consists of a higher-order general self-concept, which is then broken down into multiple, domain-specific self-concepts, with the next level identifying academic and nonacademic self-concepts. The specificity of domains becomes more differentiated with increasing age and cognitive development (Marsh & Ayotte, 2003). Research in educational psychology, and indeed this chapter, is concerned with academic self-concepts, which refers to one's own evaluation of one's ability in general (e.g., I am good at school) or in specific academic domains (e.g., I am good at reading) (Preckel et al., 2017).

A positive academic self-concept in itself is valued as a marker of positive well-being. However, it is mostly pursued for its established relationship with educational success. Guo, Marsh, Morin, Parker, and Kaur (2015) found that academic self-concept was a stronger predictor of occupational aspirations and educational attainment than intelligence. Empirical evidence supporting the reciprocal effects model indicates that academic self-concept and achievement share a reciprocal relationship whereby there is a significantly positive relation between academic self-concept and subsequent achievement and also between achievement and subsequent academic self-concept within specific academic domains (e.g., Huang, 2011; Marsh et al., 2018; Seaton, Parker, Marsh, Craven, & Yeung, 2014; Stabler, Dumont, Becker, & Baumert, 2017). The empirical research body establishing academic self-concept as a key driver of important academic outcomes has been based largely on work with either typically developing students or high-ability students (e.g., Preckel et al., 2017; Seaton, Marsh, Parker, Craven, & Yeung, 2015). To date, only one large-scale study has concluded that the reciprocal effects model does exist for students with disabilities, although the sample consisted of students with a vast range of disabilities treated as one group, where students with intellectual disabilities made up less than 10% of the sample (Ju, Zhang, & Katsiyannis, 2013).

Knowledge of the consequences of a positive academic self-concept confirms that it is a facilitator of academic achievement and other desirable outcomes (such as academic motivation; Seaton et al., 2014), which has important implications for educational practices and targeted interventions. Such implications are of paramount importance for the education of students with mild intellectual disabilities who are characterized by their low academic achievement. Prior to critiquing the research conducted with students with mild intellectual disabilities, this chapter presents a review of social comparison theory and the BFLPE, and the empirical advances in the self-concept field.

ENHANCING ACADEMIC SELF-CONCEPTS: THE ROLE OF SOCIAL COMPARISON THEORY AND THE BIG-FISH-LITTLE-POND EFFECT

Self-concept research and theory have been heavily influenced by social comparison theory since it was first proposed by Festinger some 60 years ago. Social comparison essentially refers to comparisons that one makes between oneself and others as a basis to inform self-evaluations of one's abilities, or self-concepts (Festinger, 1954). Wood (1996) asserts that, when presented with social information, people will automatically perform social comparisons in an effort to make conclusions about their own abilities. For example, when a teacher distributes marks in a spelling test to students, an individual student's self-concept of their spelling ability will be informed by not only their overall mark, but also how this mark compares with the marks achieved by the other students. Similarly, when objective feedback is not available to judge one's ability, Festinger (1954) proposes that comparisons with others can provide a frame of reference within which individuals make judgments about their abilities. The direction of the social comparisons made by individuals will influence their resulting self-concepts. When an individual compares their abilities with others who are worse off than themselves (i.e., downward comparison), the use of a lower comparison group results in a more positive self-evaluation. Likewise, if the comparison is made with others who are

better off than themselves (i.e., upward comparison), the use of a higher comparison group results in a less positive self-evaluation (Collins, 2000).

One of the most prolific applications of social comparison theory is the BFLPE, pioneered by Marsh and colleagues (Marsh, 1987), which posits that one's academic self-evaluations, operationalized as academic self-concepts, are shaped by the social comparisons made with the students in one's educational environment. Academic self-concept hinges not only on a student's own academic achievement and abilities, but also on those of the student's classmates (Marsh, Morin, & Parker, 2015). The BFLPE is the net effect of two counterbalancing influences: contrast effects and assimilation (or reflected-glory) effects (Marsh, Kong, & Hau, 2000). Contrast effects occur when higher school-average achievement leads to lower academic self-concepts, whereas assimilation effects occur when higher perceived school status leads to higher academic self-concepts. As such, the BFLPE contrast effect predicts that individuals who are educated alongside students exhibiting higher academic achievements will evidence lower academic self-concepts, whereas individuals educated alongside students exhibiting lower academic achievements will evidence higher academic self-concepts (Marsh & Parker, 1984; Wilson, Siegle, McCoach, Little, & Reis, 2014). Although one's personal academic achievement is positively related to one's academic self-concept, the average achievement level of surrounding students is negatively related to one's academic self-concept (Marsh, Abduljabbar, et al., 2014). BFLPE's assimilation effect, however, predicts that, when students associate with a high-achieving group of students, such as a selective class or school, their own academic self-concept will be heightened as a result of this reflected glory. The final academic self-concept reported by an individual, according to the BFLPE, is the net result of both contrast and assimilation effects (Marsh et al., 2000). For example, imagine a student who sits for a competitive entrance exam and is admitted into a selective school for high-achieving students. Simply through being identified as a student of the selective school, the academic self-concept of this student is likely to increase (via assimilation effects). Counterbalancing this increase, however, this student is now educated alongside other high-achieving students, where comparisons in performance may not always be favorable for this student, thus leading to a lowered academic self-concept (via contrast effects). These processes together form the academic self-concept exhibited by the student.

Empirical support for the BFLPE is significant, with a robust evidence base having amassed over the last two decades (see Marsh et al., 2008; Seaton & Marsh, 2013, for a review), notwithstanding critiques about possible moderating factors (e.g., Dai & Rinn, 2008; Jonkmann, Becker, Marsh, Lüdtke, & Trautwein, 2012). Research suggests that the more years a student spends in the same school, the more its impact is intensified (Marsh & Craven, 2002), and its impact may not be witnessed in short-term programs (e.g., a three-week gifted residential program; Dai, Rinn, & Tan, 2013). Moreover, its effects on important outcomes are still evident after students leave school (Marsh, Trautwein, Lüdtke, Baumert, & Köller, 2007). The universality of the BFLPE has been demonstrated across both student and academic characteristics (Marsh, Abduljabbar, et al., 2014), with early studies into the BFLPE relying primarily on samples in OECD and Western developed countries such as Australia, the United States, Germany, the United Kingdom, as well as Asian countries such as Singapore and Hong Kong (Marsh, Abduljabbar, et al., 2015). Recently, studies have also been conducted in Middle Eastern Islamic countries (Marsh, Abduljabbar,

et al., 2015; Marsh, Abduljabbar, et al., 2014). Using repeated data from the OECD Program for International Student Assessment (OECD-PISA), Nagengast and Marsh (2012) demonstrated the negative effect of school-average achievement on academic self-concepts in all except one of the 123 countries included, with a reported effect size of .223. Although the size of the effect does vary significantly according to cohort, country, and their interaction, cross-cultural studies confirm the widespread occurrence of the BFLPE (Marsh, Abduljabbar, et al., 2015).

A critical variable in the BFLPE is the identification of what constitutes the frame of reference, or where the “surrounding students” exist – within the class or broader school environment. Although initial BFLPE research and theory considered the school level as the frame of reference, recent findings highlight that class-level effects are more substantial where academic self-concepts are primarily influenced by comparisons with students in one’s own classroom rather than students in one’s own school (Marsh, Kuyper, Morin, Parker, & Seaton, 2014). More recent BFLPE research is now classifying the classroom as the unit of analysis rather than the school (e.g., Marsh, Abduljabbar, et al., 2015, Marsh, Kuyper, et al., 2014) in support of the demonstrated local dominance effect (Marsh, Kuyper, et al., 2014), whereby individuals typically use the most localized social information available to them (Dai et al., 2013; Zell & Aliche, 2009). The BFLPE, therefore, casts the immediate classroom in which the student resides as the most critical to the formation of academic self-concepts.

Potential Individual and Classroom Moderators of the Big-Fish-Little-Pond Effect

With the local dominance effect (Marsh, Kuyper, et al., 2014) prioritizing a student’s immediate classroom environment as central to the formation of the BFLPE, BFLPE studies have investigated a variety of potential moderators – both individual and classroom-based. Results of this body of research have mostly characterized the BFLPE as a universal phenomenon (Marsh & Hau, 2003) where, “BFLPE findings are remarkably robust, generalizing over a wide variety of different individual student and contextual level characteristics, settings, countries, long-term follow-ups, and research designs” (Marsh et al., 2008, p. 319).

Contextual variables of the classroom have largely been recognized as ineffectual in moderating the BFLPE. The composition of the student population within the classroom – and, thus, frames of references employed (e.g., gender, ethnicity-specific frames of references) – appears to have no impact on the formation of academic self-concepts (Liem, Marsh, Martin, McInerney, & Yeung, 2013). Although an increasing class size appears to decrease the effect of peers’ average achievement on an individual’s perceived academic position within the class, it did not have any significant moderating effect on students’ academic self-concepts and, thus, the instrumental BFLPE (Thijs, Verkuyten, & Helmond, 2010). Finally, a common recommendation for educators emanating from the BFLPE research is to modify the provision of feedback in order to reduce the competition and social comparison process that underpins the BFLPE (Marsh & Craven, 2002). Indeed, Liou (2014) hypothesized that, where countries evidence a lower occurrence of the BFLPE, the establishment of a less competitive classroom environment that privileges interest-driven learning may be responsible (Liou, 2014). Empirical research attests, however, that, although the teaching practice

of providing feedback that emphasizes individual improvement and effort bolsters students' academic self-concept, it does not disrupt the occurrence of the BFLPE (Lüdtke, Köller, Marsh, & Trautwein, 2005). It is concluded that, "the BFLPE is apparently a very robust effect that generalizes well over a variety of characteristics of students, teacher, and classrooms" (Lüdtke et al., 2005, p. 282).

Examination of the influence of student individual characteristics on the BFLPE has generally demonstrated no evidence of moderation (Seaton, Marsh, Yeung, & Craven, 2011). However, there is some evidence that the BFLPE is accentuated for students who are highly anxious, use memorization as a learning strategy, or report a cooperative orientation (Seaton, Marsh, & Craven, 2010), or it is minimized for students high in narcissism (Jonkmann et al., 2012).

Although the role of the BFLPE in forming academic self-concepts is recognized, Dai and Rinn (2008) contend that the BFLPE overemphasizes one aspect of social comparison while largely ignoring other critical individual and contextual factors that may mediate the BFLPE. Their critique of the BFLPE theory and research methodology calls for a broader inquiry into the more nuanced individual and social-contextual influences of the BFLPE. Dai and Rinn (2008) argue that, in order to inform educational practice and policy based on the BFLPE, "the question of when and for whom it is likely to occur should be answered" (p. 300).

Empirical Big-Fish-Little-Pond Effect Research with Students of Different Abilities

Theoretical and substantive advances regarding the BFLPE have been achieved mostly through empirical work with large samples of either typically developing students or high-achieving students in academically selective school systems such as special schools or classes for gifted and talented students (e.g., Wilson et al., 2014). Similarly, the significant educational implications posited by the BFLPE have been applied to support the psycho-educational development of high-achieving students more than any other group of students (e.g., Marsh & Craven, 2002). Consistent with predictions made by the BFLPE, research has demonstrated that placing high-achieving students in selective segregated classes with other high-achieving students has a negative consequence on their academic self-concepts (Marsh, Abduljabbar, et al., 2015). The positive impact of the assimilation effect, or reflected glory, on academic self-concept is accompanied by the negative impact of contrast effects resulting in lowered academic self-concepts and, thus, presenting the negative impact segregated classroom environments can have on high-achieving students.

International educational policy and practice also see low-achieving students placed in both regular classrooms with students of mixed ability and segregated classrooms with other low-achieving students. Emerging research is now capitalizing on unique nationwide within-school ability grouping practices across the world to interrogate the occurrence and implications of the BFLPE for low-achieving students. Singapore adopts a national within-school ability grouping policy where secondary students are placed in three tracks, or streams, based on their achievement, in English, mathematics, science, and mother tongue. These three tracks are labelled higher (high ability), standard (middle ability), and foundation (low ability). Liem et al. (2013) investigated the academic self-concepts of 4,461 Singaporean secondary students and found that,

as predicted by the BFLPE, after controlling for the impact of student achievement, students in the low-ability foundation track exhibited higher academic self-concepts in English and math than did the students in the high-ability higher track.

Liem et al. (2013) concluded that the BFLPE also operates for low-achieving students, and, as opposed to the observed ramifications for high-achieving students, segregation into tracks with students of similar abilities is an educational practice that benefits low-achieving students, as their academic self-concepts are boosted. Other research, however, questions whether components of the BFLPE, namely the reciprocal effects model, work in the same way for students with different achievement levels. Using data from the Trends in International Mathematics and Science Study in Taiwan, Liou (2014) found that there is a nonlinear relationship between individual students' achievement and academic self-concept whereby those at the top level of achievement would benefit most in academic self-concept for every incremental increase in their achievement compared with those at the lower end. As such, the positive effect of individual achievement on one's academic self-concepts may not be as prominent for students with low achievement as for students with average-to-high achievement.

STUDENTS WITH MILD INTELLECTUAL DISABILITIES

This chapter has presented the theoretical and empirical advances in the self-concept field, based largely on students with average or high academic ability, and now seeks to critique the limited research conducted with students with mild intellectual disabilities. Whereas research typically considers students with disabilities as a homogeneous group regardless of their diagnosis (e.g., Whitley, 2008), Bouck and Satsangi (2015) identify that students with mild intellectual disabilities differ in cognitive skills and aptitude from other students with high-incidence difficulties, such as learning disabilities and moderate-to-severe intellectual disabilities, and thus warrant unique consideration within the research literature. The definition and terminology employed to describe students with mild intellectual disabilities have transformed over time as societal norms and beliefs have altered. Historically, terms such as mentally handicapped and mentally retarded were used, and the label educable mentally handicapped was used more specifically to denote students with mild intellectual disabilities (Schalock et al., 2010). Today, the term intellectual disability has been adopted (WHO, 2001), with diagnostic practices shifting away from intelligence quotients as the prevailing criterion to an emphasis on adaptive functioning and the supports that an individual requires (American Psychiatric Association, 2013). This chapter seeks to focus on students with mild intellectual disabilities described as having below-average intellectual functioning together with difficulties in multiple adaptive skills (Schalock et al., 2010).

The Inclusion Movement and the Changing Classroom Environment for Students with Mild Intellectual Disabilities

In the developed world, there have been considerable changes in the philosophy and policy regarding the education of students with disabilities, in particular for those with mild intellectual disabilities who have previously been deemed “educable.” Over time, policies and practices of segregation have been replaced by policies and practices of

inclusion, a concept that emerged in the 1990s and dominates international educational policy today (Inclusion International, 2009; Whitley, 2008). Although there is no single definition of inclusion (Doyle & Giangreco, 2013), and the concept extends well beyond the idea of the physical classroom environment, many definitions include the location of the student's education as a cornerstone of inclusion. For example, Hunt and Goetz (1997, p. 3) define inclusion as a situation "in which students with disabilities are full-time members in general education classrooms," and Cologon (2013, p. 6) states that, "Inclusive education ... involves valuing and supporting the full participation of all people together within mainstream educational settings." As such, the classroom environment in which the student with a mild intellectual disability is educated becomes a core feature of the inclusion movement.

Interestingly, educational practice does not necessarily mirror educational policy, with data suggesting that in some countries, despite policy support for inclusive education, placement in the regular classroom environment with peers is "the exception rather than the rule" (Doyle & Giangreco, 2013, p. 61). For example, in Australia, inclusive education is endorsed at a policy level, and yet the data collected around school placement indicate that there still appears to be a full continuum of classroom environments in which students with mild intellectual disabilities reside: (1) special schools, (2) special classes in regular schools, and (3) regular classrooms (Australian Institute of Health and Welfare, 2017). With students with mild intellectual disabilities being educated in a range of classroom environments with peers presenting with different academic achievement levels, the BFLPE predicts that inclusive education will have a detrimental influence on students' academic self-concepts and subsequent academic achievement (based on the reciprocal effects model). Unfortunately, the quantity and quality of research investigating this phenomenon is low, as elaborated below.

RESEARCH INVESTIGATING THE IMPACT OF CLASSROOM ENVIRONMENT ON THE ACADEMIC SELF-CONCEPTS OF STUDENTS WITH MILD INTELLECTUAL DISABILITIES

Early Research: Global Self-Concepts and the Efficacy Studies

Coinciding with the rising social justice and civil rights movement of the 1960s, empirical studies became interested in testing the impact of segregation practices upon the self-concepts of students with disabilities. Students with mild intellectual disabilities were often the targeted participants of such studies as they were among the first to move into more inclusive environments, given they were perceived as "educable." A series of empirical studies were published, named the "efficacy studies," that heavily influenced the thinking of researchers and educators at the time. Studies conducted by Gottlieb, Hutten, and Budoff (1971) and Carvajal (1972) found no significant difference in global self-concept when students were placed in a segregated or integrated setting (which was the term used at the time to indicate an environment where students without disabilities were also present). Representative of the theoretical understanding at the time, self-concept was measured as a unidimensional construct with one of the most popular tools of the day – the Illinois Index of Self Derogation (Meyerowitz, 1962). Other studies were more explicit about the possible damages caused by seg-

regation. Carroll (1967) found that students with mild intellectual disabilities placed in fully segregated special schools evidenced lower self-concepts than those placed in a partially included environment where they were in a regular class for half the day. Similarly, Kendall (1977) found that students with mild intellectual disabilities placed fulltime in a special class reported a lower self-concept than those placed in either regular class fulltime or regular class with additional support from the learning resource center.

In response to this emerging body of work, Dunn (1968) called for a moratorium on segregated classroom placement, concluding that:

Separating a child from other children in his neighbourhood – or removing him from the regular classroom for therapy or special class placement – probably has a serious debilitating effect upon his self image ... Removing a handicapped child from the regular grades for special education probably contributes significantly to his feelings of inferiority and problems of acceptance.

(p. 9)

Recent Research: Emerging Studies Considering Academic Self-Concepts and the Big-Fish-Little-Pond Effect

Since the publication of the efficacy studies, a multidimensional structure of self-concept has been largely endorsed, with academic self-concepts specifically implicated in the BFLPE. Surprisingly, even though the classroom environment varies significantly for students with mild intellectual disabilities, and despite the critical importance placed on bolstering academic self-concepts, Maïano et al.'s (2019) systematic review found that few empirical studies have been conducted to examine the impact of being placed in various classroom environments on the *academic* self-concepts of students with mild intellectual disabilities (also see Huck, Kemp, & Carter, 2010; Hunt & Goetz, 1997; Szumski & Karwowski, 2015). Of those that have been conducted, although they are limited by methodological shortcomings, it appears that their results largely contradict the findings of the efficacy studies and indicate that the BFLPE is evident for students with mild intellectual disabilities.

Tracey, Marsh, and Craven (2003) conducted two complementary studies utilizing both cross-sectional and longitudinal approaches to address this issue. Following the verification of the sound validity and reliability of the Self-Description Questionnaire I (Individual Administration; SDQI-IA; Marsh, Craven, & Debus, 1991) for use with students with mild intellectual disabilities, they compared the multidimensional self-concepts of 211 students (98 placed in regular inclusive classrooms; 113 placed in special classes within regular schools). Structural equation path coefficients indicated that students placed in the segregated classes with other students with mild intellectual disabilities evidenced higher academic self-concepts (reading, mathematics, general-school) than their counterparts in regular classroom environments with students of mixed abilities. These effects remained stable across age and gender.

In their subsequent longitudinal study, Tracey et al. (2003) followed 39 students with mild intellectual disabilities across three time waves. At Time 1, students were at the end of Year 2 and all placed in a regular classroom. At the beginning of Year

3, 21 remained in a regular classroom with peers of mixed abilities, and 18 had moved into a segregated class with other students with mild intellectual disabilities within a regular school. Time 2 occurred 6 months into Year 3, and Time 3 occurred at the end of the Year 3 academic school year. With Time 1 used as a covariate, responses on the SDQI-IA (Marsh et al., 1991) revealed that, at Time 3 (but not Time 2), students placed in the segregated class reported higher reading, mathematics, and general-school self-concepts than their peers in the regular classroom. In sum, results of both the cross-sectional and longitudinal investigations support the BFLPE. Furthermore, with the administration of a measure of social comparison, it was evident that students placed in the segregated classroom were more likely to compare themselves with a person “not as good as them” (i.e., downward comparisons), whereas students in the regular classroom were more likely to compare themselves with a person “better than them” (i.e., upward comparisons).

Szumski and Karwowski (2015) conducted a cross-sectional study with 605 students with mild intellectual disabilities in either segregated schools or nonsegregated schools. Consistent with the predictions of the BFLPE, they found that students attending segregated schools reported higher academic self-concepts, even after controlling for confounding school and family characteristics. They concluded that social comparisons, and thus the immediate classroom environment of students with mild intellectual disabilities, play a key role in the witnessed effects of the BFLPE.

Interestingly, Szumski and Karwowski (2015) found that the relationship between academic self-concepts and academic achievement was complex, with achievement scores for the highest-achieving group serving as a negative predictor of academic self-concept. They hypothesized that, among students with mild intellectual disabilities, those with relatively high achievement have a greater awareness of the gap between themselves and their peers without intellectual disabilities (thus implying that the contrast effects underpinning the BFLPE would be stronger for this subgroup of students with mild intellectual disabilities).

There are, however, findings that contradict the BFLPE. Begley (1999) adopted a cross-sectional design and administered the Pictorial Scale of Perceived Competence and Acceptance (Harter & Pike, 1984) to 64 students with Down syndrome, aged 8–16 years (intelligence quotients not specified). She reported that students educated in regular schools evidenced higher mean academic self-concepts than those educated in special segregated schools (although these mean differences were not statistically different). Begley (1999) hypothesized that various innate characteristics of the sample may have contributed to this finding, with one possible reason being that, “pupils with Down syndrome may never decide to use, or develop the capacity for, making social comparisons” (p. 524). Although based on a cross-sectional study with a small sample size and utilizing an unverified scale for this population, Begley’s (1999) conclusion still calls into question not only the existence of the BFLPE in this population, but also the underlying mechanisms by which academic self-concept is formed and whether this differs for students with mild intellectual disabilities.

METHODOLOGICAL CHALLENGES LIMITING THE INVESTIGATION OF ACADEMIC SELF-CONCEPTS AND THE BIG-FISH-LITTLE-POND EFFECT WITH STUDENTS WITH MILD INTELLECTUAL DISABILITIES

Progress in understanding the academic self-concepts of students with mild intellectual disabilities and the role of the BFLPE has been undermined not only by the lack of studies tackling this issue but also because, of the limited studies available, the methodologically quality has been characterized as low (Maïano et al., 2019). Foremost, a review of the empirical investigation into the impact of classroom environments on the academic self-concepts of students with mild intellectual disabilities reveals a worrying absence of inquiry relative to the rise of the international inclusive education movement. This dearth of research may be explained by two main drivers. First, within disability research, there is an overrepresentation of studies that “essentially describe the ‘problem’” (Llewellyn, 2014, p. 8) rather than investigating practices that may enhance psycho-educational development. Indeed, Shurr and Bouck’s (2013) systematic review found that only 2% of the literature pertaining to students with intellectual disabilities published during 1996–2010 focused on how best to enhance academic achievement of students with disabilities, the ultimate goal of education. Second, advances in self-concept research with students with mild intellectual disabilities have been hindered by fundamental methodological issues (Maïano et al., 2019).

A perennial flaw in self-concept research with students with mild intellectual disabilities is the reliance on measurement tools that either provide no evidence of validity or reliability for this population (Maïano et al., 2019) or undermine validity by utilizing a measure that does not represent the multidimensional structure of self-concept as posited by Shavelson et al. (1976). The early efficacy studies based their findings on a global self-concept score that is not sensitive to the predictions of the BFLPE. The measurement of academic self-concepts for students with mild intellectual disabilities was further hampered when Silon and Harter (1985) concluded that students with mild intellectual disabilities were unable to report self-concepts in specific competence domains using Harter and Pike’s (1984) Pictorial Scale of Perceived Competence and Social Acceptance for Young Children. Studies adopting measures that do not assess specific academic self-concepts, therefore, are unable to examine the impact of the BFLPE or relationships between academic self-concepts and academic achievement (e.g., Huck et al., 2010; Whitley, 2008). Tracey et al. (2003) successfully demonstrated that students with mild intellectual disabilities (aged 7–13 years) could reliably report multidimensional self-concepts by adapting the administration of the SDQI-IA (Marsh et al., 1991), and, as such, the adapted SDQI-IA can be used to test the BFLPE and the relationship between academic self-concepts and academic achievement. Similarly, Elias, Vermeer, and Hart (2005) found a three-factor solution (cognitive, physical, and peer competence) for the Pictorial Scale of Perceived Competence and Social Acceptance for Young Children (Harter & Parker, 1984) with 106 children with mild intellectual disabilities (mean age 8 years 3 months), which is promising for this field of research.

Furthermore, research with students with mild intellectual disabilities is generally characterized by small sample sizes (e.g., Begley, 1999; Huck et al., 2010), given the labor-intensive task of recruiting students who generally make up approximately 3% of the population (ABS, 2012) and largely require individualized administration of measurement tools. As a result, sophisticated designs and statistical analyses are not applied, and often groups of students with various disabilities or difficulties, with a plethora of comorbid characteristics, are pooled together within the one study (e.g., Whitley, 2008).

Additionally, there is an absence of longitudinal designs, which precludes the examination of the reciprocal effects model to determine the relationship between academic self-concepts and academic achievement for students with mild intellectual disabilities. Such designs would not only enhance our theoretical understanding but could, most importantly, inform educational practice for students with mild intellectual disabilities. The interrogation of the BFLPE is also weakened via cross-sectional designs where the characteristics of students with mild intellectual disabilities placed in segregated versus regular classroom environments vary significantly. Longitudinal designs permit the examination of the BFLPE where changes in academic self-concept trajectories can be measured over time, with classroom environment accounted for as a covariate.

Finally, variance at both an individual and class level for students with mild intellectual disabilities may be too great to account for, resulting in questionable external validity. Trautner and Schwinger's (2018) recent study of more than 400 students (aged 7–11 years) with mild learning difficulties incorporated a sophisticated person- and variable-centered approach via factor mixture modeling. This approach examined the differences between classroom environment and the consequences of other factors such as gender, cognitive abilities, and socioeconomic status. Although an encouraging advancement in research design, the study itself considers students with an average intelligence who exhibit difficulties in learning (a group with higher incidence than that with mild intellectual disabilities) and is unable to provide advice regarding students with mild intellectual disabilities.

FUTURE DIRECTIONS FOR RESEARCH

First and foremost, there is an imperative need for an intensification of research studies that seek to understand the academic self-concepts of students with mild intellectual disabilities, the relationship between academic self-concepts and academic achievement, and the impact of various classroom environments on academic self-concepts (and potential moderators). Not only will such activity enhance our theoretical understanding of self-concepts, but such knowledge will directly benefit the psycho-educational development of a group of highly disadvantaged students. With the international rise of inclusive education, theory and research must inform and reflect practice.

Research with students with mild intellectual disabilities poses significant innate challenges that undermine robust and sophisticated research designs, as critiqued in this chapter. Notwithstanding, the improvement of the methodological quality of self-concept research with students with mild intellectual disabilities must be a priority in future research (Maïano et al., 2019). Longitudinal designs with larger sample sizes,

premised on the use of valid and reliable multidimensional measurements of self-concepts, must be expanded to address questions that remain unanswered for students with mild intellectual disabilities. In practice, these challenges are not easily overcome and would require a large investment of researcher time, given incidence rates and administration requirements. Furthermore, designs and analyses need to consider the variance across individual and class level. Future research may be focused on specific populations such as students with mild intellectual disabilities and/or adopt a “universal design for learning” approach to research where all mainstream research is designed in a manner that effectively includes students with disabilities to build our capacity in this area.

Substantively, this chapter encourages the investigation of three main lines of inquiry. First, empirical research is yet to determine if the reciprocal effects model functions for students with mild intellectual disabilities, with research to date providing equivocal results. The reciprocal effects model has gained cross-cultural support for a vast range of students, yet the work of Liou (2014) and Szumski and Karwowski (2015) suggests that this model may not be observed for students with mild intellectual disabilities or low achievement. Establishing if and how the reciprocal effects model operates for students with mild intellectual disabilities advances theory and has the potential to provide a malleable means to advance the academic achievement of these students who are characterized by low achievement.

Second, more rigorous longitudinal, large-scale investigations of the BFLPE are warranted. Research to date suggests that the BFLPE does impact on the academic self-concepts of students with mild intellectual disabilities across segregated versus regular, inclusive classroom environments. However, the research base supporting this finding is small. Thus, future research must be cognizant of the local dominance effect where the immediate classroom environment is privileged rather than the school environment. The classroom environments of students with mild intellectual disabilities, however, are complex, and, at times, the factor of “classroom environment” is oversimplified as a segregated versus inclusive placement division. Feldman, Carter, Asmus, and Brock’s (2016) finding that, although the students with disabilities in their study had a generic placement title, students were not present for a substantial proportion of the classes in which they were enrolled, disrupts the notion of a single local dominance effect for these students.

The BFLPE has largely been examined considering *individual* student achievement in relation to *school*- or *class*-level achievement. Calculating a BFLPE in which the *school* is the pond and the *class* is the fish may provide an interesting examination of the impact of classroom environment, namely inclusion versus segregation, for students with mild intellectual disabilities.

Third, the research striving to identify potential moderators of the BFLPE has been conducted with students of average or high ability. Studies with students with mild intellectual disabilities have sought to investigate the effect of the classroom environment alone, whereas it is likely that other student or classroom variables, such as perceived support or adaptive abilities, work in tandem with the variable of classroom environment. Preliminary findings suggest that the achievement and intelligence level of students with mild intellectual disabilities may serve as a moderating factor (Szumski & Karwowski, 2015), yet, without the adoption of sophisticated research designs, this vital question remains unanswered.

IMPLICATIONS FOR PRACTITIONERS

Both the quality and quantity of research regarding academic self-concepts of students with mild intellectual disabilities must be strengthened as a priority to be able to inform and influence sound educational practice (for a related discussion, see Sigafoos, Green, O'Reilly, & Lancioni, Chapter 8, this volume). Practitioners are encouraged to consider implications emerging from the limited research considering these constraints. Nonetheless, this chapter offers the following counsel for practitioners working directly to facilitate the positive psycho-educational development of students with mild intellectual disabilities.

The reciprocal effects model clearly identifies the merits of explicitly enhancing students' academic self-concepts to subsequently boost students' academic achievement. Subsequently, a plethora of teaching methods are based on the systematic encouragement of students, provision of feedback on individual progress, and maximizing opportunities for success (Lüdtke et al., 2005; Ninot & Maïano, 2007). In the limited research that has been conducted with students with mild intellectual disabilities, results suggest that the relationship between academic self-concepts and academic achievement may be more complex than the reciprocal effects model proposes. Whereas Ju et al. (2013) concluded that the reciprocal effects model does exist for students with mild intellectual disabilities, Liou (2014) and Szumski and Karwowski (2015) challenged if this is indeed the case.

The lack of clarity surrounding the relationship between academic self-concepts and academic achievement for students with mild intellectual disabilities encourages practitioners to consider the following practices. If the reciprocal effects model does exist for these students, then deliberate pedagogical and curricula strategies to elevate a malleable academic self-concept will be very important for students with mild intellectual disabilities who would benefit greatly from the subsequent elevation of academic achievement. If the reciprocal effects model is found to not operate for students with mild intellectual disabilities, is it enough to seek to elevate academic self-concepts as a desirable outcome in itself? Most practitioners would argue this is the case. On the other hand, Ninot and Maïano (2007) advise that cultivating inaccurate elevated self-perceptions in students with intellectual disabilities is problematic as it is an important developmental signpost to be able to conduct the realistic self-assessments necessary for independent life as an adult.

Inclusive education is now a philosophy widely adopted internationally. Although recognized as a complex educational approach, a core feature of inclusive education is the education of students with disabilities, including those with mild intellectual disabilities, within the regular classroom environment, with peers of mixed abilities. Practitioners and educational leaders need to be cognizant of the potential resulting detrimental impact of inclusive education on the academic self-concepts of students with mild intellectual disabilities, as predicted by the BFLPE. The BFLPE proposes that the placement of students with mild intellectual disabilities in regular classroom environments, with peers of mixed abilities, will lead to a reduction in the academic self-concepts of students with mild intellectual disabilities. Although the empirical evidence is relatively small, the theoretical predictions alone warrant substantial consideration by practitioners. What changes in educational practices should occur if this is indeed the case? Recommendations are difficult to offer when the research identifying potential moderators is yet to emerge.

Still, we are certain that this chapter does not seek to endorse that the BFLPE be used as an argument against inclusive education. We do, however, campaign for this potential negative outcome of placement in an inclusive environment to be recognized and solutions to be tested empirically to best support positive psycho-educational development within these learning environments. Although Salchegger (2016) proposes that schools should structure teaching and learning in a way that limits the BFLPE, empirical studies do not provide confidence that classroom practices can mitigate the occurrence of the BFLPE (e.g., Lüdtke et al., 2005). Dijkstra, Kuyper, van der Werf, Buunk, and van der Zee (2008) advise that, given the robust evidence that the occurrence of the BFLPE cannot be diminished by individual or contextual factors, educators are encouraged to seek to help students cope with the negative effects of social comparison. No empirical studies are available to provide guidance on how this can be achieved with students with mild intellectual disabilities, yet Dijkstra et al. (2008) recommend that discussing the advantages and disadvantages of social comparison and valuing all types of achievement may be beneficial.

Finally, practitioners and educational leaders are encouraged to actively partner with researchers so that the research evidence in this area is large and sophisticated enough to provide useful recommendations to inform practice. This partnering must surpass simple participation and extend to the co-construction of critical questions that research must answer in this under-researched yet vitally important line of inquiry. Although the development of a strong research base will require time and investment, future generations of students with mild intellectual disabilities are set to reap the rewards.

REFERENCES

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders DSM-5* (5th ed.). Washington, DC: Author.
- Australian Bureau of Statistics. (2012). *4433.0.55.003 – intellectual disability, Australia, 2012*. Australia: Author.
- Australian Institute of Health and Welfare. (2017). *Disability in Australia: Changes over time in inclusion and participation in education*. Cat. no. DIS 69. Canberra: Author.
- Begley, A. (1999). The self-perceptions of pupils with Down syndrome in relation to their academic competence, physical competence and social acceptance. *International Journal of Disability, Development and Education*, 46, 515–529. doi:10.1080/103491299100489
- Bouck, E. C., & Satsangi, R. (2015). Is there really a difference? Distinguishing mild intellectual disability from similar disability categories. *Education and Training in Autism and Developmental Disabilities*, 50(2), 186–198. www.jstor.org/stable/24827534
- Carroll, A. W. (1967). The effects of segregated and partially integrated school programs on self concept and academic achievement of educable mental retardates. *Exceptional Children*, 34(2), 93–99. Retrieved from <http://journals.sagepub.com/home/ecx>
- Carvajal, A. L. (1972). Predictors of four criteria of self concept in educable mentally retarded adolescents. *Exceptional Children*, 39(3), 239. Retrieved from <http://journals.sagepub.com/home/ecx>
- Collins, R. L. (2000). Among the better ones: Upward assimilation in social comparison. In J. Suls & L. Wheeler (Eds.), *Handbook of social comparison: Theory and research* (pp. 141–158). New York, NY: Kluwer Academic/Plenum Press.
- Cologon, K. (2013). *Issues in education: Towards equality for students with a disability*. Sydney: Macquarie University.
- Dai, D. Y., & Rinn, A. N. (2008). The big-fish-little-pond-effect: What do we know and where do we go from here? *Educational Psychological Review*, 20, 283–317. doi:10.1177/1932202X12473425

- Dai, D. Y., Rinn, A. N., & Tan, X. (2013). When the big fish turns small: Effects of participating in gifted summer programs on academic self-concepts. *Journal of Advanced Academics*, 24(1), 4–26. doi:10.1177/1932202X12473425
- Dijkstra, P., Kuyper, H., van der Werf, G., Buunk, A. P., & van der Zee, Y. G. (2008). Social comparison in the classroom: A review. *Review of Educational Research*, 78(4), 828–879. doi:10.3102/0034654308321210
- Doyle, M. B., & Giangreco, M. (2013). Guiding principles for including high school students with intellectual disabilities in general education classes. *American Secondary Education*, 42(1), 57–72. Retrieved from www.jstor.org/journal/amersecedu
- Dunn, L. (1968). Special education for the mildly retarded: Is much of it justifiable. *Exceptional Children*, 34, 5–22. Retrieved from <http://journals.sagepub.com/home/ecx>
- Elias, C., Vermeer, A., & Hart, T. (2005). Measurement of perceived competence in Dutch students with mild intellectual disabilities. *Journal of Intellectual Disability Research*, 49, 288–295.
- Feldman, R., Carter, E. W., Asmus, J., & Brock, M. E. (2016). Presence, proximity, and peer interactions of adolescents with severe disabilities in general education classrooms. *Exceptional Children*, 82(2), 192–208. doi:10.1177/0014402915585481
- Festinger, L. (1954). A theory of social comparison processes. *Human Relations*, 7, 117–140. doi:10.1177/001872675400700202
- Gottlieb, J., Hutten, L., & Budoff, M. (1971). A preliminary evaluation of the academic achievement and social adjustment of EMRs in a nongraded school placement. *Studies in Learning Potential*, 2(23), 1–31. Retrieved from <https://files.eric.ed.gov/fulltext/ED058705.pdf>
- Guo, J., Marsh, H. W., Morin, A. J. S., Parker, P. D., & Kaur, G. (2015). Directionality of the associations of high school expectancy-value, aspirations, and attainment: A longitudinal study. *American Educational Research Journal*, 52(2), 371–402. doi:10.3102/0002831214565786
- Harter, S., & Pike, R. (1984). The pictorial scale of perceived competence and social acceptance for young children. *Child Development*, 55, 1969–1982. Retrieved from www.jstor-org/stable/1129772
- Huang, C. (2011). Self-concept and academic achievement: A meta-analysis of longitudinal relations. *Journal of School Psychology*, 49, 505–528. doi:10.1016/j.jsp.2011.07.001
- Huck, S., Kemp, C., & Carter, M. (2010). Self-concept of children with intellectual disability in mainstream settings. *Journal of Intellectual and Developmental Disability*, 35(3), 141–154. doi:10.3109/13668250.2010.489226
- Hunt, P., & Goetz, L. (1997). Research on inclusive educational programs, practices and outcomes for students with severe disabilities. *The Journal of Special Education*, 31(1), 3. doi:10.1177/002246699703100102
- Inclusion International. (2009). *Better education for all*. Salamanca, Spain: Author.
- Jonkmann, K., Becker, M., Marsh, H. W., Lüdtke, O., & Trautwein, U. (2012). Personality traits moderate the big-fish-little-pond effect of academic self-concept. *Learning and Individual Differences*, 22, 736–746. doi:10.1016/j.lindif.2012.07.020
- Ju, S., Zhang, D., & Katsiyannis, A. (2013). The causal relationship between academic self-concept and academic achievement for students with disabilities: An analysis of SEELS data. *Journal of Disability Policy Studies*, 24(1), 4–14. doi:10.1177/1044207311427727
- Kendall, W. (1977). *Reading achievement and self-concept of educable retarded boys in three educational settings*. Annual International Convention, The Council for Exceptional Children. Retrieved from <https://files.eric.ed.gov/fulltext/ED139135.pdf>
- Liem, G. A. D., Marsh, H. W., Martin, A. J., McInerney, D. M., & Yeung, A. S. (2013). The big-fish-little-pond effect and a national policy of within-school ability streaming: Alternative frames of reference. *American Educational Research Journal*, 50(2), 326–370. doi:10.3102/0002831212464511
- Liou, P.-Y. (2014). Investigation of the big-fish-little-pond effect on students' self-concept of learning mathematics and science in Taiwan: Results from TIMSS 2011. *Asia-Pacific Education Researcher*, 23(3), 769–778. doi:10.1007/s40299-013-0152-3
- Llewellyn, G. (2014). *Report of audit of disability research in Australia*. Sydney, Australia: University of Sydney.
- Lüdtke, O., Köller, O., Marsh, H. W., & Trautwein, U. (2005). Teacher frame of reference and the big-fish-little-pond effect. *Contemporary Educational Psychology*, 30, 263–285. doi:10.1016/j.cedpsych.2004.10.002
- Maiano, C., Coutu, S., Morin, A. J. S., Tracey, D., Lepage, G., & Moullec, G. (2019). Self-concept research with school-aged youth with intellectual disabilities: A systematic review. *Journal of Applied Research in Intellectual Disabilities*, 32(2), 238–255.

- Marsh, H. W. (1987). The big-fish-little-pond effect on academic self-concept. *Journal of Educational Psychology*, 79, 280–295. doi:10.1037/0022-0663.79.3.280
- Marsh, H. W., Morin, A. J. S., & Parker, P. D. (2015). Physical self-concept changes in a selective sport high school: A longitudinal cohort-sequence analysis of the big-fish-little-pond effect. *Journal of Sport & Exercise Psychology*, 37(2), 150–163. doi:10.1123/jsepp.2014-0224
- Marsh, H. W., Abduljabbar, A. S., Morin, A. J. S., Parker, P., Abdelfattah, F., Nagengast, B., & Abu-Hilal, M. M. (2015). The big-fish-little-pond effect: Generalizability of social comparison processes over two age cohorts from Western, Asian, and Middle Eastern Islamic countries. *Journal of Educational Psychology*, 107(1), 258–271. doi:10.1037/a0037485
- Marsh, H. W., Abduljabbar, A. S., Parker, P. D., Morin, A. J. S., Abdelfattah, F., & Nagengast, B. (2014). The big-fish-little-pond effect in mathematics: A cross-cultural comparison of U.S. and Saudi Arabian TIMSS responses. *Journal of Cross-Cultural Psychology*, 45(5), 777–804. doi:10.1177/0022022113519858
- Marsh, H. W., & Ayotte, V. (2003). Do multiple dimensions of self-concept become more differentiated with age? The differential distinctiveness hypothesis. *Journal of Educational Psychology*, 95(4), 687–706. doi:10.1037/0022-0663.95.4.687
- Marsh, H. W., & Craven, R. G. (2002). The pivotal role of frames of reference in academic self-concept formation: The big-fish-little-pond effect. In F. Pajares & T. Urda (Eds.), *Adolescence and education* (Vol. II, pp. 83–123). Greenwich, CT: Information Age.
- Marsh, H. W., & Craven, R. G. (2006). Reciprocal effects of self-concept and performance from a multidimensional perspective: Beyond seductive pleasure and unidimensional perspectives. *Perspectives on Psychological Science*, 1(2), 133–163. doi:10.1111/j.1745-6916.2006.00010.x
- Marsh, H. W., Craven, R. G., & Debus, R. (1991). Self-concepts of young children 5 to 8 years of age: Measurement and multidimensional structure. *Journal of Educational Psychology*, 83, 377–392. doi:10.1037/0022-0663.83.3.377
- Marsh, H. W., & Hau, K. (2003). Big-fish-little-pond effect on academic self-concept: A cross-cultural (26-country) test of the negative effects of academically selective schools. *American Psychologist*, 58(5), 364–376. doi:10.1037/0003-066X.58.5.364
- Marsh, H. W., Kong, C.-K., & Hau, K.-T. (2000). Longitudinal multilevel models of the big-fish-little-pond effect on academic self-concept: Counterbalancing contrast and reflected-glory effects in Hong Kong schools. *Journal of Personality and Social Psychology*, 78(2), 337–349. doi:10.1037/0022-3514.78.2.337
- Marsh, H. W., Kuyper, H., Morin, A. J., Parker, P. D., & Seaton, M. (2014). Big-fish-little-pond social comparison and local dominance effects: Integrating new statistical models, methodology, design, theory and substantive implications. *Learning and Instruction*, 33, 50–66. doi:10.1016/j.learninstruc.2014.04.002
- Marsh, H. W., & Parker, J. (1984). Determinants of student self-concept: Is it better to be a relatively large fish in a small pond even if you don't learn to swim as well? *Journal of Personality and Social Psychology*, 47, 213–231. doi:10.1037/0022-3514.47.1.213
- Marsh, H. W., Pekrun, R., Murayama, K., Arens, A. K., Parker, P. D., Guo, J., & Dicke, T. (2018). An integrated model of academic self-concept development: Academic self-concept, grades, test scores, and tracking over 6 years. *Developmental Psychology*, 54(2), 263. doi:10.1037/dev0000393
- Marsh, H. W., Seaton, M., Trautwein, U., Lüdtke, O., Hau, K. T., O'Mara, A. J., & Craven, R. G. (2008). The big-fish-little-pond effect stands up to critical scrutiny: Implications for theory, methodology, and future research. *Educational Psychology Review*, 20, 319–350. doi:10.1007/s10648-008-9075-6
- Marsh, H. W., Trautwein, U., Lüdtke, O., Baumert, J., & Köller, O. (2007). Big fish little pond effect: Persistent negative effects of selective high schools on self-concept after graduation. *American Educational Research Journal*, 44, 631–669. doi:10.3102/0002831207306728
- Meyerowitz, J. (1962). Self-derogations in young retardates and special class placement. *Child Development*, 33, 443–451. doi:10.2307/1126456
- Nagengast, B., & Marsh, H. W. (2012). Big fish in little ponds aspire more: Mediation and cross-cultural generalizability of school-average ability effects on self-concept and career aspirations in science. *Journal of Educational Psychology*, 104(4), 1033–1053. doi:10.1037/a0027697
- Ninot, G., & Maïano, C. (2007). Long-term effects of athletics meet on the perceived competence of individuals with intellectual disabilities. *Research in Developmental Disabilities*, 28, 176–186. doi:10.1016/j.ridd.2006.02.008
- OECD. (2018). *The future of education and skills: Education 2030*. Geneva: OECD.
- Preckel, F., Schmidt, I., Stump, E., Motschenbacher, M., Vogl, K., & Schneider, W. (2017). A test of the reciprocal-effects model of academic achievement and academic self-concept in regular classes and special classes for the gifted. *Gifted Child Quarterly*, 61(2), 103–116. doi:10.1177/0016986216687824

- Salchegger, S. (2016). Selective school systems and academic self-concept: How explicit and implicit school-level tracking relate to the big-fish-little-pond effect across cultures. *Journal of Educational Psychology*, 108(3), 405–423. doi:10.1037/edu0000063
- Schalock, R. L., Borthwick-Duffy, S. A., Bradley, V. J., Buntinx, W. H., Coulter, D. L., Craig, E. M., ... Yeager, M. H. (2010). *Intellectual disability: Definition, classification, and systems of supports* (11th ed.). Washington: American Association on Intel and Developmental Disabilities.
- Seaton, M., & Marsh, H. W. (2013). Celebrating methodological substantive synergy: Self-concept theory and methodological innovation. In D. McInerney, H. W. Marsh, R. G. Craven, & F. Guay (Eds.), *International advances in self research: Vol. 4. Theory driving research: New wave perspectives on self-processes and human development* (pp. 161–181). Greenwich, CT: Information Age.
- Seaton, M., Marsh, H. W., & Craven, R. G. (2010). Big-fish-little-pond effect: Generalizability and moderation – two sides of the same coin. *American Educational Research Journal*, 47(2), 390–433. doi:10.3102/0002831209350493
- Seaton, M., Marsh, H. W., Parker, P. D., Craven, R. G., & Yeung, A. S. (2015). The reciprocal effects model revisited: Extending its reach to gifted students attending academically selective schools. *Gifted Child Quarterly*, 59, 143–156. doi:10.1177/0016986215583870
- Seaton, M., Marsh, H. W., Yeung, A. S., & Craven, R. (2011). The big fish down under: Examining moderators of the 'big-fish-little-pond' effect for Australia's high achievers. *Australian Journal of Education*, 55(2), 93–114.
- Seaton, M., Parker, P. D., Marsh, H. W., Craven, R. G., & Yeung, A. S. (2014). The reciprocal relations between self-concept, motivation and achievement: Juxtaposing academic self-concept and achievement goal orientations for mathematics success. *Educational Psychology*, 34(1), 49–72. doi:10.1080/01443410.2013.825232
- Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Self-concept: Validation of construct interpretations. *Review of Educational Research*, 46, 407–441. doi:10.2307/1170010
- Shurr, J., & Bouck, E. (2013). Research on curriculum for students with moderate and severe intellectual disability: A systematic review. *Education and Training in Autism and Developmental Disabilities*, 48(1), 76–87. Retrieved from www.jstor.org/stable/23879888
- Silon, E. L., & Harter, S. (1985). Assessment of perceived competence, motivational, orientation, and anxiety in segregated and mainstreamed educable mentally retarded children. *Journal of Educational Psychology*, 2, 217–230. doi:10.1037/0022-0663.77.2.217
- Stabler, F., Dumont, H., Becker, M., & Baumert, J. (2017). What happens to the fish's achievement in a little pond? A simultaneous analysis of class-average achievement effects on achievement and academic self-concept. *Journal of Educational Psychology*, 109(2), 191–207. doi:10.1037/edu0000135
- Szumski, G., & Karwowski, M. (2015). Emotional and social integration and the big-fish-little-pond effect among students with and without disabilities. *Learning and Individual Differences*, 43, 63–74. doi:10.1016/j.lindif.2015.08.037
- Thijs, J., Verkuyten, M., & Helmond, P. (2010). A further examination of the big-fish-little-pond effect: Perceived position in class, class size, and gender comparisons. *Sociology of Education*, 83(4), 333–345. doi:10.1177/0038040710383521
- Tracey, D., Marsh, H., & Craven, R. (2003). Self-concepts of preadolescents with mild intellectual disabilities: issues of measurement and educational placement. In H. W. Marsh, R. G. Craven, & D. M. McInerney (Eds.), *International advances in self research* (pp. 203–229). Greenwich, CT: Information Age.
- Trautner, M., & Schwinger, M. (2018). Differentiation of academic self-concept in primary school students with mild learning difficulties: A factor mixture analysis approach. *Learning and Individual Differences*, 65, 20–29.
- Whitley, J. (2008). A model of general self-concept for students with learning disabilities: Does class placement play a role? *Developmental Disabilities Bulletin*, 36(1/2), 106–134. Retrieved from <https://ddb.educ.ualberta.ca/>
- Wilson, H. E., Siegle, D., McCoach, D. B., Little, C. A., & Reis, S. M. (2014). A model of academic self-concept: Perceived difficulty and social comparison among academically accelerated secondary school students. *Gifted Child Quarterly*, 58(2), 111–126. doi:10.1177/0016986214522858
- Wood, J. (1996). What is social comparison and how should we study it? *Personality and Social Psychology Bulletin*, 22, 520–537. doi:10.1177/0146167296225009
- World Health Organization. (2001). *International classification of functioning, disability, and health – ICF*. Geneva: Author.
- Zell, E., & Alicke, M. D. (2009). Contextual neglect, self-evaluation, and the frog-pond effect. *Journal of Personality and Social Psychology*, 97, 467–482. doi:10.1037/a0015453

25

CULTURAL AND SOCIOCULTURAL INFLUENCES AND LEARNERS WITH SPECIAL NEEDS

Angus Macfarlane, Sonja Macfarlane, and Helen Mataiti

SOCIOCULTURAL INFLUENCES AND LEARNERS WITH SPECIAL NEEDS

This chapter draws on examples from the Aotearoa New Zealand context to show how sociocultural factors can be acknowledged and integrated into legislation and policy, school curriculum, and individualized psycho-educational interventions, to meet the diverse learning needs of all children, while ensuring that the educational pursuits of indigenous Māori result in equitable educational experiences and life opportunities. First, demographic data and an overview of the special needs referenced in this chapter will be outlined. Next, the sociocultural learning contexts of indigenous Māori students who have special needs will be described from an indigenous perspective, a framework that has strong similarities to embedded ecological models of human development such as Bronfenbrenner's (1979) and Rogoff's (2003). Then, research in sociocultural influences and its implications for the learner, family, and learning community will be discussed. To close, future research directions and a chapter summary will be presented.

Aotearoa New Zealand is located in the southwest of the Pacific region, with indigenous Māori representing 16% of a population of approximately 4.9 million (Statistics New Zealand, 2018). Reportedly, one in six Māori children has a learning impairment or disability (Craig et al., 2014). However, the uptake of nationally available screening assessments, as well as access to and participation in health, early intervention, and psycho-educational services for children who are Māori, has been found to occur at lower rates than for non-Māori (Craig et al., 2014; Liberty, 2014; Searing, Graham, & Grainger, 2015). These lower rates may be based on the perceived availability of formal and informal support and its helpfulness (Searing et al., 2015). Additionally, ongoing patterns of inequity in health, social development, and educational achievement data indicate that Māori frequently and disproportionately experience less than optimal outcomes (Durie, 2001, 2004; Macfarlane, 2004). With population estimates

predicting the number of Māori and Pasifika children enrolled in schools to exceed other ethnic groups in New Zealand by 2040 (Pōmare, 2011), it is of paramount importance that mainstream education and specialized psycho-educational services are responsive to the cultural needs of indigenous and priority cohorts.

SPECIAL NEEDS IN THE PRESENT CHAPTER

Although culture is not a need in itself, it may influence how a child or young person's special needs are perceived and responded to in family and community contexts. Therefore, this chapter traverses a range of special needs but offers some additional attention to autistic spectrum disorder (ASD) and kāpo Māori (those who are blind or visually impaired), as well as general perspectives in learning and behavior. Chiefly, identification of a child with a specific ethnicity or culture can be seen as an opportunity to design a rich educational program with appropriate supports.

THEORETICAL BACKGROUND

Children requiring psycho-educational support do not learn and develop in isolation. Their learning is situated socially in the exchanges between the child or young person and the people closest to them and is influenced by the cultural environments within which they live (Vygotsky, 1978). The culture of the environment is both explicit and implicit – a set of rules, beliefs, practices, behaviors, and tools shared by the collective within a particular context (Zion & Kozleski, 2005). Expressed both collectively and individually as part of one's identity (Cooper, Hedges, Lovatt, & Murphy, 2013), culture encompasses ways of “knowing,” “being,” and “doing” (Martin, 2003; Ministry of Education – Te Tāhuhu o te Mātauranga (MoE), 2009; Rameka, 2012; Royal, 2005), influencing how an individual thinks, experiences emotion, and acts (Bevan-Brown, 2003; Phinney & Rotheram, 1987).

From both indigenous and embedded ecological systems perspectives, the sociocultural context includes (1) family and community (e.g., schools, health care facilities, religious organizations; the microsystem); (2) wider formal and informal social supports (the exosystem); (3) the current beliefs, policies, and practices of wider society (the macrosystem); and (4) the occurrence of these in relation to other periods in history (the chronosystem; Bronfenbrenner, 1979; Durie, 2001; Rogoff, 2003). Strongly congruent with Bronfenbrenner's ecological systems theory, indigenous Māori consider the *tamaiti* (child) to be part of a *whānau* (family, including extended family), which consists of elders, adults, adolescents, and children (MoH, 2002). The *whānau* is part of the *hapū* (sub-tribe), which is bonded through kinship and connectedness to place, functioning to protect the land and political and social interests. In turn, alongside other similar groups, the *hapū* is part of the *iwi* (larger tribal federation), which seeks to protect and provide future opportunities for all in its jurisdiction. The child or young person with special needs may be included in the activities of *whānau*, *hapū*, and *iwi* to varying degrees. Opportunity for full access to and involvement in everyday activities is dependent on individual family and educator attitudes and capacity to confidently support the child in these settings. Later in the chapter, examples from Bevan-Brown (2004) are shared, describing how the child with ASD may need additional supports to become engaged in cultural activities, as

well as the ways in which education professionals may work with the family to instil the self-belief required to parent a child with additional needs (for a related discussion, see Gillies, Chapter 22, this volume).

The whānau is viewed as a context for the transmission of knowledge, but also as the “principal source of strength, support, security and identity” (MoH, 2002, p. 1) contributing to education, social, and well-being outcomes for children (Durie, 1994, 2001; MoH, 2002). In the educational environment, the concept of whānau influences approaches to knowledge holding and sharing, pedagogy, discipline, and the development and organization of the curriculum (Macfarlane, Glynn, Grace, Penetito, & Bateman, 2008; Smith, 1991, 1995). The centrality of whānau for the child is important, but so too is the concept of *whanaungatanga*, which denotes the connections and relationships built between those who are responsible for nurturing and supporting their development and growth. Whanaungatanga closely resembles Bronfenbrenner’s mesosystem, which describes the interactions between family and community groups and organizations that are known to directly impact the child or young person. In this way, educators and paraprofessionals practice whanaungatanga in preschool and school, through the strong and vital connections that exist when children and young people with special needs are wholly supported in their individual settings. Communication, positivity, and warmth among family members and educators alike ensure a strong network and shared sense of purpose in supporting the child (Pōmare, 2011; Te Kete Ipurangi, 2018a).

Also of significance and corresponding to Bronfenbrenner’s notion of the chronosystem, the connections between individuals and groups are seen to extend temporally. In *te ao Māori* (the Māori realm, Māori world, Māori worldview), however, the connection is through *whakapapa* (genealogy) to those who have gone before, to spiritual ancestors, and to geographies (Durie, 1997; Rameka, 2012). Specifically, the child or young person is viewed as being

an important living connection to the family past, present and future; a living embodiment of ancestors; and a link in descent lines stretching from the beginning of time into the future.

(Rameka, 2012, p. 130)

To consider the Māori child individually rather than as a member of the social unit of whānau, or to denounce their connection to both past and future, is to disregard important aspects of their being, which in turn may negatively influence the development of a strong, healthy sense of identity (*mana motuhake*; Macfarlane, Macfarlane, Derby, & Webber, 2018) and willingness to express this within the educational setting. For the child with special needs, it is important to consider their place in the immediate and wider family system and to nurture and develop a sense of place in the context of their family history. In addition, classroom materials that showcase the cultural identity of a student with special needs alongside their peers helps foster a sense of inclusion and the idea that culture is a resource that each and every child and young person holds. In this way, attention is primarily given to the student’s cultural identity, rather than exclusively to their unique special educational need(s) in the learning environment.

SOCIOCULTURAL RESEARCH AND ITS IMPLICATIONS

The components of the previously mentioned theoretical models are able to be utilized to examine sociocultural research and its implications for the compulsory education sector and psycho-educational support contexts. Material will now be discussed in relation to wider society rules, organizational factors, the tamaiti within the whānau, and methods of interaction between groups and individuals. Identifiable in each of these areas is the theme of people working together for a common purpose. This is an additional and more recent definition of whānau – where people are related not by kinship, but by a shared *kaupapa* (purpose, philosophy; Macfarlane, 2014). See Figure 25.1, from Macfarlane (2014), for a depiction of ways of working together.

At a societal level, the focus is mainly on *rurukutia* (consulting strategically to co-ordinate, plan, and prioritize activities for positive change). For example, families and adults and students with special needs work in consultation for new policy and practice frameworks. Later, in line with this, the development of the Disability Strategy 2016–2026 will be discussed. At an organizational and community group level, *rārangahia* (collaboration and weaving together knowledge, skills, and perspectives for best outcomes) is significant. For example, collaborative work is undertaken to develop learning plans and programming for individual students. Finally, within the exchanges that transpire between people in the microsystem, there is *rāhiritia* (communicating respectfully with and inclusively of others in order to achieve a shared goal; Macfarlane, 2014). This could be in the day-to-day interactions that take place between parents and educators or support staff at drop-off or pick-up of children and young people at their preschool or school classroom (Duncan, 2013). The communication that takes place in the inclusive classroom environment in Aotearoa New Zealand most often looks the same for families of students with and without special needs. However, sometimes it could involve discussion of individual programming

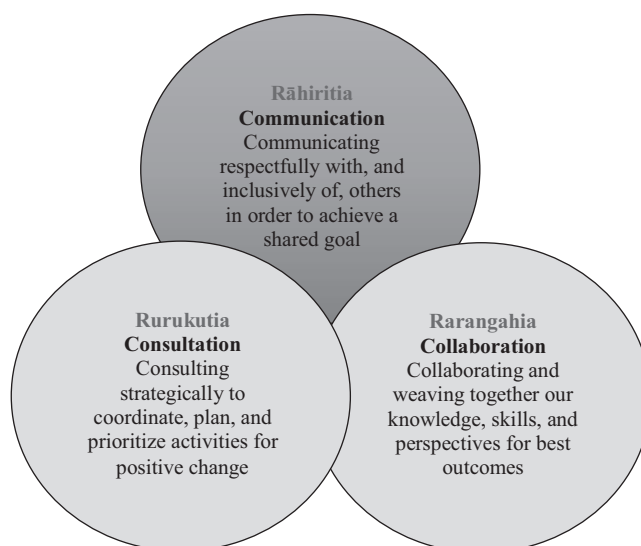


Figure 25.1 Interprofessional Practice: Mahi Tahī

goals, functioning of equipment, or details of a student's health, well-being, or behavior across the day. Additionally, *rāhiritia* could refer to the differing levels of adult support required to ensure a student with special needs (particularly in the areas of communicating and relating) is able to participate fully in classroom discussions and activities. The concepts of *rurukutia*, *rārangahia*, and *rāhiritia* are expanded in the following sections.

Societal Rules

In Aotearoa New Zealand, the preschools, schools, and other educational organizations that students with special needs attend are guided by legislation and policy, but of more significant influence is a historical agreement. In 1840, the British Crown and more than 500 Māori chiefs signed Te Tiriti o Waitangi (the Treaty of Waitangi), an agreement to help found and guide the new partnership and evolving society (Consedine & Consedine, 2012; Durie, 2001, 2004; State Services Commission, 2005). Notably, both te reo Māori (Māori language) and English language versions of the treaty exist. Though not unique in its experience of colonization, the survival of Māori as indigenous peoples was threatened by the Crown's failure to enact the premises inherent within the treaty. More recently, the political system of Aotearoa New Zealand has set about engaging with this foundational covenant as a living artifact.

In 1975, the Treaty of Waitangi Act came into existence, and the establishment of the Waitangi Tribunal followed. This provided a forum for Māori to air particular grievances, and for the Crown to acknowledge their failure to uphold the treaty intent (Waitangi Tribunal, 2011). Subsequently, the government has compensated many of these grievances by way of financial settlements as a means of reparation (State Services Commission, 2005). Not without debate, and owing to the impacts of intergenerational trauma and injustice, a shared understanding of both the Māori and English language versions of the treaty evolved. Key principles drawn from the treaty include self-governance and self-determination, partnership, active protection, and participation (Hayward, 1997; Macfarlane, 2009). Rather than being dismissed as merely a historical text, Te Tiriti o Waitangi informs the New Zealand Constitution, which in turn guides law and policymaking. In this way, educational organizations (including early years settings and schools) are required by law to enact the principles of the treaty through policy, ensuring that Māori interests are acknowledged and addressed. Importantly, not only do key treaty principles correspond strongly with empowerment and interdependent discourses and mechanisms in the disability sector, but, additionally, Māori students with special needs have the right for their interests to be met by law.

Strategic policy documents promoting Māori success in education, such as Ka Hikitia: Managing for Success (MoE, 2008) and Ka Hikitia: Accelerating Success (MoE, 2013), support educational leaders, teachers, and paraprofessionals to practice with an awareness of culture in mind at all times. These initiatives promote (1) "language, identity and culture"; (2) "knowing, respecting and valuing who students are" and "where they come from" (*tangata whenuatanga*); and (3) "building on" the unique knowledge and experiences of children (Macfarlane, Macfarlane, Graham, & Clarke, 2017, p. 4). Embedding aspects of Māori students' language, culture, and identity in the environment and curriculum by drawing from the local historical

cultural narratives – place-based education – is critical in this regard. Later in the chapter, considerations around language in psycho-educational planning are outlined, and ways that cultural and other identities (e.g. kāpo Māori), genealogies, and experiences of students and families can support the development of a meaningful curriculum and enrich the school community are discussed.

Special Needs in the Cultural Context

Special education professions working in early years settings and schools are similarly guided by educational policy and curriculum documents, as well as their own practice guidelines and ethical codes. However, until quite recently, professional learning and development in many of the psycho-educational support professions had been Western in focus; therefore, undertaking a refresh to achieve a bicultural focus for practice in line with Treaty of Waitangi obligations has been a top priority (Britt, Macfarlane, Macfarlane, Naswall, & Henderson, 2017). Furthermore, there are fewer indigenous Māori professionals than non-Māori working in health, disability, and special education, which means any shift in practice will take a longer period of time (Macfarlane, 2012; Ratima et al., 2007).

The learning needs of children and young people are diverse – physical, sensory, cognitive, attentive, motivational, social, communicative, or behavioral in nature (or combinations of these). In addition, a child’s sense of security within their whānau and community (e.g., safety, well-being, economic) is also known to impact on their learning (Center on the Developing Child, 2018). The New Zealand Education Act 1987 ensures learners with special educational needs are able to attend mainstream primary and secondary schools alongside their peers (Carrington & Macarthur, 2012). However, it should be stressed that, in practice, not all schools actively or willingly include children requiring additional learning supports, and further ongoing work is needed in this area.

Guidelines supporting the inclusion of learners with diverse needs include the United Nations Conventions on the Rights of Persons with Disabilities and the United Nations Convention on the Rights of the Child, with Aotearoa New Zealand being a signatory to both (Carrington & Macarthur, 2012). Further, the New Zealand Disability Strategy 2016–2026 (Ministry of Social Development (MSD), 2016) and Whāia Te Ao Mārama 2018–2022: The Māori Disability Action Plan (MoH, 2018) provide strong guidance and clear pathways toward the widespread empowerment of people who are disabled. Whāia Te Ao Mārama was developed through a consultation process (rurukutia), which listened to the voices of *tāngata whaikaha* (people with disabilities) in their aspirations to (1) “participate in the Māori world (te ao Māori)”; (2) “live in a world that is non-disabling”; (3) “have leadership, choice and control over their disability supports”; and (4) “be supported to thrive, flourish and live the life they want” (MoH, 2018, p. iv). The focus of the document on te ao Māori informed self-determination, and active and engaged lives in employment and wider education, health, and social networks, including “whānau, hapū” and “iwi development and celebrations” (MoH, 2018, p. 3). The document is also closely linked to the three treaty principles – those of partnership, protection, and participation – and to those in the United Nations conventions. The principle of partnership guides the education of students with special needs by laying down the expectation that students and families will have the opportunity to work together with educators and professionals to develop the best, evidence-based

programs. Further discussion regarding partnership can be found later in the next section. The principles of protection and participation are actively promoted when children's rights to access education, to attend their local school, to express their identity, and for their voice to be heard are exercised and they participate fully in all aspects of the preschool or school environment.

Frameworks such as *Tātaiako: Cultural Competencies for Teachers of Māori Learners* (MoE & New Zealand Teachers Council, 2011) and *The Hikairo Schema* (Macfarlane et al., 2019) offer a cultural competency framework for teachers – a set of expectations linking to both policy and curriculum. Providing a single depiction of *mātauranga* Māori (Māori knowledge) is challenging owing to the diversity that ensues across geographies, iwi (tribal groups), and generations (Macfarlane, 2000). However, kaupapa Māori (Māori philosophy) research has enabled the identification of a system of common concepts, practices, and protocols (*tikanga*) that hold significance, both historically and in the current era.¹ *Tātaiako* focuses on five key concepts drawn from educational research and kaupapa Māori contexts. The concepts are (1) whanaungatanga (defined above); 2) *manaakitanga* (showing integrity, sincerity, and respect towards Māori beliefs, language and culture; see also Ritchie, 1992, and Macfarlane's Educultural Wheel, 2004); (3) tangata whenuatanga (affirming Māori learners as Māori); (4) providing contexts for learning where the language, identity, and culture of Māori learners and their whānau is affirmed; (5) *ako* (taking responsibility for their own learning and that of Māori learners); and (6) *wānanga* (traditional learning contexts and processes; MoE & New Zealand Teachers Council, 2011). It is posited that these fundamental concepts are embedded in Māori psyche at both conscious and subconscious levels, impacting the way children and their whānau perceive the world, behave, and become involved in educational activities. Certainly, although their findings were based on a limited sample size, Hall, Hornby, and Macfarlane (2015) confirm that the enactment of sociocultural principles by professional leaders and teachers contributed towards positive educational experiences for secondary students and their families. In their study, the concept of *manaakitanga*, the caring for Māori learners' learning and potential, was viewed as being highly influential. In particular, this included nurturing students by acknowledging their strengths, fostering engaged and purposeful learning, having high expectations for learning, meeting learning needs, challenging students to extend their learning, and offering emotional and mentoring supports (Hall et al., 2015). Indeed, *manaakitanga* in the educational setting is frequently viewed as synonymous with inclusion (Te Kete Ipurangi, 2018b), where the student with special needs is intentionally and warmly included as a valued member of the collective at all times. With a history of excluding students with special needs from mainstream schooling and segregating them from society in institutional care, professional learning conversations around the cultural concept of *manaakitanga* act to catalyze more inclusive educator attitudes in the classroom (Macfarlane, 2004; Macfarlane et al., 2017).

Partnership through Communities

Children exist within a family unit, but they are also part of wider collectives and organizations. These may be religious, sporting, cultural, or iwi-related. However, the most commonly shared group the child and family have a connection to is likely to

be their school or educational community. Additionally, the child may be a member of an organized or imagined community specific to their unique learning needs, although having a disability and being of a minority culture bring with them their own set of challenges (Bevan-Brown, 2013; Smiler, 2006). It is widely understood that not every child experiences settings where they are socially included (Carrington & Macarthur, 2012). Furthermore, although some inroads have been made in terms of achieving equity in educational achievement data, there are cohorts of children whose engagement in learning has not been secured (Berryman, 2014; Hooper, Winslade, Drewery, Monk, & Macfarlane, 1999). Research plays an important role in ensuring the extraction of best evidence for programmatic planning for all children. Regularly, research findings suggest that sociocultural influences extend into the educational community and can be utilized as capital to help develop a stronger system of support (Macfarlane, 2012) – for example, where the family of a Māori child with special needs is fully involved in the classroom and school community program. This might include spending time as parent help in the classroom, attending school excursions and other events, and contributing ideas through formal consultation and informal conversations, as discussed in relation to *rārangahia* and *rāhiritia* above. The key here is to enable and facilitate meaningful and authentic participation for the family.

The need for systems-based approaches to enhance the learning and social inclusion of children is being increasingly noted (Macfarlane et al., 2017), but they should be seen as supplementary to individualized and targeted developmental and educational supports for learners who need them. For example, although adaptations to the curriculum are made for many students, a literacy program or prompts and visual supports can be adapted for the students by including vocabulary from their family's first language if it is not English. Similarly, from a parental perspective, having professionals who speak the family's language and incorporate this into overall intervention programming has been identified as beneficial (Kummerer, Lopez-Reyna, & Hughes, 2007).

Informed by the Treaty of Waitangi, and present in Ka Hikitia and other policy and practice documents, is an underlying premise of partnership. Indeed, partnership between schools and families and schools and *iwi* is critical if educational success is to be achieved (MoE, 2008, 2013; Pōmare, 2011). Underpinning partnership is the premise of power-sharing, which paves the way for the demonstration of respect between each party involved. Linked hand in hand with this is the idea of *rārangahia* – collaboration. For example, a child's learning is more effective when *whānau* are respected and seen as having valuable contributions to make (Pōmare, 2011). Practically speaking, this means that educators and professionals value those assertions made by family in formal (e.g., individual planning meetings and parent–teacher conferences) and informal discussion (e.g., day-to-day conversations) about their child, personality and attributes, and activities of daily living in the home and community context. For example, the funds of knowledge approach (Moll, Amanti, Neff, & Gonzalez, 1992) emphasizes an understanding of the contribution each family has to make based on their own sociocultural knowledge and ways of knowledge-making. However, we know such approaches require families, teachers, and communities to trust and open themselves to learning with, from, and about each other (Pōmare, 2011). Further discussion about collaborative efforts in individual assessment and programming for the student with special needs can be found below, but it is pertinent to mention the

underlying premises of partnership and collaboration in the Aotearoa New Zealand setting, where all children – including those with special learning and education needs – are expected to thrive in inclusive school environments under the Success for All (2010) policy (MoE, 2010). This refers to involvement and contributions of the learner as well as their families and whānau. In particular, listening to student voices in assessment, planning, and classroom activities allows the development of inclusive classrooms (Guerin, 2015; Morton & Guerin, 2016).

In Aotearoa New Zealand, partnership between home and school, families, and educators has long been promoted, but it is enhanced by programs such as Huakina Mai (Savage, Macfarlane, Macfarlane, Fickel, & Te Hēmi, 2012), The Hikairo Rationale (Macfarlane, 2004, 2007), and Te Pikinga ki Runga (Macfarlane, 2009). Huakina Mai literally means “opening doorways” – with a focus on Māori learners – and is a strengths-based approach that is focused on connecting with whānau in ways that work, where they feel comfortable, and at a pace that suits them. Initial rapport-building and establishment of the relationship allow clear conversations about learning to take place. In time, whānau grow in confidence and, in doing so, are able to make valuable contributions. Positively, not only do skills or confidence gained by whānau members to negotiate the intricacies of the educational setting on behalf of their child stand them in good stead to be able to do this in the future – particularly if the child will need significant and complex supports throughout their lifetime – but also they model self-advocacy and use of voice to the child or young person, promoting increasing independence. For example, when parents advocate for their child to have access to a school playground to allow equitable opportunities for play, not only are they advocating and executing rights on behalf of their child, but they are also modelling skills that are likely to be needed in the future by the child to self-advocate, with or without support.

Whānau contribution in the school community requires a certain openness, which is difficult without a climate of trust. It is argued that there may be two different ways of achieving such an environment – creating an environment where trust is palpable, or empowering whānau and iwi to be more self-determining. The first requires schools to enact policy, follow through, and remain consistent in their approach. The second point is related to the idea of the “achievement turn” (Bottrell & Goodwin, 2011, p. 29). Bottrell and Goodwin suggest policies over the past 10 (or more) years have sought increased educational success for learners, but governmental bodies have determined these policies. It is always problematic when indigenous peoples are not involved in deciding what learning success looks like. Aotearoa New Zealand initiatives circumvent some of this lack of involvement by promoting ideas about self-determined success, at individual, child, whānau, and iwi levels. For example, the student with special needs and their whānau will identify desirable outcomes in the educational planning process, including both curriculum and cultural aspirations (MoE, 2011b). Individual planning meetings can offer this opportunity (for a related discussion, see Wehmeyer & Shogren, Chapter 12, this volume).

In particular, there is scope for early childhood centers and schools to base strategic planning and curriculum development on student interests and needs, as well as parent and community values and aspirations (Te Kete Ipurangi, 2018a). The sociocultural-influenced Aotearoa New Zealand curricula leave space for early years settings, schools, and educators to weave place-based learning into the curricu-

lum, particularly in the social sciences but even more so in self-directed programs of inquiry. Embedding culture in the curriculum, whether by topic, use of language, symbols, or tikanga, requires authentic partnerships between home and school, as well as a shared belief between learners, educators, and whānau that all are able to learn collaboratively. Opportunities for learning more about each other can occur in a range of ways. For example, a teacher may support students to learn New Zealand sign language as a whole-class intervention to ensure a deaf or hearing-impaired peer feels a sense of belonging (Smiler, 2015).

Self-driven iwi development initiatives researching the parameters for success of Māori learners have also been valuable. One such initiative is Ka Awatea – a study of educational success within the Te Arawa tribal confederation in the central north island of Aotearoa New Zealand (Macfarlane, Webber, Cookson-Cox, & McRae, 2014). This study provides a good example of how tribal and sub-tribal collectives commission or carry out research as self-governing bodies. In this way, findings are connected to place and people, and they are more likely to have meaning at the time of dissemination. The promotion of Māori success means that education settings can establish the purpose and methods of learning by listening to and working together with children, whānau, hapū, and iwi, to ensure self-determined successes are achieved. For example, to honor their child's cultural identity, parents may choose enrollment in *marae*-based (traditional meeting place) *kōhanga reo* (Māori language nests) instead of mainstream culture kindergartens. In these settings, tikanga guides the curriculum, and te reo is exclusively spoken, in addition to individual special education needs being acknowledged and attended to within established partnerships between special education professionals, *kaiako* (teachers), and those in the wider community around the setting (e.g., elders).

Returning to the focus on partnerships and considerations for the curriculum in this regard, the literature suggests that most whānau would like some culturally specific content to be incorporated into both the curriculum and the individual program for their child with special needs (Bevan-Brown, 2004). However, Bevan-Brown (2004) found that, in some circumstances, the nature of the learning needs means that participation does not always occur. Bevan-Brown states that:

the nature of ASD [autism spectrum disorder] meant that often children's participation in cultural activities . . . was limited.

(Bevan-Brown, 2004, p. 31)

The presence of cultural content and activities in the curriculum for the child to access is but a start. Educational professionals must work with whānau to determine what participation might look like in a differentiated learning program, and they must promote and extend this at every opportunity. For example, Bevan-Brown (2004) describes how a student:

loved kapa haka [cultural performance] but couldn't cope with it, "because of the noise of all the kids, it was too much and too many people, it used to make him seizure." He did perform wearing earplugs on occasions and now, as an accomplished guitarist, he accompanies his college kapa haka group.

(Bevan-Brown, 2004, p. 10)

When working with children and young people requiring support with learning and behavior, a specific pedagogical approach may be required. Systems-wide/school-wide positive behavior initiatives (e.g., Savage et al., 2012) have been tried. However, education professionals also need to make critical pedagogical decisions specific to: (1) providing an appropriate environment for the learner and his or her peers (emphasizing student safety, predictable responses, and clear boundaries from educators); and (2) ensuring that their own interactions are minimizing attention and behavior issues. For example, Prochnow and Macfarlane (2011) and Macfarlane (2004, 2007) outline a range of classroom management strategies to support educational professionals who are working in school settings. Although the word “discipline” is sometimes used in this approach, it should be noted that the presence of *manaakitanga* (care), means that the environment supports the acknowledgment of emotion, self-regulation, pro-social behavior, and the promotion of inclusive attitudes for all. Here, the underlying principle of *manaakitanga*, drawn directly from *te ao Māori*, provides an appropriate context to support all learners, such as those with needs in the areas of communication as well as emotional and behavioral self-regulation.

To support the implementation of effective culturally responsive practice for learners with special needs, appropriate staffing and adequate professional learning and development opportunities are required. There continues to be an ongoing shortage of Māori and Pasifika special education professionals in Aotearoa New Zealand, perpetuating the reality that difficulties can arise where “the dominant culture . . . provides the majority of professionals, even though the minority culture may provide large numbers of the individuals receiving the services” (Macfarlane, Blampied, & Macfarlane, 2011, p. 6). Teachers and psycho-educational practitioners are individually required to take responsibility for developing and refining their own culturally responsive and sustaining practices, based on available evidence from the learning environment/education setting and research innovations. It is the educational organization’s role to provide space for adequate professional development, affording all personnel opportunity for formal and informal learning. For example, some professionals may take up opportunities in local tertiary-based courses, such as the University of Canterbury’s Culturally Inclusive Pedagogies course, which scaffolds teachers to reflect on their own practice and interact with research, in order to catalyze pedagogical transformation. The following section also looks to an evidence-based approach as a way of providing culturally appropriate and culturally aligned learning support for individual children with the support of their *whānau*.

The Individual Learner and Whanāu

Given the embedded nature of culture, it is necessary to consider how this relates to assessment, planning, and intervention procedures in targeted and individualized psycho-educational practice (Hoover & Patton, 2017). At the child and family level, sociocultural data provide important information in an evidence-based practice (EBP) approach. EBP is a model used to support decision-making in a range of health and education professions (Goodheart et al., 2006; Satterfield et al., 2009; Shlonsky, 2004; Thyer, 2004). In EBP, the practitioner utilizes reflection and critical thinking to appraise and integrate best research evidence with practice expertise and individual/family preferences and characteristics, in order for a practical course of action

to be chosen, with a focus on quality, safety, efficiency, and best predicted outcomes (Cullen & Adams, 2010; Goodheart et al., 2006; Satterfield et al., 2009; Shlonsky, 2004). Adaptations for kaupapa Māori contexts, to encourage integration of cultural content in mainstream and specialist support settings, include Tō Tātou Waka (Macfarlane et al., 2011, 2008) and He Ritenga Whaimōhio (Macfarlane, 2011) – frameworks that actually promote drawing from mātauranga Māori to strengthen decision-making.

Strengths in Utilizing the Family's Cultural Knowledge

In particular, knowledge held by the family – cultural or otherwise – is very useful for designing a differentiated and appropriately supported learning or transition pathway. In EBP, individual and whānau information is considered to hold equal weight with other types of data. Therefore, not only is the inclusion of sociocultural knowledge of the child and their whānau legitimized, but, further, it could be argued that a course of action planned without it would be inadequately based on all of the relevant evidence. Indeed, by not making appropriate sociocultural considerations, such as those that have been described in this chapter, there is a risk of intervention and learning programs being “hit and miss” or “one size fits all,” rather than being tailored to the individual and his or her diverse qualities.

Avoiding Assumptions

In the absence of in-depth knowledge of individual sociocultural influences, there is a risk that assumed stereotypical information may be substituted (Macfarlane et al., 2011). This risk can be addressed in a number of different ways. At a philosophical level, “stereotype threat” can be counteracted by the rejection of deficit thinking and by embracing a strengths-based approach (Bevan-Brown, 2013; Sanders & Munford, 2010), using tools such as Te Ara Whakamana: Mana Enhancement (AkoSolutionz, 2019). At a more practical level, Macfarlane et al. (2011) suggested a simple exercise developed by Crisp and Turner (2009) where, prior to an interaction, the professional imagines the upcoming event as a comfortable and positive event for both the whānau members and the professionals involved.

Cultural Perspectives on Disability

In line with this, it is known from international research that there are differences in the way culture and ethnicity influence how a child with a disability or learning need is perceived. For example, Blacher, Begum, Marcoulides, and Baker (2013) found, across a 7-year period (of children aged up to 9 years), Latino mothers expressed “higher positive impact” (p. 151) of their children with (and without) intellectual disabilities on their own parenting than European American mothers. Suggested reasons for this included self-perceived roles of parenting, a climate of acceptance of what was before them, levels of extended family support, and underpinning religious beliefs (Blacher et al., 2013). Indigenous Māori perspectives correspond with these findings. For example, although records suggest kāpo Māori (Māori who are blind, in the Ngā Puhī iwi dialect) may have been seen as a burden through times of difficulty (e.g., food shortages, security of land), or connected to a misdemeanor of a family member, earlier

data suggest that those with disabilities such as visual impairment were revered – in particular, “known for the talents that they possessed, not for what they didn’t have” (Tikao, Higgins, Phillips, & Cowan, 2009, p. 11). In the present day, kaupapa Māori sources most usually view the child as “rich, inherently competent, capable and gifted no matter what age or ability” (Rameka, 2012, p. 130).

Perceiving indigenous children – with or without disability, impairment, or identified learning needs – to have unique characteristics, untapped potential, and something to contribute to society is inherently Māori and fits strongly with a strengths-based approach. Bevan-Brown (2013) goes so far as to suggest that, “Māori values support inclusion” (p. 571). Te Whatu Pōkeka (MoE, 2009), an early years assessment resource, and Te Whariki, the early childhood curriculum itself (MoE, 2017), have congruence with these perspectives. For example, the documents encourage educators to positively view all behaviors and personal attributes as part of the child and his or her unique learning disposition. This view provides a way to further customize individual programming and to utilize strengths and interests when building areas for development. However, where the environment is at odds with these ideals – for example, where families and practitioners are struggling to see strengths and opportunities – facilitating shared understandings of traditional Māori and current social inclusion perspectives that celebrate the child and engaging in discussions about positive characteristics are encouraged.

Although it is possible that, for many whānau, the propensity for strengths-based perspectives may result in a sense of neutrality and a preference to work independently in order to avoid judgment on their abilities to cope, education professionals should not underestimate the realities of raising a child who is in need of ongoing additional supports. It is possible that the whānau is not just perceiving strengths but is also struggling to adapt to their child’s needs, while negotiating their own complex feelings in the early stages of accepting their child’s diagnosis. Bevan-Brown (2004) alludes to this in a qualitative study of 19 parents of Māori children diagnosed with *takiwātanga* (ASD). In this study, Bevan-Brown (2004) uncovered key challenges to service provision for Māori students with ASD. These included issues relating to diagnosis, service access and availability, negative attitudes, and financial implications. The need to provide “culturally appropriate, effective assessment, teaching and ASD-related services” and professionals with knowledge in “Māoritanga” were seen as solutions for many of these challenges, so that students might fully participate in cultural programs and activities at school and in the community (Bevan-Brown, 2004, p. vii).

Whatever the case, carrying out an assessment of the individual and the whānau ecology in an open and caring manner will likely reveal existent whānau functioning and coping capacities. Bevan-Brown (2004) declared that, if further supports are required, it is about approaching this in a way that ensures that the *mana* (status, prestige, dignity, esteem, authority, influence) of the whānau remains intact, and that they must not be made to feel embarrassment or shame.

In all circumstances where the education professional listens and responds to the culture of the child and their whānau, it will also be pertinent to listen separately to their respective voices. In this way, any information that appears to contribute to the need for psycho-educational support can be addressed. For example, once the child reaches secondary school, there may be a disconnect between their own aspirations and those desired by their whānau. Understanding adolescence from both

sociocultural and developmental perspectives may require drawing on both indigenous and Western theory and evidence – as in the He Awa Whiria (A Braided Rivers) approach (Macfarlane, Macfarlane, & Gillon, 2015) – and is likely to be beneficial through this time period to ensure that the views of all parties are equally represented, heard, and understood.

Macfarlane et al. (2015) suggested that it is inappropriate to seek solutions to indigenous challenges solely from within a Western knowledge stream. He Awa Whiria envisions two distinctive streams of knowledge (Western and Māori) that are each accorded equivalent recognition and status and that collectively contribute to a richer pool of knowledge. In the context of working with students with special needs and their families, blended frameworks such as He Awa Whiria offer a way to envision input from sources that are accorded equal recognition and that are drawn on in a collaborative way in order to seek resolution for the student. During adolescence, when a student with special needs may be finding his or her voice and an urgency to be heard, the various strands of a braided river flowing to a collaborative outcome might include input from the student, input from the family on their cultural values (for instance, the earlier Māori examples of whanaungatanga, manaakitanga, ako, and tangata whenuatanga), as well as input from school and special needs professionals who, in all likelihood, may bring input from the Western stream of knowledge. In this way, knowledge that is being provided from both knowledge streams is being respectfully accorded equal status; all those who provide input are given a legitimate voice. This respectful collaboration is likely to result in a rich and robust outcome – one that recognizes the voices of all parties who have concern for, and interest in, achieving a positive outcome for all.

Considering Language

The centrality of language needs consideration in some special needs areas (e.g., a specific learning disability in reading). There are distinct implications for different cultural groups whose first language is not the “dominant” language of a country. For example, in Australia, there are distinct implications for Aboriginal students with dyslexia owing to English being their second or third language. In Aotearoa New Zealand, te reo Māori language immersion educational settings are available for students to attend. It is not within the scope of the chapter to describe the experience of students with special needs in these schools in detail, and this chapter focuses on students who are educated in mainstream settings. However, some patterns concerning special needs and the learner who has two or more languages in their environment are emerging. Interestingly, there are patterns of both under-referral and over-referral of students who are bilingual, for special education support (Baker, 2011; Hardin, Mereoiu, Hung, & Roach-Scott, 2009). Under-referral of those with a range of developmental and other special learning needs may be due to linguistic and cultural barriers between educational settings and families. Over-referral of students who are underachieving is often because of the constraints of dominant culture education (as mentioned above), because it is not responsive to culturally and linguistically diverse backgrounds (Baker, 2011; Hardin et al., 2009).

Students may learn two or more languages simultaneously or sequentially (see Purcell, Lee, & Biffin, n.d.), from birth in the home, or across settings. Practitioners should expect a child to be able to develop two languages regardless of special needs

(Nemeth, 2012; Paradis, Genesee, & Crago, 2010). However, acquisition of two or more languages adds a further dimension to assessment and intervention. It is important to listen to the needs of the family and their wishes for their child; however, supporting the ongoing development of the home language is known to be of benefit in later schooling. As language is inextricably linked with individual and family cultural identity, supporting bilingual language development can have positive impact on more than just the ability to communicate in different contexts. Any steps taken to revitalize and maintain a heritage language in the educational setting means that the respective culture is increasingly visible and valued, promoting a child's cultural identity and sense of belonging and giving evidence of a co-constructed and responsive educational system.

Communicating with Each Other

As discussed earlier, Bronfenbrenner's mesosystem describes the relationships and interactions between community, groups of parents, teachers, educational leaders, paraprofessionals, and psycho-educational practitioners when responding to children with diverse learning needs in the microsystem. The mesosystem strongly resembles the connections and exchanges that exist in the kaupapa Māori concept of whanaungatanga. It is here that rāhiritia, or communication, takes place. Within these culturally aligned structures, communicative interactions are critically important to the educational outcomes and positive learning experiences for learners and their whānau in the education system. Although communication in special education practice may have traditionally taken place *kanohi ki te kanohi* (face to face), exchanges may now be supplemented by the use of technology, such as telecommunications (e.g., texts, phone calls) and the internet (e.g., video conferencing, social networking). For families of students with special needs, this is highly beneficial, as contact with professionals is frequent, and work/life demands may make it difficult to attend meetings. Phone and online tools offer a means for communication to be up to date, for rapport to be maintained, and for facilitation of and coaching around intervention programming to take place.

When entering into communication, the practitioner should always be aware that culture influences "how people communicate with each other" (Quest Rapuara, 1992, p. 7). An atmosphere of trust and openness was discussed earlier in relation to partnerships in educational communities. Here we remind ourselves what this might look like at the human interaction level, where we enter into the exchange as human beings. Kress (2017) discussed the need to work with an "Indigenous lens" to "see and hear the faces," "voices," and "kinships" of children who are disabled, as a way of understanding "inclusion and wellness" (p. 23). Macfarlane's (2004) Educultural Wheel offers teachers a tool to bring this indigenous lens into the education setting. However, practitioners also need the openness and skill to critically examine their day-to-day practice, in order to know themselves and their own cultural lens, and to develop competence in responding to the culture of others. Cartledge and Kourea (2008) suggested that this requires drawing on feedback from the practice setting. For example, where the child has special needs in addition to a cultural background that differs from the educator, it is important the practitioner regularly self-questions his or her practice to ascertain whether the focus is solely on adapting the curriculum, or

whether there is consideration of the cultural influences that shape the student's daily life, including how these can enrich individual and class programming. Tools such as the Cultural Self-Review developed for those working with Māori students, including those with special needs, guide teacher reflection and action planning in this area (Bevan-Brown, 2003). Amulya (2004) explained this as a process of exploration and curiosity, where learning has purpose owing to its meaning in the professional setting, but one should treat oneself kindly in addressing mistakes. Reflecting on one's own cultural background allows one to identify and acknowledge the lens through which the communicative interaction is being entered. Cruz (2013) explained how this acknowledgment and respect paves the way for honest and effective communication to occur between two parties, which can result in learning and growth for all.

When involving whānau in the discussions about their child's interests, aspirations, and individual special needs during assessment and intervention processes, the presence of *Kaitakawaenga* (cultural intermediaries, cultural mentors; Macfarlane et al., 2011) can sometimes help to make whānau feel supported. However, the ultimate goal is for the environment to be and feel safe and trustworthy enough for whānau or assigned caregivers to confidently and effectively communicate with teachers and educational professionals, to be empowered to share existing knowledge, to take on new information, and to develop understandings about their child and their educational pathway (Pōmare, 2011).

FUTURE DIRECTIONS

This chapter has outlined the sociocultural influences impacting the design of curricula and the implementation of psycho-educational supports in Aotearoa New Zealand, utilizing examples from the indigenous Māori context. It is apparent that the legislative framework and policy direction is constructively geared to enhance educational experiences and outcomes for Māori and others who may qualify for learning support owing to risk, impairment, or disability. The need for systems-based approaches to enhance the learning and social inclusion of children requiring developmental and educational supports has been emphasized; however, this does not dispute the need for high-quality teaching practices in the education setting/classroom and at small-group and individual-child levels.

Global and local data suggest the importance of whānau contributions, specific learning supports for children, whānau-school partnerships, and place-based learning; however, further research into the mechanisms at play in the implementation of specific interventions and practices is needed. Owing to the uniqueness of individual programming and the ethos of individual early years and school settings, case study research has the potential to provide in-depth, rich data. Whānau and iwi self-determination (see Wehmeyer & Shogren, Chapter 12, this volume) and involvement in curriculum planning have been found to influence positive outcomes for children with and without special and unique learning needs. However, further outcomes-based research is needed to show specifically what *is* working for Māori children. This requires two things: determining what Māori view success to be and finding ways to measure any unpredicted gains, those not planned for or aspired to. For Māori students with special needs, this will involve researching student and whānau perspectives, including narrowing to focus on specific special needs such as the work among

deaf and ASD students (Smiler, 2015) and comparing these perspectives with those of the practitioner and available research evidence from overseas. In addition, it will be important to identify factors that influence successful individual programming within the classroom and school community context.

Running through this chapter is the notion of partnership and working together; however, the need for ongoing professional learning in this space is evident. One area for further attention in the Aotearoa New Zealand context is the imbalance in Māori compared with non-Māori teachers and in those who hold leadership positions. Educators and specialist professionals need to remain aware and critically examine their ability to respond skilfully and appropriately in diverse situations. To do this, their exposure to, and integration of, “culturally responsive” evidence-based professional learning material is required. Therefore, studies into the effectiveness of integrated cultural content in professional learning for pre- and in-service teachers are indicated. In particular, the impact of culturally responsive pedagogy on learning and life outcomes, in addition to teachers’ own understandings, could provide valuable data to new generations of those working with children who require learning support.

REVISITING CULTURAL PERSPECTIVES AND STUDENTS WITH SPECIAL NEEDS

As was noted at the beginning of the chapter, any child requiring psychosocial and psycho-educational support does not learn and develop in isolation. Therefore, to bring a singular remedial response to them as though they were an isolated individual significantly impedes the chances of attaining favorable outcomes for the child. The sociocultural approach understands the social world (place, order, and institution) and the cultural world (language, identity, values) as having an effect on educational outcomes, and this is no less true for learners with special needs. How a particular culture views disability, and the influence of this view within the relevant family, will in turn shape interactions around the child. As noted in preceding text, the cultural perspective may be to value the child’s special need or, alternatively, to view it negatively. In responding to the needs of the child, education professionals need awareness of these elements.

For families of children with special needs from indigenous cultures, connectedness and relationships typically have a strong emphasis. Their connections to wider family, ancestors, and cultural imperatives are likely to be central to their sense of identity and belonging. The cultural value placed on connections and relationships means that establishing, or not establishing, a relationship between the school and the family will be significant and will impact what can be achieved for the child. Families from non-Western migrant cultures are likely to place similar value on connectedness, including relationships to ancestors and cultural identity, which will inform their sense of belonging and security. On occasion, it may be wise for educators to use a cultural mentor or intermediary to connect in culturally responsive ways. Establishing a partnership approach with the family will require that diverse worldviews and knowledge systems be accorded equal respect and value as part of mutually affirming planning and solution-seeking. Use of the child’s cultural iconography or resources in the classroom setting can affirm a special needs learner and draw attention to diversity and wider knowledge, rather than a default focus on the support elements needed by the learner.

Many indigenous cultures hold strong values around inclusion and have an ability to embrace diversity, as has been noted in the example of Māori in Aotearoa New Zealand described above. These values can provide a platform and mandate for learners with special needs, affirming their right to access quality educational opportunities. Utilizing the family's (cultural) knowledge can assist in finding creative or adaptive solutions to overcome challenges for special needs learners – for example, where a tribal network may enable increased support, access, or a safe environment that is advantageous to the individual learner. A sociocultural approach recognizes all of the cultural ecologies of the special needs learner, valuing their culture as a strength and as the context for collaboratively achieving quality outcomes for the learner. Such an approach views each learner as being unique and having strengths and potential, and it values the contributions and collaborations of others in seeking responses to challenges that may present.

CONCLUSION

This chapter describes the requirement to see culture as an influencing factor in how an individual child's needs present in the everyday context of family and community. It argues for an ecological systems/sociocultural perspective that perceives the child as part of a wider social unit and notes the congruence between indigenous cultural constructs and Bronfenbrenner's ecological systems theory. Culture needs to be a paramount consideration in societies where a dominant culture provides the educational professionals, even though a minority culture has large numbers of individuals requiring services. Earlier discussion has described the importance of professional development in cultural responsiveness, as needed for partnering with families, decisions on assessments, and individual interventions. Here, the model of evidence-based practice is useful to bring in complementary sources of expertise.

Partnerships with families and communities are integral to sociocultural practices in special needs education, including partnering to identify desired goals and outcomes, curriculum adaptations, and cultural aspirations. Such partnerships need to acknowledge and give equal value to both the minority culture and the dominant culture knowledge systems. The chapter proposes that building relationships with families and communities in order to facilitate inclusion and collaboration is central to successful learning in a special needs context. These practices of authentic engagement will actualize the valuable contributions that diverse cultures are able to offer and will dually enrich the educational experiences of, and outcomes that are achieved by, special needs learners. Embracing diversity and facilitating inclusion for learners with special education needs will surely serve to strengthen learners' self-concepts and self-beliefs, their cultural identity, and their sense of place and belonging, and it will also send the message that their participation and achievements in education and beyond are valued and important.

NOTE

- 1 These concepts have been explained at length in sources written by both indigenous Māori and non-indigenous observers and academics (see, for example, Ritchie, 1992, and Smith, 1991).

GLOSSARY OF TERMS

ako	to learn, reciprocal learning
Aotearoa	literally The Land of the Long White Cloud, New Zealand
Ka Hikitia	The New Zealand Ministry of Education (MoE) Māori Education Strategy. <i>Ka hikitia</i> literally means “to step up” and “to lengthen one’s stride”
kanohi ki te kanohi	face to face
Ka Awatea	a tribe-specific case study of Māori secondary students experiencing educational success; <i>ka awatea</i> literally means “the dawning of a new era”
kāpo Māori	Māori who are blind or visually impaired
kaupapa	purpose, topic, guiding principles, philosophy
kōhanga reo	preschool language settings based on Māori language and culture
He Awa Whiria	a treaty-based partnership framework representing streams of knowledge. <i>He awa whiria</i> literally means “braiding streams”
He Ritenga Whaimōhio	a Māori philosophical framework representing evidence-based practice. <i>He Ritenga Whaimōhio</i> literally means “informed practice”
Huakina Mai	a Māori philosophy-based school-wide behavior management program; <i>huakina mai</i> literally means “opening doorways”
iwi	tribal kin group; nation
manaakitanga	displaying care, respect, hospitality, kindness, mutual trust, respect, and concern
mana motuhake	autonomy, self-government, self determination
Māori	indigenous person/people of Aotearoa New Zealand
mātauranga	knowledge, tradition, epistemology
marae	tribal meeting grounds, traditional village
Ngā Puhi	a tribe located in Northland, New Zealand
rāhiritia	communicating respectfully with and inclusively of others in order to achieve a shared goal
rārangahia	collaboration and weaving together our knowledge skills and perspectives for best outcomes
rurukutia	consulting strategically to co-ordinate, plan, and prioritise activities for positive change
takiwātanga	the Māori term for autism spectrum disorder (ASD); <i>takiwātanga</i> literally means “his or her own time and space”
tangata whenua	indigenous peoples, people of the place, or land
tangata whenuatanga	the knowledge or awareness of people and place
Tātaiako	the MoE cultural competencies framework for teachers of Māori learners; <i>tātaiako</i> literally means “to measure learning”
te ao Māori	Māori worldview
te reo Māori	the Māori language
Te Whāriki	the New Zealand MoE Early Childhood Curriculum; <i>te whāriki</i> literally means “the woven mat”
Te Whatu Pōkeka	the MoE Māori philosophical assessment for learning early childhood exemplars; <i>te whatu pōkeka</i> literally means “the baby blanket,” something that takes the shape of the baby, providing warmth, comfort, security, and refuge
Te Tiriti o Waitangi	the Treaty of Waitangi
tikanga	customs, protocols, practices
wānanga	houses of higher learning, tertiary institutes, transmitting the knowledge of the culture from one generation to the next
whakapapa	genealogy, ancestry, familial relationships
whānau	family, nuclear/extended family
whanaungatanga	the process of establishing and maintaining relationships; the interrelationship of Māori with their ancestors, their whānau, hapū, iwi, as well as the natural resources within their tribal boundaries such as mountains, rivers, streams, and forests; recognition of relationships iwi and waka

REFERENCES

- AkoSolutionz. (2019). *Te Ara Whakamana/Mana Enhancement*. Retrieved from www.akosolutionz.com/mana-enhancement/mana-enhancement-overview
- Amulya, J. (2004). *What is reflective practice?* Centre for Reflective Community Practice at the Massachusetts Institute of Technology. Retrieved from www.itslifejimbutnotasweknowit.org.uk/files/whatisreflectivepractice.pdf
- Baker, C. (2011). *Foundations of bilingual education and bilingualism*. Bristol, UK: Multilingual Matters.
- Berryman, M. (2014). Relational and culturally responsive, indigenous approach to belonging and inclusion. In M. McLean, M. Morton, & R. Wills (Eds.), *Tales from school: Learning disability and state education after administrative reform* (pp. 199–211). Rotterdam, The Netherlands: Sense Publishers. doi:10.1007/978-94-6209-893-0_18
- Bevan-Brown, J. (2003). Providing for Māori learners with special needs. In D. Fraser & R. Openshaw (Eds.), *Informing our practice* (pp. 22–28). Palmerston North, NZ: Kanuka Grove Press.
- Bevan-Brown, J. (2004). *Māori perspectives of autistic spectrum disorder. Report to the Ministry of Education*. Wellington, NZ: Ministry of Education.
- Bevan-Brown, J. (2013). Including people with disabilities: An indigenous perspective. *International Journal of Inclusive Education*, 17(6), 571–583.
- Blacher, J., Begum, G. F., Marcoulides, G. A., & Baker, B. L. (2013). Longitudinal perspectives of child positive impact on families: Relationship to disability and culture. *American Journal on Intellectual and Developmental Disabilities*, 118(2), 141–155.
- Bottrell, D., & Goodwin, S. (Eds.). (2011). *Schools, communities and social inclusion*. South Yarra, Australia: Palgrave Macmillan.
- Britt, E., Macfarlane, A., Macfarlane, S., Naswall, K., & Henderson, J. (2017). Growing a culturally responsive tertiary programme in psychology. *The Australian Journal of Indigenous Education*, 1–13. doi:10.1017/jie.2017.35
- Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press.
- Carrington, S. B., & Macarthur, J. (2012). *Teaching in inclusive school communities*. Melbourne, Australia: John Wiley.
- Cartledge, G., & Kourea, L. (2008). Culturally responsive classrooms for culturally diverse students with and at risk for disabilities. *Journal of Exceptional Children*, 74(3), 351–371.
- Center on the Developing Child. (2018). *Understanding motivation: Building the brain architecture that supports learning, health, and community participation (Working Paper 14)*. Cambridge, MA: Harvard University Press.
- Consedine, R., & Consedine, J. (2012). *Healing our history: The challenge of the treaty of Waitangi* (3rd ed.). Auckland, NZ: Penguin.
- Cooper, M., Hedges, H., Lovatt, D., & Murphy, T. (2013). Responding authentically to Pasifika children's learning and identity development: Hunter's interests and funds of knowledge. *Early Childhood Folio*, 17(1), 6–11.
- Craig, E., Reddington, A., Adams, J., Dell, R., Jack, S., Oben, G., ... Simpson, J. (2014). *Te Ohonga Ake: The health of Māori children and young people with chronic conditions and disabilities in New Zealand*. Dunedin, NZ: University of Otago.
- Crisp, R. J., & Turner, R. N. (2009). Can imagined interactions produce positive perceptions? Reducing prejudice through simulated contact. *American Psychologist*, 64, 231–240.
- Cruz, M. (2013). Building culturally respectful learning spaces for Aboriginal children. *Early Childhood Folio*, 17(2), 38–44.
- Cullen, L., & Adams, S. (2010). What is evidence-based practice? *Journal of PeriAnesthesia Nursing*, 25(3), 171–173. doi:10.1016/j.jopan.2010.03.004
- Duncan, J. (2013). *Early childhood education: Seeing and being seen* [video file]. Retrieved from www.youtube.com/watch?v=Ylbt1_cUmAE
- Durie, A. (1997). Te aka matua: Keeping a Māori identity. In P. Te Whaaiti, M. McCarthy, & A. Durie (Eds.), *Mai i rangiatea: Wellbeing and development* (pp. 142–162). Auckland, NZ: Auckland University Press, Bridget Williams Press.
- Durie, M. (1994). *Whaiora: Māori health development*. Auckland, NZ: Oxford University Press.
- Durie, M. (2001). *Mauri Ora: The dynamics of Māori health*. Melbourne, Australia: Oxford University Press.

- Durie, M. H. (2004). *Race and ethnicity in public policy: Does it work?* Paper presented at the Social Policy, Research and Evaluation Conference "What Works?" Wellington, NZ.
- Goodheart, C. D., Levant, R. F., Barlow, D. H., Carter, J., Davidson, K. W., & Hagglund, K. J., & American Psychological Association. (2006). Evidence-based practice in psychology. *American Psychologist*, 61(4), 271–285.
- Guerin, A. (2015) *Hearing voices: Supporting the participation of all students in their schools*. Whakatane, NZ: New Zealand Association for Research in Education Conference and AGM (NZARE). 17–20 Nov 2015. (Conference Contributions – Other).
- Hall, N., Hornby, G., & Macfarlane, S. (2015). Enabling school engagement for Māori families in New Zealand. *Journal of Child and Family Studies*, 24(10), 3038–3046.
- Hardin, B. J., Mereoiu, M., Hung, H.-F., & Roach-Scott, M. (2009). Investigating parent and professional perspectives concerning special education services for preschool Latino children. *Early Childhood Education Journal*, 37, 93–102.
- Hayward, J. (1997). The principles of the treaty of Waitangi. In A. Ward (Ed.), *National overview* (Vol. 2, pp. 475–494). Wellington, New Zealand: Waitangi Tribunal.
- Hooper, S., Winslade, J., Drewery, W., Monk, G., & Macfarlane, A. (1999, July). School and family group conferences: Te Hui Whakatika (a time for making amends). Paper presented at Keeping Young People in School Summit Conference on Truancy, Suspensions and Effective Alternatives, Auckland.
- Hoover, J. J., & Patton, J. R. (2017). *IEPs for ELs and other diverse learners*. Thousand Oaks, CA: Corwin.
- Kress, M. M. (2017). Reclaiming disability through Pimatisiwin: Indigenous ethics, spatial justice, and gentle teaching. In A. Gajewski (Ed.), *Ethics, equity, and inclusive education* (pp. 23–57). Bingley, UK: Emerald. Retrieved from: www.emeraldinsight.com/doi/pdfplus/10.1108/S1479-363620170000009002
- Kummerer, S. E., Lopez-Reyna, N. A., & Hughes, M. T. (2007). Mexican immigrant mothers' perceptions of their children's communication disabilities, emergent literacy development, and speech-language therapy program. *American Journal of Speech-Language Pathology*, 16(3), 271–282.
- Liberty, K. (2014). Early intervention in Aotearoa New Zealand: Services and challenges. *New Zealand Research in Early Childhood Education*, 17, 115–145.
- Macfarlane, A. (2000). The value of Māori ecologies in the study of human development. In L. Bird & W. Drewery (Eds.), *Human development in Aotearoa: A journey through life* (pp. 46–52). Auckland, NZ: McGraw-Hill.
- Macfarlane, A. (2004). *Kia hiwa ra! Listen to culture – Māori students' plea to educators*. Wellington, NZ: NZCER Press.
- Macfarlane, A., Macfarlane, S., Derby, M., & Webber, M. (2018). Bridges to success for Māori: An aspirational lens. *Psychology Aotearoa*, 10(1), 11–15.
- Macfarlane, A., Macfarlane, S., Graham, J., & Clarke, T. (2017). Social and emotional learning and indigenous ideologies in Aotearoa New Zealand: A biaxial blend. In E. Frydenberg, A. J. Martin, & R. Collie (Eds.), *Social and emotional learning in Australia and the Asia Pacific* (pp. 273–289). Singapore: Springer.
- Macfarlane, A., Macfarlane, S., Teirney, S., Kuntz, J. R., Rarere-Briggs, B., Currie, M., ... Macfarlane, R. (2019). *The Hikairo schema: Culturally responsive teaching and learning in early childhood settings*. Wellington, NZ: NZCER Press.
- Macfarlane, A. H. (2007). *Discipline, democracy, and diversity: Working with students with behavioural difficulties*. Wellington, NZ: NZCER Press.
- Macfarlane, A. H., Blampied, N. M., & Macfarlane, S. H. (2011). Blending the clinical and the cultural: A framework for conducting formal psychological assessment in bicultural settings. *New Zealand Journal of Psychology*, 40(2), 5–15.
- Macfarlane, A. H., Glynn, T. E. D., Grace, W., Penetito, W., & Bateman, S. (2008). Indigenous epistemology in a national curriculum framework? *Ethnicities*, 8(1), 102–127. doi:10.1177/1468796807087021
- Macfarlane, A. H., Webber, M., Cookson-Cox, C., & McRae, H. (2014). *Ka Awatea: An iwi case study of Māori students' success*. Report to Ngā Pae o te Māramatanga.
- Macfarlane, S. (2009). Te Pikinga ki Runga. Raising possibilities. *SET Journal for Teachers*, 2, 42–50.
- Macfarlane, S. (2011, October). *In pursuit of culturally responsive pathways: Whaia ki te ara tika*. Keynote presentation to the New Zealand RTL Annual Conference 2011. Palmerston North, NZ: Awapuni Function Centre.
- Macfarlane, S. (2012). *In pursuit of culturally responsive evidence based special education pathways in Aotearoa New Zealand: Whaia ki te ara tika*. PhD thesis, Christchurch, NZ: University of Canterbury.

- Macfarlane, S. (2014, July). *Interprofessional practice: Mahi tahi*. Presentation to the Specialist Teaching Block Course, July 5, Central Theatre, Christchurch, NZ: University of Canterbury.
- Macfarlane, S., Macfarlane, A., & Gillon, G. (2015). Sharing the food baskets of knowledge: Creating space for a blending of streams. In A. Macfarlane, S. Macfarlane, & M. Webber (Eds.), *Sociocultural realities: Exploring new horizons* (pp. 52–67). Christchurch, NZ: Canterbury University Press.
- Martin, K. (2003). Ways of knowing, being and doing: A theoretical framework and methods for indigenous and indigenist re-search. *Journal of Australian Studies*, 27(76), 203–214.
- Ministry of Education – Te Tāhuhu o te Mātauranga. (2017). *Te Whāriki: He whāriki mātauranga mō ngā mokopuna o Aotearoa. Early childhood curriculum. (Update)*. Wellington, NZ: Author.
- Ministry of Education – Te Tāhuhu o te Mātauranga. (2008). *Ka Hikitia: Managing for success. The Ministry of Education Māori education strategy, 2008–2012*. Wellington, NZ: Author.
- Ministry of Education – Te Tāhuhu o te Mātauranga. (2009). *Te whatu pōkeka: Kaupapa Māori assessment for learning – early childhood exemplars*. Wellington, NZ: Learning Media.
- Ministry of Education – Te Tāhuhu o te Mātauranga. (2010). *Success for all – Every School, Every Child. Fact sheet*. Retrieved from www.parliament.nz/resource/mi-nz/49SCES_EVI_00DBSCH_INQ_9975_1_A147433/8a9fb7778f8192ba495fa74edd5b1bebafd57b0
- Ministry of Education – Te Tāhuhu o te Mātauranga. (2011a). *Toolkit: Resource teacher of learning and behaviour*. Wellington, NZ: Author.
- Ministry of Education – Te Tāhuhu o te Mātauranga. (2011b). *Collaboration for success. Individual education plans*. Retrieved from <http://seonline.tki.org.nz/IEP/IEP-guidelines>
- Ministry of Education – Te Tāhuhu o te Mātauranga. (2013). *Ka Hikitia – Accelerating Success 2013–2017*. Wellington, NZ: Author.
- Ministry of Health – Manatū Hauora (MoH). (2002). *He Korowai Oranga: Māori health strategy*. Wellington, NZ: Author.
- Ministry of Health – Manatū Hauora (MoH). (2018). *Whāia te Ao Mārama 2018 to 2022: The Māori disability action plan*. Wellington, NZ: Author. Retrieved from www.health.govt.nz/publication/whaia-te-ao-marama-2018-2022-maori-disability-action-plan
- Ministry of Social Development – He Manatū Whakahiato Ora (MSD). (2016). *New Zealand disability strategy 2016–2026*. Wellington, NZ: Author.
- Moll, L., Amanti, C., Neff, D., & Gonzalez, D. (1992). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory into Practice*, 31(2), 132–141. doi:10.1080/00405849209543534
- Morton, M., & Guerin, A. (2016). Examining assessment for students with special education needs in Aotearoa New Zealand: Creating new possibilities for learning and teaching for all. In J. Allan & A. Artiles (Eds.), *World yearbook of education 2017: Assessment inequalities* (pp. 198–218). London: Routledge.
- Nemeth, K. N. (2012). Bilingual infants and toddlers with special needs. In *Many language, building connections: Supporting infants and toddlers who are dual language learners* (pp. 81–86). Lewisville, NC: Gryphon House.
- Paradis, J., Genesee, F., & Crago, M. (2010). *Dual language development and disorders: A handbook on bilingualism and second language learning* (2nd ed.). Baltimore, MD: Brookes.
- Phinney, J., & Rotheram, M. (1987). *Children's ethnic socialization: Pluralism and development*. Newbury Park, CA: Sage.
- Pōmare, H. (2011). *Ka haote rangatahi. Ka hikitia: Managing for success*. Wellington, NZ: Hana & Ministry of Education.
- Prochnow, J. E., & Macfarlane, A. H. (2011). Managing classroom behaviour: Assertiveness and warmth. In C. M. Rubie-Davies (Ed.), *Educational psychology: Concepts, research and challenges* (pp. 150–166). London: Routledge.
- Purcell, J., Lee, M., & Biffin, J. (n.d.). *Supporting bilingual children in early childhood (Information sheet 50)*. Peakhurst, NSW: Learning Links.
- Quest Rapuara. (1992). *Cultural identity – Whakamana tangata: A resource for educators*. Wellington, NZ: Author.
- Rameka, L. (2012). Culturally located assessment in early childhood education. *Waikato Journal of Education – Te Hautaka Mātauranga O Waikato*, 17(2), 7–21.
- Ratima, M. M., Brown, R. M., Garrett, N. K., Wikaire, E. I., Ngawati, R. M., Aspin, C. S., & Potaka, U. K. (2007). Strengthening Māori participation in the New Zealand health and disability workforce. *Medical Journal of Australia*, 186(10), 541–543.

- Ritchie, J. (1992). *Becoming bicultural*. Wellington, NZ: Huia.
- Rogoff, B. (2003). *The cultural nature of human development*. Oxford: Oxford University Press.
- Royal, C. (2005). *Exploring indigenous knowledge*. Retrieved from <https://charles-royal.squarespace.com/s/Exploring-Indigenous-Knowledge>
- Sanders, J., & Munford, R. (2010). *Working with families: Strengths-based approaches*. Wellington, NZ: Dunmore.
- Satterfield, J. M., Spring, B., Brownson, R. C., Mullen, E. J., Newhouse, R. P., Walker, B. B., & Whitlock, E. P. (2009). Toward a transdisciplinary model of evidence-based practice. *The Milbank Quarterly*, 87(2), 368–390.
- Savage, C., Macfarlane, A., Macfarlane, S., Fickel, L., & Te Hēmi, H. (2012). *Huakina mai: A whole school strength-based behavioural intervention for Māori*. Christchurch, NZ: Te Tapuae o Rehua & University of Canterbury.
- Searing, B. M. J., Graham, F., & Grainger, R. (2015). Support needs of families living with children with Autism spectrum. *Journal of Autism and Developmental Disorders*, 45(11), 3693–3702.
- Shlonsky, A. (2004). Will the real evidence-based practice please stand up? Teaching the process of evidence-based practice to the helping professions. *Brief Treatment and Crisis Intervention*, 4(2), 137–153.
- Smiler, K. (2006). Māori deaf identity. *SITES: New Series*, 3(1), 108–125.
- Smiler, K. (2015). Refocusing lenses on Māori deaf children and their whānau. In J. Bevan-Brown, M. Berryman, H. Hickey, S. Macfarlane, K. Smiler, & T. Walker (Eds.), *Working with Māori children with special education needs. He mahi whakahirahira* (pp. 86–106). Wellington, NZ: New Zealand Council for Educational Research (NZCER).
- Smith, G. (1995). Whakaoho whānau: New formations of whānau as an innovative intervention into Māori cultural and educational crises'. *He Pūkenga Korero*, 1(1), 18–36.
- Smith, G. H. (1991). *Reform and Māori educational crisis: A grand illusion*. Auckland, NZ: University of Auckland.
- State Services Commission – Te Komihana O Ngā Tari Kāwanatanga. (2005). *All about the treaty*. Wellington, NZ: State Services Commission.
- Statistics New Zealand. (2018). *Tatauranga Aotearoa*. Retrieved from www.stats.govt.nz/
- Te Kete Ipurangi. (2018a). Partnering with parents, whānau and communities. Retrieved from <http://inclusive.tki.org.nz/guides/partnering-with-parents-whanau-and-communities/>
- Te Kete Ipurangi. (2018b). Inclusive education: Guides for schools. Leading schools that include all learners. Retrieved from <http://inclusive.tki.org.nz/guides/leading-schools-that-include-all-learners/>
- Thyer, B. A. (2004). What is evidence-based practice? *Brief Treatment and Crisis Intervention*, 4(2), 167–176.
- Tikao, K., Higgins, N., Phillips, H., & Cowan, C. (2009). Kāpo (blind) Māori in the ancient world. *MAI Review*, 2(1), 4–19. Retrieved from <http://review.mai.ac.nz/MR/article/download/237/237-1621-1-PB.pdf>
- Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Waitangi Tribunal. (2011). *Ko Aotearoa Tēnei – This is New Zealand*. Wellington, NZ: Author.
- Zion, S., & Kozleski, E. (2005). *On Point: Understanding culture*. Tempe, AZ: National Institute for Urban School Improvement. Retrieved from http://guide.swiftschools.org/sites/default/files/documents/Understanding_Culture_Part_1_.pdf

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TECHNOLOGY AND ITS IMPACT ON READING FOR STUDENTS WITH LEARNING DISABILITIES

Cynthia M. Okolo and Ralph P. Ferretti

Reading is one of the most important tasks that students are expected to learn in school, and the failure to master it has significant developmental consequences. For this reason, reading is an important topic within the field of educational psychology. A perusal of the *Journal of Educational Psychology*, one of the premier journals, attests to the interest in and importance of reading research within the field of education. Reading research spans decades and has been informed by multiple theoretical perspectives that are familiar to educational psychologists, including information processing, problem-solving, self-regulation, executive functioning, and social cognition.

Despite the extensive research about reading, data from international, national, and statewide assessments converge on the conclusion that many American students struggle with reading (e.g., Loveless, 2017; National Center for Educational Statistics, 2017). Students with learning disabilities score at the very bottom on many of these assessments (e.g., Thurlow & Kopriva, 2015), and their learning trajectory is significantly constrained by their poor reading skills. Poor readers are less likely to choose literacy tasks and more likely to avoid reading, and therefore, receive less practice developing their reading skills (Stanovich, 1986). As a result, continued development of specific reading skills, including vocabulary, background knowledge, and the comprehension of challenging academic content, are compromised (e.g., Biancarosa & Snow, 2006; Cunningham & Stanovich, 1998).

There are also social and motivational consequences for poor readers. Educators and parents may lower their expectations for struggling readers, trapping them in a self-perpetuating cycle of poor achievement. Students who cannot read proficiently may develop negative beliefs about themselves as learners and become less likely to persist when reading demands become formidable (Linnenbrink & Pintrich, 2003). Finally, there are serious economic consequences of poor reading. The increasing importance of workplace expertise makes clear the value of sophisticated literacy skills as children progress through the curriculum (Ferretti & De La Paz, 2011). Without

strong literacy skills, workers are increasingly likely to be relegated to low-paying jobs in the service sector of the economy (Snow, 2002). For these reasons, reading has been the focus of intense investigation for more than two decades.

TECHNOLOGY AND STUDENTS WITH LEARNING DISABILITIES

Technology can help ameliorate the reading difficulties experienced by many students (Kennedy & Deshler, 2010). It continues to evolve in its sophistication, providing new affordances for teaching and learning, as well as changing the very nature of what we teach and how we learn. These developments have come at a lower cost, making a wider variety of robust technological options available to schools, teachers, and students. Advances in hardware, software, apps, and the web, supported by artificial intelligence and learning analytics, have spurred the growth of technology-supported personalized learning (Pane, Steiner, Baird, & Hamilton, 2015). The increased availability of technology that replaces or augments text, often driven by consumers seeking more convenient and flexible technology tools, has given rise to numerous options for interacting with information. Text remains the primary instructional material in classroom instruction, but technology has expanded the forms of text and the features it can include.

These developments broaden instructional options for students with reading difficulties. Students with decoding difficulties or lack of fluency can listen to text read aloud. Students with limited vocabulary knowledge can access information, from within the text, to expand their knowledge and understanding of words or concepts. Students with comprehension difficulties can engage with text through tools such as highlighting, outlining, annotation, and intelligent tutoring systems that help deepen their comprehension and support self-regulation of reading processes (for a related discussion, see Perry, Mazabel, & Yee, Chapter 13, this volume). Features such as prompting and embedded strategy instruction can model more effective approaches to comprehending text.

In this chapter, we will examine the opportunities afforded by technology to improve reading for students with learning disabilities (LD). Students with LD comprise about 34% of the 6.7 million students who receive special education services in the United States (National Center for Educational Statistics, 2017). It is estimated that the majority of students with LD have reading and other literacy disabilities, including dyslexia (Fletcher, Lyon, Fuchs, & Barnes, 2018). Dyslexia is recognized as a specific type of LD rooted in language processing. Dyslexia is sometimes differentiated from LD in clinical settings and research samples, but is not explicitly diagnosed in school settings. Therefore, the studies reviewed below in which participants are students with reading disabilities may include students with LD and students with dyslexia. In our discussion, we try to differentiate among these three diagnoses when data are appropriately disaggregated. We recognize that students with other diagnoses also struggle with reading skills, but our focus is on the group of students for whom reading is the primary reason for receiving specialized services. Our review centers on students with LD in preschool through 12th grade.

We organize the chapter around two theoretical models of reading: bottom-up (simple view of reading) and interactive models of reading. We briefly discuss

bottom-up and interactive models and summarize literature about the relationships between the skills and processes represented in the models and the characteristics of students with LD. We focus on technological affordances, or possibilities to improve reading for students with LD. We describe examples of technologies and summarize illustrative studies of their impact on students with LD. We operationalize learning technologies as *interactive, digital environments* that can be leveraged to provide learning opportunities.

THEORIES OF READING AND THEIR RELATIONSHIP TO TECHNOLOGY

Educators agree that the primary goal of reading is to understand text. The simplicity of this statement belies the complexity of reading and the many skills and processes that must be coordinated to support skilled reading. Spanning decades, researchers have developed models to explain how readers gain meaning from text. We recognize the theoretical significance of other models of reading, such as the parallel distributed processing models (Rumelhart & McClelland, 1986; Seidenberg & McClelland, 1989) and social constructivist models (Lave & Wenger, 1991).

Additionally, the new literacies perspective (Leu, Kinzer, Coiro, Castek, & Henry, 2013) accounts for the reading of multimedia, hyperlinked text. However, the focus of this chapter is on the bottom-up (the simple view) and interactive models, because these views have significantly impacted instruction practices for students with LD. We will revisit the new literacies perspective toward the end of the chapter.

BOTTOM-UP MODELS: THE SIMPLE VIEW OF READING

According to *bottom-up models* of reading (Gough, 1972a; Gough & Tunmer, 1986; Hoover & Gough, 1990; LaBerge & Samuels, 1974; Samuels, 1994), lower-level processes precede the operation of higher-level representational and strategic processes (Stanovich, 1980, 2000). Based on traditional information-processing models (e.g., Atkinson & Shiffrin, 1968) bottom-up models include memory structures that store information for specific durations (e.g., short-term memory) and have associated processes that transfer it to more permanent storage (long-term memory), where the information is represented in the form of abstract knowledge structures (i.e., schemata). These processes were thought to be initiated by sensory input that evoked a sequence of information processes under the management of executive functions (for a related discussion, see Follmer & Sperling, Chapter 5, this volume). They included attention, perception, and memorial processes such as rehearsal and an articulatory loop that resulted in a durable and abstracted representation of the information.

Gough's (1972a) *simple view of reading* is a bottom-up model involving a sequence of processes that putatively occur during a single second of reading by a moderately skilled adult. The processes begin with the formation of a visual icon, proceed to letter identification, and then map the orthography onto meaning processes (Tunmer & Chapman, 2012). Once print is decoded, oral language abilities permit text to be understood. If either of these abilities is weak, then reading comprehension will be constrained.

The first component of the simple view is *decoding*. Efficient decoding of English requires students to learn an alphabetic orthography in which print (orthography) encodes speech (phonology) by mapping sounds (phonemes) to letters (graphemes). However, the nature of these relationships is not immediately apparent. Phonemes are abstractions from a larger stream of speech. In everyday discourse, phonemes are co-articulated: one phoneme blends into another. Readers must understand that the speech stream can be segmented, and that those segments can be mapped onto letters. They must then learn the processes involved in accurately and fluently using these relationships to decode words. Adding to these challenges, English is an alphabetic orthography (Katz & Frost, 1992) in which there are many irregularities in the correspondence between phonemes and graphemes. These irregularities preserve morphological relationships between words but introduce irregularities that defy one-to-one mapping of phonemes to graphemes.

The second component is *linguistic comprehension*, or the process of interpreting lexical information that includes words, sentences, and discourses rooted in oral language (Gough & Tunmer, 1986). As a reader converts the written forms of words into speech, words are matched to the readers' vocabulary knowledge and sentence-processing abilities. Researchers have debated the specific components of linguistic comprehension (Lonigan, Burgess, & Schatschneider, 2018), but vocabulary knowledge and listening comprehension appear to make the most substantial contributions to reading (e.g., Tunmer & Chapman, 2012). The latter components are affected by many factors, including differences in language skills, experiences at home and in school, and exposure to information (e.g., Hoff, 2003). Students with LD may experience specific language-processing deficits and severe domain-specific deficits in various components of phonological processing, including their ability to hear and manipulate sounds within words (Stanovich, 2000; Stanovich & Siegel, 1994).

Not surprisingly, Gough's original model has been criticized and adapted over decades (e.g., Francis, Kulesz, & Benoit, 2018). However, it has identified two necessary components of the reading process that parsimoniously predict reading disabilities (e.g., Wagner, Herrera, Spencer, & Quinn, 2014) and provided a foundation for highly effective diagnostic and instructional practices for many students with LD. For an extended discussion of the simple view of reading, including recent investigations of its validity in the field of special education, see the 2018 special issue of *Remedial and Special Education*.

INTERACTIVE MODELS OF TEXT COMPREHENSION

Interactive models recognize that reading involves the simultaneous, interacting influences of lower- and higher-level processes. Rumelhart (1977, 1994) observed that words can be identified in different ways in authentic reading contexts, and that higher-level processes such as sentence comprehension influence lower-level processes such as word identification.

Consequently, he proposed an interactive model in which there is a simultaneous convergence of multiple processes on orthographic, lexical, syntactic, and semantic information. Like models of the simple view, interactive models posit the existence of information processes and memory structures. However, the processes operate simultaneously rather than in a linear, bottom-up direction (Stanovich, 1980).

In contrast to bottom-up models, interactive models help explain the compensatory effects of higher-level processes for weaknesses in lower-level processes (Stanovich, 1980). For example, children who struggle with reading comprehension, including students with LD, benefit from learning how to use specific reading strategies (Gersten, Fuchs, Williams, & Baker, 2001). Also, interactive models provide a framework for understanding how the reader's background and cultural experiences impact their reading proficiency.

Kintsch's (1988, 1994; Kintsch & Kintsch, 2005) construction-integration model provided an influential explanation of how lower- and higher-level reading processes interact to drive comprehension. Comprehension involves the representation of language in working memory (van Dijk & Kintsch, 1983). At least three levels of representation are involved in the comprehension process (Kintsch, 1988, 1994; Kintsch & Kintsch, 2005; Kintsch & van Dijk, 1978; van Dijk & Kintsch, 1983). First, a *surface code* that links graphemic and phonemic elements with linguistic structures must be denoted. Second, a *propositional textbase* that strips away the surface features and preserves the text's gist must be constructed. Third, a *situation model* must be built in which the textbase is integrated with a reader's prior knowledge. According to van Dijk and Kintsch (1983), text is encoded at increasingly abstract levels of representation as a reader moves from the surface code to a more fully integrated situation model (Murray & Engle, 2005) that is highly dependent on the reader's knowledge of the discipline, domain, and genre (Ferretti & De La Paz, 2011; Lewis & Ferretti, 2009, 2011). In this model, knowledge-based schemas and scripts interact with the lower-level processes to constrain the interpretation of the text (Kintsch, 2005).

READING AND STUDENTS WITH LD

Both bottom-up and interactive models of reading identify core processes that contribute to students' reading difficulties. Below, we briefly discuss some of the critical processes and skills that are affected by LD. In the remainder of the chapter, we refer back to these skills and processes in our discussion of affordances of technology for remediating and mitigating the difficulties experienced by students with LD.

Print Awareness

Experiences with text from a young age help students develop print awareness (Justice, Logan, Kaderavek, & Dynia, 2015), or concepts and conventions of print such as that English is written from left to right, and written words are composed of letters. Early reading experiences help children to develop story schema, which promote students' comprehension of a variety of texts. Shared reading experiences facilitate an appreciation for reading as a form of communication, access to information, and a source of pleasure. Lack of exposure to early reading experiences constrains the development of print awareness (Justice & Ezell, 2000)

Phonemic Awareness

In order to learn to read an alphabetic orthography, students must first develop *phonemic awareness*, or the ability to focus on, isolate, and manipulate phonemes in

spoken words. There is ample research that demonstrates phonemic awareness is a core deficit for many students with LD (Snowling, 1998). Children who have difficulty acquiring phonemic awareness experience significant problems learning to read (Stanovich, 1998).

Letter–Sound Associations

Knowledge of letter names and sounds is also a strong predictor of reading acquisition. The accurate and fluent assembly of sub-word units into words develops from phonemic awareness and letter–sound knowledge, which are the foundation upon which decoding skills are built (Catts, Hogan, & Adlof, 2005).

Decoding

As students develop fluency in analyzing individual letters and sounds within a word, they can develop more effective strategies for decoding text (Moats, 1998). These include recognition of larger chunks of letters such as phonograms, words as whole entities, and syllables and morphemes. In order to develop automatic and fluent word recognition skills, students need instruction and repeated practice reading both familiar and unfamiliar words (National Reading Panel, 2000).

Vocabulary Knowledge

Decades of research show that vocabulary knowledge is strongly related to reading comprehension (Davis, 1944; Snow, Tabors, Nicholson, & Kurland, 1995). Early differences in vocabulary knowledge adversely affect reading, which in turn affects the developmental prospects of students from economically disadvantaged backgrounds and those with learning difficulties (Hart & Risley, 1995; Stanovich, 2000). Like phonological awareness, letter–sound relationships, and decoding, there is a reciprocal relationship between individual differences in vocabulary and reading efficiency.

Fluency

Fluency, which requires efficient and rapid processing of individual words, demands expertise beyond accurate word recognition (National Reading Panel, 2000). Reading fluency has been characterized as a necessary, but not sufficient, condition for comprehending text (Fuchs, Fuchs, Hosp, & Jenkins, 2001). Slower readers, who cannot decode fluently with little conscious effort, have to devote substantial cognitive effort to word-level reading at the expense of the effort needed to comprehend.

Text Structure Knowledge

Knowledge of the underlying organization of text, or *text structure*, supports the construction of coherent mental representations (Kintsch, 1988, 1994; Kintsch & Kintsch, 2005). For example, narrative text structures are characterized by elements such as character, setting, plot, and solution (Mandler & Johnson, 1977). Readers can use this knowledge of the underlying organization of a text to support comprehension and

subsequent recall (Pyle et al., 2017). Exposure to different types of text—particularly expository text, which is less familiar to young readers (Duke & Bennett-Armistead, 2003)—can help readers develop knowledge of text structure. Text structure knowledge also can be improved through explicit instruction (Pyle et al., 2017; Williams & Pao, 2011), which is particularly important for students with LD.

Cognitive Strategies and Metacognition

Strategic readers employ a range of cognitive strategies to support the comprehension of texts. They are also able to control the use of these strategies, evaluate their efficacy, and revise them to meet task demands (Gersten et al., 2001; Klingner, Morrison, & Eppolito, 2011). Students can be accurate and fluent readers and not comprehend text because of memory constraints or difficulties with higher-level processes involving inference making and comprehension monitoring (Williams & Pao, 2011; for related discussion, see Swanson, Chapter 2, this volume). The failure to regulate problem-solving and strategically allocate limited processing resources adversely affects reading performance (Gersten et al., 2001).

TECHNOLOGY SUPPORT FOR READING SKILLS AND PROCESSES

Digital technology and the features that are built into digital software, tools, and apps have been used to support and improve both lower- and higher-level reading skills and processes. We organize the remainder of this chapter around five categories of literacy technology that we believe have the strongest potential for improving the reading of students with LD: (a) computer-assisted instruction, (b) modifications to digital text, (c) text-to-speech technology, (d) enhanced digital text, and (e) technology support for strategic regulation of reading comprehension.

COMPUTER-ASSISTED INSTRUCTION

A seemingly endless number of computer-assisted instructional (CAI) programs to teach and practice specific literacy skills reside on digital devices. Some are stand-alone programs; others are components of multifaceted systems that include text- and teacher-directed instruction. CAI can help students with LD develop basic skills by supporting explicit and systematic instruction (e.g., Kame'enui & Buamann, 2012; National Reading Panel, 2000; Torgeson, 1998).

CAI programs can be responsive to a student's errors and personalize instruction by offering remediation, additional practice, and review. The pace of instruction can be adjusted to decrease response time and develop automaticity. Additionally, CAI can incorporate motivating features and themes that appeal to students, offering optimal levels of both challenge and reward. Finally, it can be used without direct teacher guidance and supervision, addressing the challenges teachers encounter in finding the additional instructional time often required by students with LD.

Four major integrative literature reviews, analyzing research conducted with students with LD and struggling readers between 1987 and 2011, demonstrate the efficacy of CAI (Cheung & Slavin, 2013; Hall, Hughes, & Filbert, 2000; MacArthur,

2013; MacArthur, Ferretti, Okolo, & Cavalier, 2001). In all four reviews, the majority of studies that examined basic reading skills, including phonemic awareness, word recognition, and vocabulary knowledge, documented improvements associated with the use of CAI. Reviews suggest that CAI that targets basic skills, however, has minimal impact on reading comprehension (MacArthur, 2013; MacArthur et al., 2001),

Across this body of research, CAI programs that incorporated research-based principles of explicit instruction (e.g., Archer & Hughes, 2011) were associated with better student outcomes. These included carefully sequenced practice activities, both speed and accuracy criteria for target tasks, game-like features that appealed to students, and elaborated feedback. Furthermore, literacy outcomes were stronger when CAI was integrated with the curriculum and used in conjunction with teacher-directed instruction.

MODIFICATIONS TO DIGITAL TEXT

When used merely as a medium for displaying traditional print in a digital form, technology offers no significant advantage (e.g., MacArthur et al., 2001). A recent meta-analysis comparing print-on-paper to digital display of the same text found poorer reading comprehension for digital text (Delgado, Vargas, Ackerman, & Salmerón, 2018). However, when text is digital, its visual features and substantive complexity can be changed in ways that may be advantageous for readers with LD.

Visual Features of Digital Text

The role of visual processing in LD and dyslexia has a long and contentious history (for a review, see Schulte-Körne & Bruder, 2010). Although visual processing differences have been documented in some students with LD, the degree to which these differences are causes or consequence of reading disabilities is unclear, particularly when research suggests that at least some differences resolve over time (Jeon, Hamid, Maurer, Lewis, 2010; O'Brien, Mansfield, & Legge, 2005; Quercia, Feiss, & Michel, 2013). However, the malleability of digital text has led to renewed interest in how visual features of text affect reading for students with LD.

Matthew Schneps conducted a series of studies based on theories of the role of visual attention span in reading. Schneps and colleagues found that, for high school students with dyslexia, text display on a small digital device, formatted to show a few words per line, resulted in improved reading speed, efficiency, and comprehension (Schneps, Thomson, Chen, Sonnert, & Pomplun, 2013a; Schneps et al., 2013b). Although this research awaits independent replication, empirical data such as Schneps's, along with anecdotal reports of improvements in reading on digital devices (e.g., Hill, 2010), have led to optimism among educators and individuals with reading disabilities.

However, as in many areas of research in special education, simple fixes, such as changes in how text is displayed, can be misleading. An illustrative example of unwarranted enthusiasm without empirical evidence is the 2009 introduction of the Dyslexie font (www.dyslexiefont.com/en/typeface/). Designed to reduce visual crowding, its developer contended that the font improved reading accuracy among students with dyslexia. Kuster, van Weerdenburg, Gompel, and Bosman (2018) compared Dyslexie to several more standard fonts (i.e., Arial and Times New Roman). In two experiments

with students with dyslexia aged 7–12, they did not find an advantage for the Dyslexie font on measures of reading speed or accuracy. Additionally, students preferred the more typical fonts to Dyslexie.

Readability of Digital Text

Leveled readers have a long history in reading education (e.g., Fountas & Pinnell, 1996), and their current popularity stems from the recommendations of the Common Core State Standards (2010) and from the practical challenges of differentiating instruction. Based on indices of syntax and semantic difficulty (Smith, Stenner, Horabin, & Smith, 1989), these levels are computed by a mathematical algorithm that produces a level ranging from 0 to 2,000 (Hiebert, 2010/2011). Many standardized tests now express students' reading ability as a Lexile level. The Lexile framework, then, facilitates the matching of a text to the skills of a reader.

A wide variety of technology-based literacy reading programs now include sets of text about the same topic written at multiple Lexile levels. Furthermore, there is a growing trend toward dynamic text leveling, in which the readability level of text is altered upon request to conform to a specific range of Lexile levels. Digital leveling increases the possibility that students with LD will have access to text that is appropriate for their current reading abilities. This fit may be particularly important when students read independently or are expected to learn substantial content from the text itself. Because digital leveled text sets typically cover the same content and are read by students on devices whose screens afford more privacy, they may reduce the risk of stigmatization often experienced when students with LD use instructional materials that differ from those of peers (Vaughn, Schumm, & Forgan, 1998).

Despite its potential advantages and widespread use, we found only one peer-reviewed research study that examined the efficacy of leveled digital text for poor readers. Marino, Coyne, and Dunn (2010) studied the impact of a technology-based science curriculum with middle school students who were poor readers or who were diagnosed with a severe reading disability. Students were randomly assigned to read text at either fourth- or eighth-grade level. Text readability level did not have an impact on the comprehension of terms and concepts presented in the curriculum. It is important to note, however, that leveled text was only one aspect of this curriculum, which included video, games, and interactive tutorials. These features may have played a stronger role in learning than the text itself.

Readability formulas such as the Lexile system have been widely criticized because of their insensitivity to other factors that affect a student's comprehension of text, including text genre, text organization, background knowledge, and student motivation (Swanson & Wexler, 2017). Special educators have expressed concerns that leveled texts inadvertently promote the idea that the need for explicit and intensive reading instruction is less acute if the text can be easily altered to fit students' current skill levels. Furthermore, the algorithmic nature of readability measures gives them the patina of exactitude that obscures their imprecision (Cunningham, Hiebert, & Mesmer, 2018).

The availability of text-to-speech tools, which are embedded in or operate with digital leveled text, introduce other problematic issues. Lexile assignments based on low phonological and word recognition skills may underestimate listening comprehension,

particularly among the lowest readers (Hua & Keenan, 2017). As students with LD advance through the grades, listening comprehension becomes a better predictor of reading comprehension than decoding skill (Catts et al., 2005; Vellutino, Tunmer, Jaccard, & Chen, 2007). These considerations suggest that educators must exercise caution in using digital leveled text for students with LD, particularly when Lexile prescriptions may constrain the complexity and interest level of the text.

TEXT-TO-SPEECH TECHNOLOGY

One of the most straightforward ways to support readers with LD is to provide the option of having text read aloud. This feature is most commonly referred to as text-to-speech (TTS), and it supports what is referred to as audio-assisted reading or audio-supported reading. TTS provides access for students who cannot read print-based text with sufficient accuracy or fluency, bypassing the word reading deficits of students with LD. It is ubiquitous and freely available in nearly every technology that works with digital text. The impact of TTS has been investigated as both a test accommodation and as a support in instructional contexts.

Test Accommodations and TTS

Read-aloud accommodations on high-stakes tests are one of the most common uses of TTS (Thurlow & Kopriva, 2015). Read-aloud accommodations include not only TTS, but also human readers, audio or video recordings, and reading pens. They are intended to reduce construct irrelevance or response modes that have little to do with the construct being measured (Ferrier, Lovett, & Jordan, 2011).

The Fall 2014 issue of *Educational Measurement: Issues and Practices* published two independent meta-analyses of the impact of read-aloud accommodations on test scores. Buzick and Stone (2014) analyzed 19 studies, 15 of which included students identified with either reading disabilities and/or LD. Li (2014) analyzed 23 studies published between 1993 and 2012; 15 included students with either reading disabilities and/or LD. Both reviews found that read-aloud accommodations improved test scores for students with and without disabilities. Students with disabilities benefitted to a greater degree, but the difference in improvement, compared with peers without disabilities, was small. Read-aloud accommodations were more favorable for reading tests. Requiring fewer resources to create and implement, TTS has practical advantages over other read-aloud accommodations. However, the reviewers found no apparent differences among different types of read-aloud accommodation.

TTS and Instruction

Another body of research has investigated the impact of TTS on performance in tasks that are more closely tied to reading and learning from instructional text. The conclusions of these reviews, taken as a whole, present an optimistic picture of the potential of TTS to bypass the word recognition deficits that inhibit the text comprehension of students with LD. Two reviews conducted by MacArthur and colleagues (MacArthur, 2013; MacArthur et al., 2001) did not find a clear advantage for TTS for students with poor reading skills or LD. However, these authors noted stronger outcomes when the

use of TTS was mandated and not optional, and when TTS was accompanied by other features that support text comprehension.

A more recent review by Wood, Moxley, Tighe, and Wagner (2018) shows that the number of studies examining the use of TTS has increased significantly. These researchers located 81 studies conducted between 1993 and 2014, 22 of which met criteria for inclusion in a meta-analysis. Although participants in these studies could have multiple disabilities, all had a reading disability. The researchers found that the use TTS tools had a positive impact on reading comprehension scores, obtaining effect sizes similar to those reported by Li (2014) and Buzick and Stone (2014) for TTS as a test accommodation.

Wood et al.'s (2018) meta-analysis reported larger effect sizes for a subset of studies published after 2000. This finding is an example of an essential consideration in the review of research about technology. Technology evolves quickly, and that evolution changes the ways in which people interact with it. Perhaps improvements in the quality of TTS account for more favorable outcomes in more recent studies. Students in recent studies may be more familiar with TTS, increasing its effectiveness as a learning tool. Additionally, improvements in research quality may lead to more sensitive literacy measures. All of these factors and others remind us of the continually evolving context that affects the interpretation of research about the effects of technology.

An important consideration of the research about TTS is its wide scope. TTS is a tool that can operate in diverse ways across multiple contexts for a variety of outcomes. In digital environments, text can be read aloud at the level of words, sentences, or essays. Characteristics of the digital speaker, including speed, volume, pitch, and accent or dialect, can be changed. How TTS is coordinated with text can vary. The reader's familiarity with TTS and its features may also influence outcomes. For example, a study by Young, Courtad, Douglas, and Chung (2018) showed that gradual and systematic increases in speed of TTS over time improved students' reading fluency. Other research suggests that TTS use over time may have an impact not only on comprehension of target instructional materials, but also on more distal literacy skills (Esteves & Whitten, 2011; Young et al., 2018). Besides, it may increase students' ability to keep pace with the high demands of reading in general education classrooms (Hodapp & Rachow, 2010) and promote improved attitudes toward reading (Meyer & Bouck, 2014).

There are many individual differences among students with LD, and, given the prevalence of TTS, along with the growing consensus of its potential for students with reading and LD, future research might focus on specific factors that can support its use in the classroom. These include the impact of student characteristics such as working memory, self-regulation, and specific reading skills. Some researchers have found that students with low vocabulary knowledge, poor listening comprehension, or high fluency are not as likely to benefit from TTS as students with poor decoding skills or dysfluent reading (Guisto & Ehri, 2019). Erickson and Geist (2016) have recommended developing reader profiles regarding TTS, which could guide educators about which students might benefit most from TTS and how to support them to make more effective use of TTS.

It would be remiss to conclude this section without acknowledging disagreements about the use of TTS by students with LD. As Woodward and Ferretti (2014) observe, technology often introduces the dilemma of balancing information access against

specific learning goals. Some educators are cautious about TTS out of concern that it will distract from teaching literacy skills. Others question the point at which the focus of a student's educational program should shift from instruction to accommodation. However, strong advocates of technology argue that these questions are moot. If a technology, such as TTS, can bypass a significant impediment to learning, then why would we not want students to use that technology as much as possible? Other pro-technology educators have argued that technologies such as TTS will eliminate the need to read and, thus, the investment of time and effort in teaching print-based reading skills is misplaced. These issues provide grist for debates about the evolution of technology that are unlikely to be resolved by empirical evidence.

ENHANCED DIGITAL TEXT

Digital text can include features that support the comprehension and learning of students with LD. Anderson-Inman and Horney developed a typology of 11 digital reading supports that extend beyond TTS. These include resources for translating text from one form to another, for illustrating information, for navigating, and for annotating (Anderson-Inman & Horney, 1997, 1998; Horney & Anderson-Inman, 1994). Dalton and Proctor (2008) note that digital texts are unique in their flexibility, opportunity for choice, just-in-time resources, and access to information and social networks. Furthermore, digital text can be linked to dynamic and responsive metacognitive models and supports. Enhancements can be accessible within digital reading materials or operate alongside these materials, often as add-ons or extensions in a web browser.

The most common text enhancement is TTS. Vocabulary support, another common text enhancement, is particularly advantageous for students with LD, given the lower vocabulary knowledge of many of these students (Ciullo, Lo, Wanzek, & Reed, 2016; Jitendra, Edwards, Sacks, & Jacobson, 2004). CAI can also be an effective tool for explicit vocabulary instruction. However, it is not possible to target the volume of words that readers need to adequately comprehend text (Hiebert & Kamil, 2005). Vocabulary support permits a reader to click on a word within the text to access a gloss, glossary, dictionary definition, or brief written, audio, or video explanation. Similarly, on-demand links to additional information can compensate for or extend students' background knowledge.

Engagement with the text itself is integral to text comprehension (Duke, Pearson, Strachan, & Billman, 2011). Text enhancements such as graphic organizers and other visual maps, annotations, and embedded questions or prompts can structure text engagement (Faggella-Luby, Drew, & Schumaker, 2015; Watson, Gable, Gear, & Hughes, 2012) and help students construct mental models of the text while reading (Berkeley, Scruggs, Mastropieri, 2010). Text highlighting may assist readers to identify critical ideas for encoding, focusing attention on relevant information and assisting in later retrieval of information (Li, Tseng, & Chen, 2016). Graphic organizers help students with LD learn complex content by visualizing main ideas, details, and relationships among them (Ciullo, Lo, Wanzek, & Reed, 2016). As tools embedded or used alongside digital text, concept maps and other digital diagrams can be used before, during, or after reading.

Digital text that includes these enhancements has been characterized as e-text, e-books, supported digital text, and scaffolded digital text. We refer to it as *enhanced*

digital text and will consistently use that designation throughout this chapter. We review two bodies of research about enhanced digital text. The first includes studies about *digital storybooks* designed for emergent and young readers. The second is a more eclectic set of studies about digital text used primarily as a means to learn content, rather than to read stories for their own sake. We refer to these as studies of *digital instructional text*.

Digital Storybooks

Digital storybooks, or digital forms of children's literature, offer affordances for acquiring reading skills and improving text comprehension. The digital format of children's books makes it possible to present the text and lively pictures that typify these stories and add enhancements and interactive elements. In digital storybooks, text is typically read aloud by a recorded human voice, and narration is often synchronized with the highlighting of words or sentences. Hotspots on pictures and text can link to additional content that can teach and entertain, potentially affecting comprehension, learning, and motivation. Digital children's literature is widely available for computer platforms, on digital devices, and on the web through sites such as Raz-Kids (www.raz-kids.com/) or CommonLit (www.commonlit.org/).

Given the increasing use of digital technology by very young children (Rideout, 2017), digital storybooks may provide emergent readers with print exposure that is not dependent on the availability of adult readers. In many individual studies (e.g., Cunningham & Stanovich, 1998) and several meta-analyses (Bus, van IJzendoorn, & Pellegrini, 1995; Mol & Bus, 2011), print exposure is associated with improved literacy outcomes, including general knowledge, receptive vocabulary, word reading, spelling, and reading comprehension (Strasser, Vergara, & del Río, 2017). Print exposure may also promote students' statistical learning, or the ability to learn, through multiple repeated exposures, the patterns of a language such as the co-occurrence of letters and regularities such as sentence structures (Seidenberg & MacDonald, 2018), vocabulary, and oral language skills (Spencer, Kaschak, Jones, & Lonigan, 2015). Experience with digital storybooks can also assist students in developing an understanding of story schema that supports the construction of meaning (Anderson & Pearson, 1984).

There is considerable evidence that digital storybooks can improve a variety of early literacy skills for emergent readers (see Bus, Takacs, & Kegel, 2015; Zucker, Moody, & McKenna, 2009). Similar to the importance of instructional design in studies of CAI, design features of digital storybooks are key moderators of their impact. Many digital storybooks contain games and other activities, music, and sound effects that are minimally connected to the text. These may be designed to increase interest and to motivate readers (Shamir, Korat, & Fellah, 2012), but may be distracting to readers with LD (Sweller, 2005) because of less well-developed executive functions (Bus et al., 2015). In fact, Bus et al. (2015) found that features such as games and extended animation sequences that did not relate closely to the story were associated with decreased text comprehension in students with LD (e.g., Okolo & Hayes, 1996), as well as in typically developing learners (de Jong & Bus, 2002; Trushell, Maitland, & Burrell, 2003). Furthermore, in a study of kindergarteners with severe language impairment, Smeets, van Dijken, and Bus (2014) found that elements of music and sound in some digital storybooks appeared to have a negative impact on vocabulary learning.

The research of Adina Shamir and colleagues represents the most extensive and rigorous set of studies available to date about digital storybooks with young learners at risk for LD. Most of these studies have employed researcher-developed storybooks that are based on popular Israeli children's literature and permit comparison of digital storybook features of theoretical interest. Design features include: (a) coordinated text highlighting and narration, (b) teacher control over access to or use of game-like activities, (c) hotspots explicitly designed to support phonological awareness and text comprehension, (d) close alignment of hotspots with the story narrative or target vocabulary, and (e) multimedia dictionaries that support vocabulary development (Shamir & Korat, 2015). Across three studies of kindergarten at-risk readers (reported in Shamir et al., 2012; Shamir & Shlafer, 2011), students who participated in storybook reading made more significant gains in phonological awareness, vocabulary knowledge, and print concepts than students in business-as-usual conditions.

Shamir and colleagues have also investigated ways to leverage the affordances of digital storybooks to improve child-adult interactions (e.g., Segal-Drori, Korat, Shamir, & Klein, 2012; Shamir, 2009). These studies offer at least a partial response to concerns that digital storybooks suppress dialogic engagement during shared storybook reading (e.g., Parrish-Morris, Mahajan, Hirsh-Pasek, Golinkoff, & Collins, 2013), a practice that has a long-standing and sizeable research base supporting its impact on early literacy outcomes (Swanson et al., 2011; Towson, Fetting, Fleury, & Abarca, 2017).

In summary, research offers some support for the contention that digital storybooks can facilitate improved literacy outcomes for emergent readers who are likely to encounter reading difficulties. Furthermore, research points to potential advantages of using digital storybooks in combination with effective adult-directed interventions—a finding that is echoed in the CAI research reviewed above. It is essential to keep in mind that scholarship demonstrating the potential of digital storybooks, best exemplified in the work of Shamir and colleagues, rests on intentional design of storybook features. Bus et al.'s (2015) review provides useful information about features that have both theoretical and empirical significance.

Given the documented importance of early literacy intervention (e.g., Blachman et al., 2014) and the potential of digital storybooks, there is a surprising dearth of research about digital storybooks and students with LD. Exemplary in its design, Shamir's research has been conducted almost exclusively with researcher-designed digital storybooks, with features that may not generalize to the digital storybooks available to teachers and parents. Furthermore, much of the research with typically developing children has been conducted in the Netherlands, with books written in Dutch. Shamir's research with students with LD has been conducted with books written in Hebrew. It is unknown whether language differences may affect literacy outcomes associated with digital storybooks.

Digital Instructional Text

In contrast to the digital storybook literature, research about digital instructional text is more diverse and less programmatically coherent owing to the many different text types, learning tasks, and learners that have been studied. Dalton and Strangman (2006) and Stetter and Hughes (2010) reviewed research conducted between 1985 and

2009 with low readers and students with LD. Text enhancements included vocabulary and syntactic support, summaries of main ideas, embedded questions, graphics, outlines, note-taking features, study guides, and glossaries. Most studies targeted students in middle to high school. The authors noted that study quality was variable, with many studies lacking a control group, small sample sizes, and questionable outcome measures. Trends for improved reading comprehension in digital text conditions were noted but were often not significant, and better outcomes tended to occur in studies of longer duration and in which students were required to use the enhancements.

The National Center for Supported e-Text (NCSeT; Anderson-Inman, 2009) investigated the impact of text supports defined by the Anderson-Inman and Horney typology through a set of coordinated studies. Among those studies that included students with LD, Izzo, Yurick, and McArrell (2009) compared the impact of TTS (a translational resource in the typology) to print-on-paper reading, finding an advantage for TTS among five of seven participants. Okolo, Socol, Feyen, and Ferrerri (2011) also compared TTS to print-on-paper conditions for students with LD and found a difference between conditions for 10th graders who read passages from an 8th-grade world history text but not for 8th graders who read the same text passages. The authors attributed the grade level difference to the stronger content knowledge of the 10th-grade sample. Horney et al. (2009) compared two forms of digital note-taking (a notational resource). Fifth-graders comprised predominantly of students with LD took either voice or typed notes while reading a science text. Science comprehension increased in both conditions, with no significant differences between the two note-taking options. Clay, Zorfass, Brann, Kotula, and Smolkowski (2009) compared eighth-graders' knowledge of key social studies vocabulary words and content knowledge in an online visual thesaurus and online dictionary conditions. Students made gains in vocabulary knowledge from pre- to post-test in both conditions. Although students reported a preference for the visual thesaurus, gains were more significant in the dictionary support condition. Lower readers in the sample made more significant gains than higher readers.

More recently, a line of research about digital instructional text for students with LD and other literacy differences has originated from the work of CAST (www.cast.org) under the auspices of universal design for learning (UDL). Although this research has not focused on students with LD, these studies include students who struggle with reading, including poor readers and students who are English language learners. Dalton, Proctor, and colleagues describe two studies that employed digital literacy environments developed following principles of UDL. The universal literacy environment (ULE; Proctor, Dalton, & Gresham, 2007) included the following components: TTS; comprehension strategy prompts and animated "coaches" who modeled appropriate comprehension strategies; and hyperlinks to vocabulary support that included definitions, English-to-Spanish translations, and example sentences. In a subsequent study, Dalton and colleagues (Dalton, Proctor, Uccelli, Mo, & Snow, 2011) examined the impact of ICON (improving comprehension online), a digital literacy environment that included TTS, a glossary, strategy coaches, and referential highlighting.

Gains in standardized tests scores were not documented in either study; however, these studies are relevant for their attention to students' use of digital text supports. Analyses showed that stronger gains in reading comprehension were associated with more frequent use of strategy coaches, and that less skilled readers were more likely to

make use of embedded supports. The authors concluded that students' use of embedded supports in these environments was higher than the use of similar supports in other studies (e.g., the NCSeT studies reviewed above). They attributed the difference to design features in their digital literacy environments that "push" students to use the supports to accomplish instructional goals. The authors recommend the withdrawal of mandated activities as students become more metacognitively sophisticated in their use of digital supports.

In summary, research about digital instructional text documents its potential to improve text comprehension, develop vocabulary, and teach or model strategic reading processes. A rich array of enhancements that address both top-down and bottom-up processes can be made available to students as they read digital text, but they may not know how to or choose to use them (Anderson-Inman, 2009; Dalton & Strangman, 2006; Stetter & Hughes, 2010). Instructional digital text may be most effective when it helps students learn to make appropriate choices, self-monitor and regulate, and gain expertise about their learning.

TECHNOLOGY SUPPORT FOR STRATEGIC REGULATION OF READING COMPREHENSION

Executive functions enable a person to inhibit responding, allocate attention, and engage in many self-management processes needed for effective problem-solving (Diamond, 2013; Follmer & Sperling, Chapter 5, this volume). These self-regulatory processes include planning, goal-setting, and strategy selection, evaluation, and revision (Ferretti & Fan, 2016). Students with LD have well-documented challenges concerning these self-regulatory processes (Zimmerman, 2000) that affect their reading and writing (Graham & Harris, Chapter 20, this volume; Graham & Harris, 2003; Klingner et al., 2011; Perry, Mazabel, & Yee, Chapter 13, this volume). In what follows, we describe research that assesses the efficacy of intelligent tutoring systems designed to support self-regulation of reading comprehension processes. The affordances of these systems for improving reading comprehension for a student with LD are considerable. Although studies to date have not involved students with LD, we include them in our discussion to inform the reader of their potential.

iSTART and iSTART-2

McNamara and her colleagues (Jackson, Boonthum, & McNamara, 2010; McNamara, Levinstein, & Boonthum, 2004; McNamara, O'Reilly, Best, & Ozuru, 2006) developed iSTART (Interactive Strategy Training for Active Reading and Thinking) to address the self-regulatory challenges experienced by students with comprehension problems (McNamara et al., 2004, 2006). In each of three automated modules, an avatar provides instruction by interacting with the student and other student avatars. In the Introduction module, students watch an instructional avatar teach self-explanation and reading comprehension strategies to student avatars. In the Demonstration module, a student avatar explains a brief science text during which it asks students to identify the strategies that are used. Finally, in the Practice module, the student provides self-explanations for two science texts. The system provides tailored feedback to each student based on the quality of their self-explanations.

iSTART has been shown to improve the reading comprehension of students who lack knowledge of comprehension strategies, as well as those who possess strategic knowledge (O'Reilly, Best, & McNamara, 2004). Importantly, the quality of students' self-explanations and the level of their strategic knowledge were predictive of their reading comprehension performance. Jackson et al. (2010) showed that extended practice with iSTART over 6 months could overcome initial deficits in students' self-explanation ability. Although students with high strategic knowledge produced better self-explanations than their peers with low strategic knowledge at the beginning of training, the quality of their self-explanations converged throughout the training. The authors concluded that low-ability students can catch up with extended practice.

iSTART-2 (<http://istart.soletlab.com>; Snow, Jacovina, Jackson, & McNamara, 2016) uses a game-based learning environment to promote student engagement and persistence during long periods of training. During the training phase, students watch videos that introduce them to the process of self-explanation and teach five comprehension strategies for understanding content area text. After completing the instruction, students interact with practice games during which they read challenging text and type self-explanations in response to target sentences. Jackson and McNamara (2013) compared and contrasted the effects of iSTART and iSTART-2 on the learning and motivation of high school students. Analyses of students' self-explanations showed that both systems produced comparable learning. However, iSTART-2 training was associated with greater student enjoyment, motivation, and self-efficacy. The authors concluded that the motivational benefits associated with iSTART-2 training should promote persistence in learning challenging content.

3D-Readers is a web-based application for supporting reading comprehension that integrates high-interest content area text and instruction in five reading comprehension strategies. The strategies include comprehension monitoring, question answering, question generation, summarization, and the use of graphic organizers. The instructional program requires students' active engagement in setting goals, maintaining the coherence of their representations of the text read by them, and generating questions and explanations about the objects and events described in the text. Prior to every lesson, students are prompted with an open-ended question designed to activate prior knowledge. In addition, students learn about the benefits of the aforementioned strategies and how to ask questions that support comprehension monitoring. Interestingly, 3-D Readers includes training the construction of visual models on the computer screen which are intended to support internal mental models of the text. The system includes texts that support several different genres, or intended to be engaging and are aligned with different national and state content standards.

Johnson-Glenberg (2007) described three studies that reported evidence about the efficacy of 3D-Readers for middle school students who are having difficulty understanding text. In the first study, the 3D-Reader condition was associated with improvements in students' reading comprehension scores and vocabulary, although caution is warranted given methodological limitations. In a subsequent study with improved interface, prompts, and scoring algorithms, the authors found gains in vocabulary but also in students' reported use of self-questioning strategies (Johnson-Glenberg, 2007).

The above studies illustrate the potential benefits of intelligent tutoring systems such as iSTART, iSTART-2, and 3D-Readers. Systems such as these can diagnose difficulties with self-regulation and provide instructional support for the self-regulatory processes that impact reading comprehension, addressing a critical instructional need for students with LD.

DISCUSSION AND CONCLUSIONS

We bring this chapter to a close by first looking back at lessons learned over three decades of research about technology, reading, and students with LD. We then look forward to the ways that the development of online reading tools and experiences compel attention to new literacies (Leu et al., 2013) for students with LD. Theoretical, conceptual, and empirical work about the benefits of new literacies for students with LD is surprisingly absent in the extant literature.

LOOKING BACK: THREE DECADES OF RESEARCH ABOUT TECHNOLOGY, READING, AND LD

Despite substantial changes in technology and variability in outcomes and the size of their effects, we can point to three trends that are relatively consistent across studies.

Instructional Design Matters

In this chapter, we have emphasized the affordances of technology, such as the ease of transforming digital print into speech, or on-demand access to vocabulary or background knowledge through readily accessible networks of information. However, research consistently demonstrates better outcomes when evidence-based principles of instruction are used in conjunction with technology's affordances.

The studies we reviewed show that the instructional design of programs, tools, and apps has a substantial impact on reading outcomes for students with LD. In the realm of CAI, effective design features follow principles of explicit instruction, including a logical sequence, sufficient practice and feedback, review, a focus on accuracy before speed, and, as appropriate, activities that reduce response time to foster automaticity. There is substantial empirical support for the efficacy of explicit instruction for learners with LD (Archer & Hughes, 2011).

The research about enhanced digital text, particularly storybooks, also demonstrates the importance of design. Features that are presumed to make books more engaging for early readers, struggling readers, and students with LD can interfere with learning. Hotspots that attract students to animation, music, and games that have little to do with reading processes may be seductive, but potentially distract students who have difficulties with self-management and working memory. Design features associated with improvements in reading include coordinated highlighting and narration, hotspots that align with the narrative and support specific phonological or comprehension skills, and options for the teacher to control access to features that may be distracting or misleading for some students (Bus et al., 2015; Korat & Falk, 2017; Shamir & Korat, 2015).

Opportunities not Taken

Another consistent finding across studies is that, when left to their own devices, students with LD do not make effective use of instructional features that can support learning from text. This outcome is particularly notable in studies of TTS and digitally enhanced text (Anderson-Inman, 2009; Dalton & Strangman, 2006; MacArthur et al., 2001; Stetter & Hughes, 2010). Researchers have recommended that digital literacy programs incorporate features that incentivize or mandate the use of enhancements (e.g., Anderson-Inman, 2009). However, even if required, students with LD may not have the skills, knowledge, and self-regulatory abilities needed to benefit from text enhancements. Some research shows that stronger readers are more likely to use and benefit from digital supports for reading comprehension (Dalton & Proctor, 2008; Lan, Lo, & Hsu, 2014). Students with LD are likely to need explicit guidance about how these features can be used to support their understanding of text.

Furthermore, tools such as TTS and text enhancements, unless well automatized, make additional demands on attention and working memory—creating another level of activity that students must now coordinate with basic and higher-level reading processes. Dalton and Proctor (2008) note that some of the features of digital text, such as on-demand links to vocabulary and background knowledge, have no analogs in print-on-paper text, so that their value will be unfamiliar to most students. Finally, students need the metacognitive and self-regulatory capabilities to strategically deploy these supports as appropriate (Englert et al., 2009).

Technology Does not Replace Teacher-Directed Instruction

An expectation that students with LD will learn skills from incidental experiences with digital reading tools is unrealistic (e.g., Coyne, McCoach, Kapp, 2007; Coyne, Simmons, Kame'enui, & Stoolmiller, 2004). Even CAI, which supports lower-level skills that can be efficiently provided by technology, produces stronger outcomes with the inclusion of teacher-directed instruction (MacArthur, 2011). To manage the demands inherent in different reading environments, students with LD need continued instruction in basic skills and strategies; explicit teaching and guided practice in using tools fluently; and guidance about how, when, and why to use specific technologies.

Furthermore, digital tools introduce new learning demands that require explicit instruction in relevant skills. For example, learning from listening using TTS is similar but not identical to learning from reading print. Listeners are expected to construct a coherent mental model from an ephemeral stream of auditory information that requires both attentional and inhibitory control (Kim & Phillips, 2014). Students are taught to learn through reading, but rarely taught to learn from listening (e.g., Boyle, 2010).

LOOKING FORWARD: NEW LITERACIES AND STUDENTS WITH LD

Multimedia, networked, digital texts have become a staple of everyday life. Unlike print-on-paper text that resides within a book, the Internet and other digital reading environments are unbounded (Coiro, 2011). Readers can pursue many different

paths through unbounded text, with substantial choice about how to shape their own reading experience. In the 1990s, educators realized the limitations of existing theories of reading and literacy in the context of multimedia, hyperlinked reading environments. The new literacies perspective that emerged views literacy as pluralistic and evolutionary, shaped by changes in the technologies used to consume and produce information (Coiro, Knobel, Lankshear, & Leu, 2008). Research about new literacies drew attention to how models of reading, assessment, and instructional practices can be expanded to account for unbounded digital reading experiences (e.g., Rouet, 2006; Spiro & Jehng, 1990).

Reading and learning from multimedia, networked digital text rely on many of the same skills used in reading print-on-paper text. However, the relative importance of skills and their application in the reading process varies from print to digital environments. Defining questions, searching, and navigating become essential skills for finding information and learning from digital text. Skimming and scanning skills enable readers to traverse large amounts of text more efficiently. Evidence evaluation skills, including determining accuracy, reliability, and bias, play an essential role in deciding how to integrate different text to support understanding or problem-solving. The ability to compare, contrast, and synthesize information is required for learning from multiple sources. Self-regulatory skills for monitoring a path through text and for maintaining attention in the face of the numerous distractions have greater importance (Coiro, 2011; Coiro, Kiili, & Castek, 2017; Leu et al., 2013).

Based on extant research about students with LD, there is little doubt that acquiring and applying these skills and strategies are a formidable challenge. Effective search and navigation skills and strategies require sophisticated self-regulatory skills and make significant demands on working memory. Decisions about how and what to read are strongly influenced by readers' prior knowledge. Although the networked, multimedia nature of text offers many new options for learning, it also places demands on attentional and inhibitory control. Students with LD may be significantly disadvantaged by digital text because of the aforementioned reading difficulties they experience (Wolf, 2018).

We found a dearth of information about theory, research, and instruction related to the reading of students with LD in new literacy environments. This is particularly discouraging considering large-scale studies conducted by Leu and colleagues at the New Literacies Research Lab. These have documented a sizeable online reading gap based on economic advantage that is not fully explained by differences in offline reading skills, offline writing, or prior knowledge (Leu et al., 2015). Failure to understand how students with LD read in these environments may compound existing disparities in reading skill and performance.

In closing, we make five observations. First, there is a need for research about the characteristics of reading and learning for students with LD from a new literacies perspective. These include methods for effectively teaching search, navigation, evidence evaluation, inferencing, and listening comprehension skills.

Second, the opportunity to study reading under different conditions can expand our understanding of the underlying cognitive, perceptual, literacy, and learning processes of students with LD. Digital literacy environments offer a laboratory in which to explore self-regulatory, attentional, and memory capacities (e.g., Gyselinck, Jamet, & DuBois, 2008). Digital reading environments also facilitate investigation

of interactions between cognitive processes and learning supports (e.g., Sullivan & Puntambekar, 2015).

Third, technology can inspire us to take a fresh look at long-standing assumptions and practices associated with reading text. Schneps (2015) notes the features and organization of books are, to a large extent, artifacts of the conditions under which ancient civilizations created text. The shape and spacing of letters and the layout of pages are consequences of the high cost of parchment and the need for human scribes to write as fluidly and rapidly as possible. When print becomes digital, it can be shaped, configured, and organized in many different ways that may, or may not, be advantageous for readers with LD. Similarly, when TTS is always available to a reader, reading becomes a hybrid decoding and listening process (Dalton & Proctor, 2008). The implications for simultaneous reading by eye and by ear (Richardson, Vanden Boogart, & Douce, 2015) may be significant for students whose phonological deficits severely impact text comprehension.

Fourth, we need to resist premature claims about the impact of new technologies on students with LD. The widespread adoption of the Dyslexie font, as discussed above, offers a cautionary illustration of the risks of unwarranted enthusiasm. The extant research is clear that decoding difficulties are almost always based in phonological, not visual, processing, and, thus, it would be unreasonable to expect that a change in characteristics of a font would substantially reduce reading disabilities. Although it is unrealistic to think that research can keep pace with rapid advances in technology, we need to approach new developments with a healthy mix of cautious optimism and skepticism. Research on and practice of the efficacy of technology-supported environments should be informed by theoretical analysis and empirical evidence.

Fifth, our research questions and methods must evolve to keep pace with emerging technology and its use. In writing this chapter, it struck us that some research questions have become less relevant over the years. For example, before technologies such as TTS were in widespread use, research that compared reading with and without TTS was useful. When they are ubiquitous, however, they are available for everyone to use all the time. A more useful set of questions might address how students use tools such as TTS, how variations in the tools themselves affect outcomes, and how to teach students to make better use of them. Across the decades, researchers have almost always studied the same outcomes: acquisition of basic skills and vocabulary knowledge, passage comprehension, and, to a lesser extent, knowledge of comprehension strategies. Far less attention has been paid to attitudinal and motivational variables, which are of considerable importance in initiating and sustaining reading, particularly in more open-ended reading environments. There is minimal data about the transfer and generalization of self-regulatory reading strategies across literacy environments and tasks. We have not sufficiently explored the actual thoughts, decisions, or experiences of readers as they interact with digital text and its features.

Finally, we need to cultivate a more nuanced understanding of how technology can influence the learning of students with LD. As an example, consider the widely touted advantage of multimedia for students with LD. Multimedia technology is frequently cited as a technology that affords opportunities for multiple representations—one of the three critical tenets of Universal Design for Learning (Rose, Meyer, Strangman, & Rappolt, 2002). However, the considerable, still-evolving research base on multimedia learning (e.g., Mayer, 2005, 2017) shows that simplistic conclusions about how

multiple representations improve learning may be misleading. For example, the effects of multimedia vary for different pairings of representations. The simultaneous presentation of two representations of information can, in some cases, interfere with learning (Knoop van-Campen, Segers, & Verhoeven, 2018). Some research suggests that multimedia advantages are stronger for students with better comprehension skills (Scheiter, Schüler, Gerjets, Huk, & Hesse, 2014), and that attention and working memory constrain the integration of different representations (Olander, Brante, & Nyström, 2017).

This chapter offers highlights from a rich and extensive literature about the affordances of technology and its implications for reading and students with LD. The price of reading failure is too high, and closing the reading gap that disadvantages students with LD should be a national priority. The potential match between the learning needs of students with LD and the affordances of many different types of technology are considerable, but not yet fully realized. For this reason, theory and research should focus intensely on the development of knowledge that will result in the use of technology, supported by effective instructional practices, to improve reading for students with LD.

REFERENCES

- Anderson, R. C., & Pearson, P. D. (1984). A schema-theoretic view of basic processes in reading comprehension. In P. D. Pearson (Ed.), *Handbook of reading research* (pp. 255–291). New York: Longman.
- Anderson-Inman, L. (2009). Supported eText: Literacy scaffolding for students with disabilities. *Journal of Special Education Technology*, 24(3), 1–7. doi: 10.1177/016264340902400301
- Anderson-Inman, L., & Horney, M. (1997). Electronic books for secondary students. *Journal of Adolescent and Adult Literacy*, 40, 486–491. Retrieved from www.jstor.org/stable/40015524
- Anderson-Inman, L., & Horney, M. (1998). Transforming text for at-risk readers. In D. Reinking, L. Labbo, M. McKenna, & R. Kieffer (Eds.), *Handbook of literacy and technology: Transformations in a post-typographic world* (pp. 15–43). Mahwah, NJ: Lawrence Erlbaum.
- Archer, A. L., & Hughes, C. A. (2011). *Explicit instruction. Effective and efficient teaching*. New York: Guilford Press.
- Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control processes. In K. W. Spence & J. T. Spence (Eds.), *The psychology of learning and motivation: II*. Oxford, UK: Academic Press. doi: 10.1016/S0079-7421(08)60422-3
- Berkeley, S., Scruggs, T. E., & Mastropieri, M. A. (2010). Reading comprehension instruction for students with learning disabilities, 1995–2006: A meta-analysis. *Remedial and Special Education*, 31(6), 423–436. doi: 10.1177/0741932509355988
- Biancarosa, C., & Snow, C. E. (2006). *Reading next—A vision for action and research in middle and high school literacy: A report to Carnegie Corporation of New York* (2nd ed.). Washington, DC: Alliance for Excellent Education. Retrieved from: www.carnegie.org/media/filer_public/b7/5f/b75fba81-16cb-422d-ab59-373a6a07eb74/ccny_report_2004_reading.pdf
- Blachman, B., Schatschneider, C., Fletcher, J. M., Murray, M. S., Munger, K., & Vaughn, M. G. (2014). Intensive reading remediation in Grade 2 or 3: Are there effects a decade later? *Journal of Educational Psychology*, 106(1), 46–57. doi: 10.1037/a0033663.
- Boyle, J. R. (2010). Strategic note-taking for middle-school students with learning disabilities in science classes. *Learning Disability Quarterly*, 33(2), 93–109. doi: 10.2307/25701436
- Bus, A. G., Takacs, Z. K., & Kegel, C. A. T. (2015). Affordances and limitations of electronic storybooks for young children's emergent literacy. *Developmental Review*, 35, 79–97. doi: 10.1016/j.dr.2014.12.004
- Bus, A. G., van IJzendoorn, M. H., & Pellegrini, A. D. (1995). Joint book reading makes for success in learning to read: A meta-analysis on intergenerational transmission of literacy. *Review of Educational Research*, 65, 1–21. doi: 10.3102/00346543065001001

- Buzick, H. M., & Stone, E. A. (2014). A meta-analysis of research on read aloud accommodations. *Educational Measurement: Issues and Practice*, 33(3), 17–30. doi: 10.1111/emip.12040
- Catts, H. W., Hogan, T. P., & Adlof, S. M. (2005). Developmental changes in reading and reading disabilities. In H. W. Catts & A. G. Kamhi (Eds.), *The connections between language and reading disabilities* (pp. 25–40). Mahwah, NJ: Lawrence Erlbaum.
- Cheung, A. C. K., & Slavin, R. E. (2013). Effects of educational technology applications on reading outcomes for struggling readers. A best-evidence synthesis. *Reading Research Quarterly*, 48(3), 277–299. Retrieved from www.jstor.org/stable/43497623
- Clay, K., Zorfass, J., Brann, A., Kotula, A., & Smolkowski, K. (2009). Deepening content understanding in social studies using digital text and embedded vocabulary supports. *Journal of Special Education Technology*, 24(4), 1–16. doi: 10.1177/016264340902400401
- Coiro, J. (2011). Predicting reading comprehension on the Internet: Contributions of offline reading skills, online reading skills, and prior knowledge. *Journal of Literacy Research*, 43(4), 352–392. doi: 10.1177/1086296X11421979.
- Coiro, J., Kiili, C., & Castek, J. (2017). Designing pedagogies for literacy and learning through personal digital inquiry: Theory and practice from New London to New Times. In F. Serafini & E. Gee (Eds.), *Remixing multiliteracies: 20th century anniversary* (pp. 11–133). New York: Teachers College Press.
- Coiro, J., Knobel, M., Lankshear, C., & Leu, D. J. (2008). *Handbook of research on new literacies*. New York: Routledge.
- Common Core State Standards Initiative. (2010). *Common core state standards for English language arts & literacy in history, social studies, science, and technical subjects*. Retrieved from: www.corestandards.org/ELA-Literacy
- Coyne, M. D., McCoach, B., & Kapp, S. (2007). Vocabulary intervention for kindergarten students: Comparing extended instruction to embedded instruction and incidental exposure. *Learning Disability Quarterly*, 30(2), 74–88. doi: 10.2307/30035543
- Coyne, M. D., Simmons, D. C., Kame'enui, E. J., & Stoolmiller, M. (2004). Teaching vocabulary during shared storybook readings: An examination of differential effects. *Exceptionality*, 12, 141–162.
- Ciullo, S., Lo, Y.-L. S., Wanzek, J., & Reed, D. K. (2016). A synthesis of research on informational text reading interventions for elementary students with learning disabilities. *Journal of Learning Disabilities*, 49(3), 257–271. doi: 10.1177/0022219414539566
- Cunningham, A. E., & Stanovich, K. E. (1998). What reading does for the mind. *American Educator*, 22(1–2), 8–15. Retrieved from: www.aft.org/sites/default/files/periodicals/cunningham.pdf
- Cunningham, J. W., Hiebert, E. H., & Mesmer, H. A. (2018). Investigating the validity of two widely used quantitative text tools. *Reading & Writing*, 31(4), 813–833. doi: 10.1007/s11145-017-9815-4
- Dalton, B., & Proctor, C. P. (2008). The changing landscape of text and comprehension in the age of new literacies. In J. Coiro, M. Knobel, C. Lankshear, & D. J. Leu (Eds.), *Handbook of research on new literacies* (pp. 297–324). New York: Routledge.
- Dalton, B., Proctor, C. P., Uccelli, P., Mo, E., & Snow, C. E. (2011). Designing for diversity: The role of reading strategies and interactive vocabulary in a digital reading environment for fifth-grade monolingual and bilingual students. *Journal of Literacy Research*, 43(1), 68–100. doi: 10.1177/1086296X10397872
- Dalton, B., & Strangman, N. (2006). Improving struggling readers' comprehension through scaffolded hyper-texts and other computer-based literacy programs. In D. Reinking, M. C. McKenna, L. D. Labbo, & R. D. Keifer (Eds.), *Handbook of literacy and technology. Volume 2.* (75–85). Mahwah, NJ: Lawrence Erlbaum.
- de Jong, M. T., & Bus, A. G. (2002). Quality of book-reading matters for emergent readers: An experiment with the same book in a regular or electronic format. *Journal of Educational Psychology*, 94, 145–155. doi: 10.1037/0022-0663.94.1.145
- Delgado, P., Vargas, C., Ackerman, R., & Salmerón, L. (2018). Don't throw away your printed books: A meta-analysis on the effects of reading media on comprehension. *Educational Research Review*, 25, 33–38. doi: 10.1016/j.edurev.2018.09.003.
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64, 135–168. doi: 10.1146/annurev-psych-113011-143750
- Duke, N. K., & Bennett-Armistead, V. S. (2003). *Reading and writing informational text in the primary grades: Research-based practices*. New York: Scholastic.
- Duke, N. K., Pearson, P. D., Strachan, S. L., & Billman, A. (2011). Essential elements of fostering and teaching reading comprehension. In J. Samuels & A. E. Farstrup (Eds.), *What research has to say about reading instruction* (4th ed., pp. 51–93). Newark, DE: International Reading Association. doi: 10.1598/0829.03.

- Englert, C. S., Mariage, T. V., Okolo, C. M., Shankland, R. K., Moxley, K. D., Courtad, C. A., ... Chen, H. (2009). The learning-to-learn strategies of adolescents with disabilities. *Assessment for Effective Intervention*, 34(3), 147–161. doi: 10.1177/1534508408318804
- Erickson, K. A., & Geist, L. A. (2016). The profiles of students with significant cognitive disabilities and complex communication needs. *Augmentative and Alternative Communication*, 32(3), 187–197. doi: 10.1080/07434618.2016.1213312
- Esteves, K. J., & Whitten, E. (2011). Assisted reading with digital audiobooks for students with reading disabilities. *Reading Horizons*, 51(1), 21–40. Retrieved from https://scholarworks.wmich.edu/reading_horizons/vol51/iss1/4
- Faggella-Luby, M. N., Drew, S. V., & Schumaker, J. B. (2015). Not such a simple story: Contradictory evidence from a review of story structure research for students at-risk. *Learning Disabilities Research and Practices*, 30(2), 61–75. doi: 10.1111/ldrp.12057
- Ferretti, R. P., & De La Paz, S. (2011). On the comprehension and production of written texts: Instructional activities that support content-area literacy. In R. O'Connor & P. Vadasy (Eds.), *Handbook of reading interventions* (pp. 326–355). New York: Guilford Press.
- Ferretti, R. P., & Fan, Y. (2016). Argumentative writing. In C. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (2nd ed., pp. 301–315). New York: Guilford Press.
- Ferrier, D., Lovett, B., & Jordan, A. (2011). Construct-irrelevant variance in achievement test scores: A social cognitive perspective. In L. E. Madson (Ed.), *Achievement tests: Types, interpretations and uses* (pp. 89–108). Hauppauge, NY: Nova Science.
- Fletcher, J. M., Lyon, G. R., Fuchs, L. S., & Barnes, M. A. (2018). *Learning disabilities. From identification to intervention* (2nd ed.). New York: Guilford Press.
- Fountas, I. C., & Pinnell, G. S. (1996). *Guided reading: Good first teaching for all students*. Portsmouth, NH: Heinemann.
- Francis, D. J., Kulesz, P. A., & Benoit, J. S. (2018). Extending the simple view of reading to account for variation within readers and across texts: The complete view of reading (CVRi). *Remedial and Special Education*, 39(5), 274–288. doi: 10.1177/0741932518772904
- Fuchs, L. S., Fuchs, D., Hosp, M. K., & Jenkins, J. R. (2001). Oral reading fluency as an indicator of reading competence: A theoretical, empirical, and historical analysis. *Scientific Studies of Reading*, 5(3), 239–265. doi: 10.1207/S1532799XSSR0503_3
- Gersten, R., Fuchs, L. S., Williams, J. P., & Baker, S. (2001). Teaching reading comprehension strategies to students with learning disabilities: A review of research. *Review of Educational Research*, 71, 279–320. doi: 10.3102/00346543071002279
- Gough, P., & Tunmer, W. (1986). Decoding, reading, and reading disability. *Remedial and Special Education*, 7, 6–10. doi: 10.1177/074193258600700104
- Gough, P. B. (1972a). Theoretical models and processes of reading. In J. F. Kavanagh & I. G. Mattingly (Eds.), *Language by ear and by eye* (pp. 661–685). Cambridge, MA: MIT Press.
- Gough, P. B. (1972b). One second of reading. *Visible Language*, 6(4), 291–320.
- Graham, S., & Harris, K. R. (2003). Students with learning disabilities and the process of writing: A meta-analysis of SRSD studies. In L. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of research on learning disabilities* (pp. 383–402). New York: Guilford Press.
- Guisto, M., & Ehri, L. C. (2019). Effectiveness of a partial read-aloud test accommodation to assess reading comprehension in students with a reading disability. *Journal of Learning Disabilities*, 52(3), 259–270. doi: 10.1177/0022219418789377
- Gyselinck, V., Jamet, E., & DuBois, V. (2008). The role of working memory components in multimedia comprehension. *Applied Cognitive Psychology*, 22(3), 353–374.
- Hall, T. E., Hughes, C. A., & Filbert, M. (2000). Computer assisted instruction in reading for students with learning disabilities: A research synthesis. *Education and Treatment of Children*, 23(2), 173–193. Retrieved from www.jstor.org/stable/42940524?seq=1#page
- Hart, B., & Risley, T. R. (1995). *Meaningful differences in the everyday experience of young American children*. Baltimore, MD: Paul H Brookes.
- Hiebert, E. H. (2010/2011). Beyond single readability measures: Using multiple sources of information in establishing text complexity. *The Journal of Education*, 191(2), 33–42. doi: 10.1177/002205741119100206
- Hiebert, E. H., & Kamil, M. L. (2005). *Teaching and learning vocabulary: Bringing research to practice*. Mahwah, NJ: Lawrence Erlbaum.

- Hill, H. (2010, April). My iPhone has revolutionised my reading. *The Guardian*. Retrieved from: www.theguardian.com/education/2010/apr/06/iphone-makes-reading-books-easier
- Hodapp, J. B., & Rachow, C. (2010). Impact of text-to-speech software on access to print: A longitudinal study. In S. Seok, E. L. Meyen, & B. DaCosta (Eds.), *Handbook of research on human cognition and assistive technology: Design, accessibility, and transdisciplinary perspectives* (pp. 199–219). Hershey, PA: Medical Information Science Reference.
- Hoff, E. (2003). The specificity of environmental influence: Socioeconomic status affects early vocabulary development via maternal speech. *Child Development*, 74(5), 1368–1378. doi: 10.1037/a0027238.
- Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing: An Interdisciplinary Journal*, 2, 127–160. doi: 10.1007/BF00401799
- Horney, M., Anderson-Inman, L., Terrazas, F., Schulte, W., Mundorf, J., Wiseman, S., ... Frisbee, M. L. (2009). Exploring the effects of digital note taking on student comprehension of science texts. *Journal of Special Education Technology*, 24, 45–61. doi: 10.1177/016264340902400305
- Horney, M. A., & Anderson-Inman, L. (1994). The electro-text project: Hypertext reading patterns of middle school students. *Journal of Educational Multimedia and Hypermedia*, 3(1), 71–91.
- Hua, A. J., & Keenan, J. M. (2017) Interpreting reading comprehension test results: Quantile regression shows that explanatory factors can vary with performance level. *Scientific Studies of Reading*, 21(3), 225–238. doi: 10.1080/10888438.2017.1280675
- Izzo, M. V., Yurick, A., McArrell, B. (2009). Supported eText: Effects of Text-to-Speech on Access and Achievement for High School Students with Disabilities. *Journal of Special Education Technology*, v 24(3), 9–20.
- Jackson, G. T., Boonthum, C., & McNamara, D. S. (2010) The efficacy of iSTART extended practice: Low ability students catch up. In V. Aleven, J. Kay, & J. Mostow (Eds.), *Intelligent tutoring systems. ITS 2010. Lecture notes in computer science* (Vol. 6095). Berlin, Heidelberg: Springer. doi: 10.1007/978-3-642-13437-1_67
- Jackson, G. T., & McNamara, D. S. (2013). Motivation and performance in a game-based intelligent tutoring system. *Journal of Educational Psychology*, 105(4), 1036–1049. doi: 10.1037/a0032580
- Jeon, S. T., Hamid, J., Maurer, D., & Lewis, T. L. (2010). Developmental changes during childhood in single-letter acuity and its crowding contours. *Journal of Experimental Child Psychology*, 107, 423–437. doi: 10.1016/j.jecp.2010.05.009
- Jitendra, A. K., Edwards, L. L., Sacks, G., & Jacobson, L. A. (2004). What research says about vocabulary instruction for students with learning disabilities. *Exceptional Children*, 70(3), 299–322. doi: 10.1177/001440290407000303
- Johnson-Glenberg, M. C. (2007). Web-based reading comprehension instruction: Three studies of 3D-Readers. In D. S. McNamara (Ed.), *Reading comprehension strategies: Theories, interventions, and technologies* (pp. 293–324). Mahwah, NJ: Lawrence Erlbaum.
- Justice, L. M., & Ezell, H. K. (2000). Enhancing children's print and word awareness through home-based parent intervention. *American Journal of Speech-Language Pathology*, 9(3), 257–269. doi: 10.1044/1058-0360.0903.257
- Justice, J. M., Logan, J. A. R., Kaderavek, J. N., & Dynia, J. M. (2015). Print-Focused Read-Alouds in Early Childhood Special Education Programs. *Exceptional Children* 2015, 81(3), 292–311.
- Kame'enui, E. J., & Buamann, J. F. (2012). *Vocabulary instruction. Research to practice* (2nd ed.). New York: Guilford Press.
- Katz, L., & Frost, L. (1992). Reading in different orthographies: The orthographic depth hypothesis. In R. Frost & L. Katz (Eds.), *Orthography, phonology morphology, and meaning* (pp. 67–84). Amsterdam: Elsevier.
- Kennedy, M. J., & Deshler, D. D. (2010). Literacy instruction, technology, and students with learning disabilities: Research we have, research we need. *Learning Disability Quarterly*, 33(4), 289–298. doi: 10.1177/073184871003300406
- Kim, Y.-S., & Phillips, B. (2014). Cognitive correlates of listening comprehension. *Reading Research Quarterly*, 49, 269–281. doi: 10.1002/rrq.74
- Kintsch, W. (1988). The role of knowledge in discourse comprehension: A construction-integration model. *Psychological Review*, 95(2), 163–182. doi: 10.1037/0033-295X.95.2.163
- Kintsch, W. (1994). Text comprehension, memory, and learning. *American Psychologist*, 49(4), 294–303. doi: 10.1037/0003-066X.49.4.294
- Kintsch, W. (2005). An overview of top-down and bottom-up effects in comprehension: The CI perspective. *Discourse Processes*, 39(2–3), 125–128. doi: 10.1207/s15326950dp3902&3_2

- Kintsch, W., & Kintsch, E. (2005). Comprehension. In: S. G. Paris & S. A. Stahl (Eds.), *Current issues in reading comprehension and assessment* (pp. 71–92). Mahwah, NJ: Lawrence Erlbaum.
- Kintsch, W., & van Dijk, T. A. (1978). Toward a model of text comprehension and production. *Psychological Review*, 85(5), 363–394. doi: 10.1037/0033-295X.85.5.363
- Klingner, J. K., Morrison, A., & Eppolito, A. (2011). Metacognition to improve reading comprehension. In R. E. O'Connor & P. F. Vadasy (Eds.), *Handbook of reading interventions* (pp. 220–253). New York: Guilford Press.
- Knoop van-Campen, C., Segers, E., & Verhoeven, L. (2018). The modality and redundancy effects in multimedia learning in children with dyslexia. *Dyslexia*, 24(2), 40–155. doi: 10.1002/dys.1585.
- Korat, O., & Falk, Y. (2017). Ten years after: Revisiting the question of e-book quality as early language and literacy support. *Journal of Early Childhood Literacy*. Advance online publication. doi: 10.1177/1468798417712105
- Kuster, S. M., van Weerdenburg, M., Gompel, M., & Bosman, A. M. T. (2018). Dyslexie font does not benefit reading in children with or without dyslexia. *Annals of Dyslexia*, 68, 25–42. doi: 10.1007/s11881-017-0154-6
- LaBerge, D., & Samuels, S. J. (1974). Toward a theory of automatic information processing in reading. *Cognitive Psychology*, 6(2), 293–323. doi: 10.1016/0010-0285(74)90015-2
- Lan, Y.-C., Lo, Y.-L., & Hsu, Y.-S. (2014). The effects of meta-cognitive instruction on students' reading comprehension in computerized reading contexts: A quantitative meta-analysis. *Journal of Educational Technology & Society*, 17(4), 186–202. doi: 10.2307/jeductechsoci.17.4.186
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.
- Leu, D. J., Forzani, E., Rhoads, C., Maykel, C., Kennedy, C., & Timbrell, N. (2015). The new literacies of online research and comprehension: Rethinking the reading achievement gap. *Reading Research Quarterly*, 50(1), 37–59. doi: 10.002/rrq.85.
- Leu, D. J., Kinzer, C. K., Coiro, J., Castek, J., & Henry, L. A. (2013). New literacies: A dual-level theory of the changing nature of literacy, instruction, and assessment. In D. E. Alverman, N. J. Unrau, & R. Ruddell (Eds.), *Theoretical models and processes of literacy* (6th ed., pp. 1150–1181). Newark, DE: International Reading Association.
- Lewis, W. E., & Ferretti, R. P. (2009) Defending interpretations of literary texts: The effects of Topoi instruction on the literary arguments of high school students. *Reading & Writing Quarterly*, 25(4), 250–270. doi: 10.1080/10573560903120656
- Lewis, W. E., & Ferretti, R. P. (2011). Topoi and literary interpretation: The effects of a critical reading and writing intervention on high school students' analytic literary essays. *Contemporary Educational Psychology*, 36(4), 334–354.
- Li, H. (2014). The effects of read-aloud accommodations for students with and without disabilities: A meta-analysis. *Educational Measurement: Issues and Practice*, 33(3), 3–16. doi: 10.1111/emip.12027
- Li, L.-Y., Tseng, S.-T., & Chen, G.-D. (2016). Effect of hypertext highlighting and browsing, reading, and navigational performance. *Computers in Human Behavior*, 54, 318–325. doi: 10.1016/j.chb.2015.08.012.
- Linnenbrink, E. A., & Pintrich, P. R. (2003). The role of self-efficacy beliefs in student engagement and learning in the classroom. *Reading and Writing Quarterly*, 19, 119–137. doi: 10.1080/10573560308223
- Lonigan, C. L., Burgess, S. R., & Schatschneider, C. (2018). Examining the simple view of reading with elementary school children: Still simple after all these years. *Remedial and Special Education*, 39(5), 260–273. doi: 10.1177/0741932518764833.
- Loveless, T. (2017). *The 2017 Brown Center Report on American education: How well are American students learning? Vol 3 (6)*. Washington, DC: The Brookings Institute. Retrieved from: www.brookings.edu/wp-content/uploads/2017/03/2017-brown-center-report-on-american-education.pdf
- MacArthur, C. A. (2013). Technology applications for improving literacy: A review of research. In Swanson, H. L., Harris, K., & Graham, S. (Eds.), *Handbook of learning disabilities* (pp. 565–592). New York: Guilford Press.
- MacArthur, C. A., Ferretti, R. P., Okolo, C. M., & Cavalier, A. R. (2001). Technology applications for students with literacy problems: A critical review. *The Elementary School Journal*, 101(3), 273–301. doi: 10.1086/499669
- Mandler, J. M., & Johnson, N. S. (1977). Remembrance of things parsed: Story structure and recall. *Cognitive Psychology*, 9, 111–151. doi: 10.1016/0010-0285(77)90006-8
- Marino, M. T., Coyne, M., & Dunn, M. (2010). The effect of technology-based altered readability levels on struggling readers' science comprehension. *Journal of Computers in Mathematics and Science*, 29(1), 31–49. doi: 10.1177/016264341002500305

- Mayer, R. E. (2005). Cognitive theory of multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 31–48). Cambridge: Cambridge University Press.
- Mayer, R. E. (2017). Using multimedia for e-learning. *Journal of Computer Assisted Learning*, 33(5), 403–423. doi: 10.1111/jcal.12197
- McNamara, D. S., Levinstein, I. B., & Boonthum, C. (2004). iSTART: Interactive strategy training for active reading and thinking. *Behavior Research Methods, Instruments, and Computers*, 36(2), 222–233. doi: 10.3758/BF03195567
- McNamara, D. S., O'Reilly, T. P., Best, R. M., & Ozuru, Y. (2006). Improving adolescent students' reading comprehension with iSTART. *Journal of Educational Computing Research*, 34, 147–171. doi: 10.2190/1RU5-HDTJ-A5C8-JVWE
- Meyer, N. K., & Bouck, E. C. (2014). The impact of text to speech on expository reading for adolescents with LD. *Journal of Special Education Technology*, 29(1), 29–33. doi: 10.1177/016264341402900102
- Moats, L. C. (1998). Teaching decoding. *American Educator*, 22(1 & 2), 42–49, 95–96.
- Mol, S. E., & Bus, A. G. (2011). To read or not to read: A meta-analysis of print exposure from infancy to early adulthood. *Psychological Bulletin*, 137, 267–296. doi: 10.1037/a0021890
- Murray, J. D., & Engle, R. W. (2005). Accessing situation model information: Memory based processing versus here-and-now accounts. *The Journal of Psychology*, 139(3), 261–272. doi: 10.3200/JRLP.139.3.261-272
- National Center for Educational Statistics. (2017). *The condition of education, 2017*. Retrieved from: <https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2017144>
- National Reading Panel. (2000). *Teaching children to read*. Washington, DC: U.S. Government Printing Office. Retrieved from: www.nichd.nih.gov/sites/default/files/publications/pubs/nrp/Documents/report.pdf
- O'Brien, B. A., Mansfield, J. S., & Legge, G. E. (2005). The effect of print size on reading speed in dyslexia. *Journal of Research in Reading*, 28(3), 332–349. doi: 10.1111/j.1467-9817.2005.00273.x
- O'Reilly, T., Best, R., & McNamara, D. S. (2004). Self-explanation reading training: Effects for low-knowledge readers. In K. Forbus, D. Gentner, & T. Regier (Eds.), *Proceedings of the 26th Annual Cognitive Science Society* (pp. 1053–1058). Mahwah, NJ: Lawrence Erlbaum.
- Okolo, C., & Hayes, R. (1996, April). *The impact of animation in CD-ROM books on students' reading behavior and comprehension*. Paper presented at the Annual International Convention of the Council for Exceptional Children, Orlando, FL.
- Okolo, C. M., Socol, I., Feyen, S., & Ferrerri, S. (2011, April). *The impact of literacy software on comprehension of content-area text*. Annual Meeting of the Council for Exceptional Children. National Harbor, MD.
- Olander, M. H., Brante, E. W., & Nyström, M. (2017). The effect of illustration on improving text comprehension in dyslexic adults. *Dyslexia*, 23(1), 42–65. doi: 10.1002/dys.1545
- Pane, J. F., Steiner, E. D., Baird, M. D., & Hamilton, L. S. (2015). *Continued progress: Promising evidence on personalized learning*. Santa Monica, CA: RAND. doi: <https://dx.doi.org/10.7249/RR1365>
- Parrish-Morris, J., Mahajan, N., Hirsh-Pasek, K., Golinkoff, R. M., & Collins, M. F. (2013). Once upon a time: Parent-child dialogue and storybook reading in the electronic era. *Mind, Brain, and Education*, 7, 200–211. doi: 10.1111/mbe.12028
- Proctor, C. P., Dalton, B., & Gresham, D. L. (2007). Scaffolding English language learners and struggling readers in a universal literacy environment with embedded strategy instruction and vocabulary support. *Journal of Literacy Research*, 39(1), 71–93. doi: 10.1080/10862960709336758
- Pyle, N., Vasquez, A. C., LignugarisKraft, B., Gillam, S. L., Reutzel, R. D., Olszewski, A., ... Pyle, D. (2017). Effects of expository text structure interventions on comprehension: A meta-analysis. *Reading Research Quarterly*, 52(4), 469–501. doi: 10.1002/rrq.179
- Quercia, P., Feiss, L., & Michel, C. (2013). Developmental dyslexia and vision. *Clinical Ophthalmology*, 7, 869–881. doi: 10.2147/OPTH.S41607
- Richardson, J., Vanden Boogart, A. E., & Douce, D. (2015). *Balancing ear and eye reading*. Baltimore, MD: International Dyslexia Association. Retrieved from: https://dyslexiaida.org/balancing_ear_and_eye_reading/
- Rideout, V. (2017). *The common sense census: Media use by kids age zero to eight*. San Francisco, CA: Common Sense Media. Retrieved from: www.common SenseMedia.org/sites/default/files/uploads/research/csm_zerotoeight_fullreport_release_2.pdf
- Rose, D. H., Meyer, A., Strangman, N., & Rappolt, G. (2002). *Teaching every student in the digital age: Universal design for learning*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Rouet, J. F. (2006). *The skills of document use: from text comprehension to Web-based learning*. Mahwah, NJ: Erlbaum.

- Rumelhart, D. E. (1977). Toward an interactive model of reading. In S. Dornic (Ed.), *Attention and performance* (Vol. 6, pp. 573–603). Hillsdale, NJ: Lawrence Erlbaum.
- Rumelhart, D. E. (1994). Toward an interactive model of reading. In R. B. Ruddell, M. R. Ruddell, & H. Singer (Eds.), *Theoretical models and processes of reading* (4th ed., pp. 864–894). Newark, DE: International Reading Association.
- Rumelhart, D. E., & McClelland, J. L. (1986). *Parallel distributed processing: Explorations in the microstructure of cognition. Volume 1. Foundations*. Cambridge, MA: MIT Press.
- Samuels, S. J. (1994). Toward a theory of automatic information processing in reading, revisited. In M. R. Ruddell & H. Singer (Eds.), *Theoretical models and processes of reading* (pp. 816–837). Newark, DE: International Reading Association.
- Scheiter, K., Schöler, A., Gerjets, P., Huk, T., & Hesse, F. W. (2014). Extending multimedia research: How do prerequisite knowledge and reading comprehension affect learning from text and pictures? *Computers in Human Behavior*, 31(1), 73–84. doi: 10.1016/j.chb.2013.09.022
- Schneps, M. (2015). Using Technology to Break the Speed Barrier of Reading. *Scientific American*. Retrieved from: <https://www.scientificamerican.com/article/using-technology-to-break-the-speed-barrier-of-reading/>
- Schneps, M. H., Thomson, J. M., Chen, C., Sonnert, G., & Pomplun, M. (2013a). E-readers are more effective than paper for some with dyslexia. *PLoS One* 8(9), e75634. doi: 10.1371/journal.pone.0075634
- Schneps, M. H., Thomson, J. M., Sonnert, G., Pomplun, M., Chen, C., & Heffner-Wong, A. (2013b). Shorter lines facilitate reading in those who struggle. *PLoS One* 8(8), e71161. doi: 10.1371/journal.pone.0071161
- Schulte-Körne, G., & Bruder, J. (2010). Clinical neurophysiology of visual and auditory processing in dyslexia: A review. *Clinical Neurophysiology*, 121(11), 1794–1809. doi: 10.1016/j.clinph.2010.04.028
- Segal-Drori, O., Korat, O., Shamir, A., & Klein, P. S. (2012). Reading electronic and printed books with and without adult support: Effects on emergent reading. *Reading and Writing*, 23(8), 913–930. doi: 10.1007/s11145-009-9182-x
- Seidenberg, M. S., & MacDonald, M. C. (2018). The impact of language experience on language and reading: A statistical learning approach. *Topics in Language Disorders*, 38, 66–83. doi: 10.1097/TLD.0000000000000144
- Seidenberg, M. S., & McClelland, J. (1989). A distributed, developmental model of word recognition and naming. *Psychological Review*, 96, 523–568. doi: <https://doi.org/10.1037//0033-295X.96.4.523>
- Shamir, A. (2009). Processes and outcomes of joint activity with e-books for promoting kindergarteners' emergent literacy. *Educational Media International*, 46(1), 81–96. doi: 10.1080/09523980902781295
- Shamir, A., & Korat, A. (2015). Educational electronic books for supporting emergent literacy of kindergarteners at risk for reading difficulties—What do we know so far? *Computer in the Schools*, 32, 105–121. doi: 10.1080/07380569.2015.1027868
- Shamir, A., Korat, O., & Fellah, R. (2012). Promoting vocabulary, phonological awareness and concept about print among children at risk for learning disability: Can e-books help? *Reading and Writing*, 25, 45–69. doi: 10.1007/s11145-010-9247-x
- Shamir, A., & Schlafer, I. (2011). E-books effectiveness in promoting phonological awareness and concept about print. A comparison between children at risk for reading disabilities and typically developing kindergarteners. *Computer & Education*, 57, 1989–1997. doi: 10.1016/j.compedu.2011.05.001
- Smeets, D. J. H., van Dijken, M. J., & Bus, A. G. (2014). Using electronic storybooks to support word learning in children with severe language impairments. *Journal of Learning Disabilities*, 47, 435–449. doi: 10.1177/0022219412467069
- Smith, D., Stenner, A. J., Horabin, I., & Smith, M. (1989). *The Lexile scale in theory and practice* (Final report). Washington, DC: MetaMetrics. Retrieved from: <https://eric.ed.gov/?id=ED307577>
- Snow, C. (2002). *Reading for understanding: Toward a research and development program in reading comprehension*. Washington, DC: Office of Research and Educational Improvement, U.S. Department of Education. Retrieved from: www.rand.org/content/dam/rand/pubs/monograph_reports/2005/MR1465.pdf
- Snow, E. L., Jacobina, M. E., Jackson, G. T., & McNamara, D. S. (2016). iSTART-2: A reading comprehension and strategy instruction tutor. In D. S. McNamara & S. A. Crossley (Eds.), *Adaptive educational technologies for literacy instruction* (pp.104–121). New York: Taylor & Francis, Routledge.
- Snow, C. E., Tabors, P. O., Nicholson, P. A., & Kurland, B. F. (1995) SHELL: Oral Language and Early Literacy Skills in Kindergarten and First-Grade Children. *Journal of Research in Childhood Education*, 10(1), 37–48.
- Snowling, M. (1998). Dyslexia as a phonological deficit. Evidence and implications. *Child Psychology and Psychiatry Review*, 3(1), 4–11. doi: 10.1111/1475-3588.00201
- Spencer, M., Kaschak, M. P., Jones, J. L., & Lonigan, C. J. (2015). Statistical learning is related to early literacy-related skills. *Reading and Writing*, 28(4), 467–490. doi: 10.1007/s11145-014-9533-0

- Spiro, R. J., & Jehng, J. C. (1990). Cognitive flexibility and hypertext: Theory and technology for the nonlinear and multidimensional traversal of complex subject matter. In D. Nix & R. Spiro (Eds.), *Cognition, education, and multimedia: Exploring ideas in high technology* (pp. 163–205). Hillsdale, NJ: Lawrence Erlbaum.
- Stanovich, K. (1986). Matthew effects in reading: Some consequences of individual differences in literacy acquisition. *Reading Research Quarterly*, 21, 360–406. doi: 10.1177/0022057409189001-204
- Stanovich, K. E. (1980). Toward an interactive-compensatory model of individual differences in the development of reading fluency. *Reading Research Quarterly*, 16(1), 32–71. doi: 10.2307/747348
- Stanovich, K. E. (1998). Refining the phonological core deficit model. *Child Psychology and Psychiatry Review*, 3, 17–21.
- Stanovich, K. E. (2000). *Progress in understanding reading: Scientific foundations and new frontiers*. New York: Guilford Press.
- Stanovich, K. E., & Siegel, L. S. (1994). Phenotypic performance profile of children with reading disabilities: A regression-based test of the phonological-core variable-difference model. *Journal of Educational Psychology*, 86, 24–53. doi: 10.1037/0022-0663.86.1.24
- Stetter, M. E., & Hughes, M. T. (2010). Computer-assisted instruction to enhance the reading comprehension of struggling readers: A review of the literature. *Journal of Special Education Technology*, 25(4), 1–16. doi: 10.1177/016264341002500401
- Strasser, K., Vergara, D., & del Río, M. F. (2017). Contributions of print exposure to first and second grade oral language and reading in Chile. *Journal of Research in Reading*, 40(1), S87–S106. doi: 10.1111/1467-9817.12086
- Sullivan, S. A., & Puntambekar, S. (2015). Learning with digital texts: Exploring the impact of prior domain knowledge and reading comprehension ability on navigation and learning outcomes. *Computers in Human Behavior*, 50, 299–313. doi: 10.1016/j.chb.2015.04.016
- Swanson, E., Vaughn, S., Wanzek, J., Petscher, Y., Heckter, J., Cavanaugh, C., ... Tackett, K. (2011). A synthesis of read-aloud interventions on early reading outcomes among preschool through third graders at risk for reading difficulties. *Journal of Learning Disabilities*, 44, 258–275. doi: 10.1177/0022219410378444.
- Swanson, E., & Wexler, J. (2017). Selecting appropriate text for adolescents with disabilities. *Teaching Exceptional Children*, 49(3), 160–167. doi: 10.1177/0040059916670630
- Sweller, J. (2005). Implications of cognitive load theory for multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 19–30). Cambridge: Cambridge University Press.
- Thurlow, M. L., & Kopriva, R. (2015). Advancing accessibility and accommodations in content assessments for students with disabilities and English learners. *Review of Research in Education*, 39, 331–369. doi: 10.3102/0091732X14556076
- Torgeson, J. (1998). Catch them before they fall. Identification and assessment to prevent reading failure in young children. *American Educator*, 22(1–2), 32–39. Retrieved from: www.aft.org/sites/default/files/periodicals/torgesen.pdf
- Towson, J. A., Fetting, A., Fleury, V. P., & Abarca, D. L. (2017). Dialogic reading in early childhood settings: A summary of the evidence base. *Topics in Early Childhood Special Education*, 37, 132–146. doi: 10.1177/0271121417724875
- Trushell, J., Maitland, A., & Burrell, C. (2003). Pupils' recall of an interactive storybook on CD-ROM. *Journal of Computer Assisted Learning*, 19, 80–89. doi: 10.1046/j.0266-4909.2002.00008.x
- Tunmer, W. E., & Chapman, J. W. (2012). The simple view of reading redux: Vocabulary knowledge and the independent components hypothesis. *Journal of Learning Disabilities*, 45(5), 453–466. doi: 10.1177/0022219411432685
- van Dijk, T. A., & Kintsch, W. (1983). *Strategies of discourse comprehension*. New York: Academic Press.
- Vaughn, S., Schumm, J. S., & Forgan, J. W. (1995). Instructing students with high-incidence disabilities in the general education classroom. In J. A. Walter (Ed.), *Curriculum handbook* (pp. 12.269–12.307). Alexandria, VA: Association for Supervision and Curriculum Development.
- Vellutino, F. R., Tunmer, W. E., Jaccard, J. J., & Chen, R. (2007). Components of reading ability: Multivariate evidence for a convergent skills model of reading development. *Scientific Studies of Reading*, 11, 3–32. doi: 10.1080/10888430709336632
- Wagner, R. K., Herrera, S. K., Spencer, M., & Quinn, J. M. (2014). Reconsidering the simple view of reading in an intriguing case of equivalent models: Commentary on Tunmer and Chapman. *Journal of Learning Disabilities*, 48(2), 115–119. doi: 10.1177/0022219414544544

- Watson, S. M. R., Gable, R. A., Gear, S. B., & Hughes, K. C. (2012). Evidence-based strategies for improving the reading comprehension of secondary students: Implications for students with learning disabilities. *Learning Disabilities Research & Practice, 27*(2), 79–89.
- Williams, J. P., & Pao, L. S. (2011). Teaching narrative and expository text structure to improve comprehension. In R. E. O'Connor & P. F. Vadasy (Eds.), *Handbook of reading interventions* (pp. 254–278). New York: Guilford Press.
- Wolf, M. (2018). *Reader, come home. The reading brain in a digital world*. New York: Harper Collins.
- Wood, S. G., Moxley, J. H., Tighe, E. L., & Wagner, R. K. (2018). Does use of text-to-speech and related read-aloud tools improve reading comprehension for students with reading disabilities? A meta-analysis. *Journal of Learning Disabilities, 51*(1), 73–84.
- Woodward, J., & Ferretti, R. P. (2014). The evolving use of technology in special education: Is “effectiveness” the right question? In L. Florian (Ed.), *Handbook of special education* (2nd ed., pp. 731–748). London: Sage.
- Young, M. C., Courtad, C. A., Douglas, K. H., & Chung, Y. (2018). The effects of text-to-speech on reading outcomes for secondary students with learning disabilities. *The Journal of Special Education Technology*. Advance online publication. doi: 10.1177/0162643418786047
- Zimmerman, B. (2000). Self-efficacy: An essential motive to learn. *Contemporary Educational Psychology, 25*(1), 82–91. doi: 10.1006/ceps.1999.1016
- Zucker, A., Moody, K., & McKenna, M. (2009). The effects of electronic books on prekindergarten-to-grade 5 students’ literacy and language outcomes: A research synthesis. *Journal of Educational Computing Research, 40*, 47–87. doi: 10.2190/EC.40.1.c

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THE RELEVANCE OF NEUROSCIENCE TO UNDERSTANDING ACHIEVEMENT IN SPECIAL NEEDS CHILDREN

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Neuroscience. The very term, in an era of increasing emphasis on scientific research in the social sciences, can evoke in many researchers a sense of intrigue and promise. For many, neuroscience represents an underdeveloped new frontier that may provide the key to increasing our understanding of the inner workings of the human mind. Such insights could prove particularly relevant for studies of learners with special needs, providing valuable information about how and why these learners' processes differ from those of a typically developing (TD) learner. It is easy to approach such research with a sense of awe and fascination that may, at times, preclude our ability to appropriately critique this work. In the forthcoming chapter, we will examine the field of educational neuroscience and its most recent findings, with an eye towards hesitant optimism. We will examine the point of intersection between neuroscience and special education, from the lens of educational psychology. Further, we will provide a scaffold for determining the usefulness of neuroscientific research for studies of learners with special needs and for the education sciences more broadly. Finally, we will summarize some of the most promising findings about the nature of learning and apply these findings to several specific groups of special needs learners.

The chapter is organized as follows: In the first section, we will outline the progression of the relationship between neuroscience and the social sciences, with a particular emphasis on psychological theory. The next section will present three ways in which, we propose, neuroscience research can be particularly informative and helpful in advancing the field's knowledge of learners with special needs. We then provide an overview of the latest neuroscience research in educational psychology in the areas of mathematics and reading, including how this research is relevant to students experiencing significant difficulties or disability in these areas. To provide a comprehensive review, we then provide an account of the latest neuroscientific

research in the areas of three significant education-related disorders, autism spectrum disorder (ASD), conduct disorder (CD) and attention deficit hyperactivity disorder (ADHD). Finally, we provide implications for practitioners and suggestions for future research directions.

NEUROSCIENCE AND THE SOCIAL SCIENCES: EARLY HISTORY

The fields of psychology and education have had an on-again, off-again relationship with the field of neuroscience since the 1960s. Initially, it was argued that psychological theorists could be agnostic about how exactly mental processes such as reasoning and language comprehension emerged out of neurological processes, in much the same way that software designers could ignore the issue of whether a computer program that they wrote would run on a PC versus a Mac (Marr, 1982; Neisser, 1967). That is, designers cared about what the program would do (e.g., play chess), rather than how it would be implemented in a machine. Moreover, special educators in the 1970s and early 1980s vehemently added the caution that it was not helpful to appeal to neurological defects to explain a learning disorder, because parents and teachers would give up even trying to remediate the problem if it was believed to be “hardwired in the brain.” Furthermore, philosophers at that time appealed to a “levels of analysis” argument in which it was claimed that disciplines explain entirely different phenomena using entirely different constructs because of where they fall in a hierarchy of levels, such as the cell level, organ level, individual mind level, group level, and so on (Putnam, 1973). Biology focuses on the organ level, psychology focuses on the mind level, and sociology focuses on the group level. It would be wrongheaded, they argued, for a biologist to explain a psychological phenomenon using biological constructs, and for a psychologist to try and explain a biological process using psychological constructs. Indeed, it could be said that the biological construct of the brain was kept intentionally distinct from the psychological construct of the mind.

Then, everything changed in the 1980s and 1990s when many psychologists, educators, and people in the media seemed to argue that *everything* could be explained by appealing to neuroscience. Numerous books, professional talks, and magazine articles were devoted to explaining personality, communication styles, creative thinking, memory failures (to name a few), all in terms of where these psychological processes were carried out in the brain. Perhaps most notably, here, researchers increasingly used neuroscientific studies in an attempt to explain differences in learning, and research on brain differences in the study of students with special needs proliferated (e.g., Rubia, 2018). This love affair was helped along in large measure by the development of technologies such as positron emission tomography (PET), structural magnetic resonance imaging (MRI), and functional magnetic resonance imaging (fMRI) in the 1980s and 1990s. These technologies greatly supplemented the use of electroencephalograms, which were already in increasing use in the 1970s (Byrnes, 2001; Molfese, Molfese, & Kelly, 2001).

Having been reared in the initial stance that held sway in the early 1980s, the first author stepped into the foray by attempting to quell the overexuberance by writing articles (e.g., Byrnes & Fox, 1998) and a book (Byrnes, 2001) to show how the neuroscience enthusiasts went too far. To his surprise, he discovered, through a thorough

review of the literature and reflective analysis, that both the original position of the 1960s and 1970s and the overexuberance of the 1980s and 1990s were wrong in their extremity. That is, it is wrong to say that psychologists and educators can learn nothing of value from neuroscientific research (contra the initial position), but also wrong to say that every psychological or educational problem can be explained by appealing to neuroscience (contra the overexuberance position).

The middle position, which was proposed previously by the first author and is maintained in this chapter, is that the results of *certain kinds* of neuroscientific study could be informative when they are combined with the results of traditional (non-neuroscientific) studies. However, the information value also depends on the quality of the reasoning and research methods of the neuroscientists. This twofold stance of recognizing the need to look at both kinds of evidence (psychological and neurological) and evaluate the quality of both has been recently echoed by Howard-Jones et al. (2016). We also have to engage our ability to think critically about *both* psychological and neuroscientific studies by considering the validity of the inferences researchers draw from their data (i.e., is the conclusion warranted or justified?) and the validity of their research methods and forms of assessment. For most of the 1980s and 1990s, consumers of neuroscientific research suspended the kinds of criticism they regularly applied to traditional psychological work. For example, a traditional study that examined the efficacy of a new way to teach reading may experience considerable difficulty getting published in many of the top journals in educational psychology if there were only seven people in each of the treatment group and the control group. However, because of the expense of fMRI, many neuroscientific studies of cognitive phenomena were published in highly regarded outlets despite having only a few participants. This problem compounds interpretive difficulties for studies of special needs students, given the heterogeneity that exists within disorders such as ASD and ADHD. But Howard-Jones et al. (2016) added that properly designed neuroscientific studies of learning disorders can have considerable information value. We concur with the latter point.

As a foundation for the rest of this chapter, in which research on neuroscientific studies with relevance to special education is reviewed, it is useful to first say a little more about the kinds of study that could have relevance to psychologists and educators, but also point out potential problems with these designs that would make it difficult to draw firm conclusions from the findings.

THREE POTENTIALLY USEFUL NEUROSCIENTIFIC DESIGNS

We propose that there are three primary neuroscientific designs that have the potential to contribute to our understanding of school-related learning and, therefore, to students with special needs. (Other useful and informative designs may emerge over time, but the following three are the informative ones that we have discovered to date.) The first kind of design exploits the fact that there is a certain level of localization of function in the brain that was initially discovered in case studies of brain-injured adults. That is, injuries to a particular region of the brain seemed to correlate with the loss of a particular function. For example, patients who suffered strokes in a region of the upper left frontal lobe (the Broca area) often lost the ability to speak or recognize grammatically incorrect sentences (Byrnes, 2001; McCarthy & Warrington, 1990).

Furthermore, injuries to other language-related parts of the brain seemed to spare the ability to produce speech but cause a deficit in a different aspect of language-related skill (e.g., speech comprehension). These so-called “double dissociations” have been found in a variety of domains such as categorical concepts (e.g., one region seems to be associated with concrete nouns, and another seems to be associated with abstract nouns) and mathematics (e.g., one region seems to be associated with multiplication facts, and another seems to be associated with addition and subtraction).

With the emergence of new technologies in the 1980s and 1990s such as fMRI and transcranial magnetic stimulation (TMS), the regions identified by studies of brain-injured adults were often confirmed in studies using people with intact brains who were asked to perform the skills identified in studies of double dissociations. So, for example, the scans of people who produce speech in an fMRI scanner show activity in the Broca area, which corroborates the findings of brain-injured patients; in a similar way, when a TMS wand is passed over a participant’s forehead above the Broca area, they have difficulty retrieving the names of objects (Krieger-Redwood & Jefferies, 2014).

Notwithstanding this convergence of evidence across methodologies, it is important to note *that findings of localized brain function are not informative to psychologists and special educators in and of themselves* (any more than if a family doctor pointed to a patient’s stomach and said, “Your stomach is located here,” after the patient asked the doctor for help in solving a digestion problem). Rather, localization findings are only informative to the extent that they help decide among two or more competing *psychological* theories.

For example, psychologists used to pride themselves on always accepting the most parsimonious of theories when more than one explanation of a phenomenon existed. When, in the 1970s, a newly emerging claim that we have two kinds of working memory (WM) was first proposed (e.g., visual-spatial and verbal), it was immediately criticized by those who claimed that it is more parsimonious to believe that we have a single memory store in which both verbal and visual items can be temporarily held. The fight between the one-store versus two-store camps was largely resolved when PET and fMRI studies showed that different regions of the brain are active when people are engaged in verbal WM tasks and visuospatial WM tasks (e.g., Smith, Jonides, & Koeppel, 1996). Note that the two-store theory of WM is a psychological theory (Baddeley & Hitch, 1994), not a neuroscientific theory. It initially gained support in traditional psychological studies in which an experimenter flashed items on a screen or said items into headphones. But the evidence from psychological experiments that suggested that there were two WM stores was supported by the fMRI studies.

It is important to note that, when neuroscientific evidence is used to support psychological theories, the argument of philosophers that biological constructs cannot be used to explain psychological phenomena (and vice versa) is not violated, because psychological phenomena are still being explained with psychological constructs. However, neuroscientific evidence that supports or refutes theories now has information value beyond the fact of where an ability seems to be performed in the brain. Nevertheless, whereas it is the case that there are many competing psychological theories that could be partially officiated by exploiting localization of brain function (in addition to psychological evidence), there are many competing psychological theories that cannot be so decided.

That said, there are four things that have to be kept in mind when reading any one article that exploits localized function to support or refute a psychological theory (Byrnes & Vu, 2015). The first is that the entire utility of the information depends on whether there is a one-to-one correspondence between a particular brain region (e.g., Broca's area) and a particular psychological process (e.g., ability to produce speech). If the same brain region shows activity for more than one psychological process (e.g., producing speech, detecting subtle syntactical differences, recognizing rhymes, depressive rumination in the case of Broca's area), this one-to-many correspondence undermines the ability to rule in or rule out a psychological claim (Henson, 2005). The second thing to keep in mind is that there is considerable variability across studies regarding whether a particular brain region was active during a particular task. Meta-analyses across these studies can help establish or firm up a claim that a particular brain region seems important for a psychological skill when most studies find this outcome, but it must be kept in mind that there are always some studies that do not show activity in the alleged area when tasks are performed. Such non-findings also undermine the utility of using localized function arguments to support a psychological theory. Third, some neuroscientists discuss findings from experimental studies of nonhuman animals (e.g., mice, rhesus monkeys) to support the claim of localized function (or other things such as sex differences in brains) in humans. However, it is increasingly clear that the human brain cannot be equated with the brains of even our closest primate cousins. If nothing else, lower animals do not have all of the intellectual skills as humans (e.g., self-reflection ability, language, etc.) and have far less frontal lobe capacity. What would it mean to focus on a homologous "Broca" area in an animal that lacks spoken language ability, for example? Other skills that an animal does have will likely take over that area in the same way that the auditory cortex "invades" and takes over the visual cortex in visually impaired people (Ptito, Kupers, Lomber, & Pietrini, 2012). Fourth, neuroscientists have recently shifted from focusing on specific areas to focusing on *networks* of spatially segregated locations that seem to be active in a correlated fashion (Nelson, 2016). Looking at a single component of a network is missing the forest for the trees, inferentially. If only specialists know these four limitations (and there are others) and fail to qualify their findings in their articles, nonspecialists may think the findings are more informative or airtight than they are.

The second potentially useful kind of neuroscientific method pertains to brain maturation. As children grow between birth and late adolescence, they typically show increases in a variety of intellectual skills; that is, if we measured their ability at one age (e.g., vocabulary at age 3) and then measured their ability at a later age (e.g., vocabulary at age 6), we would typically find a higher level of skill at the later age. Developmental psychologists have sometimes appealed to brain maturation as a "developmental mechanism" that can explain such improvements in skill. Brain maturation has also been evoked to explain why a skill seems to emerge in children all over the world at particular ages (e.g., speaking their first words at 12 months of age; the ability to understand abstract material in mathematics around age 12 or 13, etc.). Some have even explained the rise and fall of risky behaviors such as drunk driving between adolescence and adulthood in terms maturation of the frontal lobes (Steinberg, 2008).

Although scientists have been speculating about brain maturation as both the cause of ability shifts and individual differences in ability for centuries, knowledge of the eight processes involved in brain maturation (Byrnes, 2001) coupled with

technological advances can help to identify possible reasons for structural (and, concomitantly, functional) differences between older and younger students, and between same-aged peers when some have been diagnosed with a disorder. The eight processes include proliferation (the production of brain cells), migration (the produced cells travelling to particular locations in the brain), differentiation (the migrated cell turning into a particular kind of neuron or glial cell), growth (each neuron growing in length and finding target neurons to connect with), synaptogenesis (formation of synapses between neurons to allow neural impulses to travel along chains of neurons), myelination (formation of a fatty acid coating that greatly speeds up transmission of neural impulses), and two regressive processes: apoptosis (cell death) and axonal regression (one neuron retracting a dendrite away from another that it initially formed a synapse with). Some of these processes operate for a fixed period of time (e.g., proliferation, differentiation until the seventh prenatal month), whereas others continue for the rest of a person's life (e.g., synaptogenesis, myelination, and regressive processes). The two regressive processes are required because, as an apparent protective mechanism, healthy infants develop three times as many brain cells and synaptic connections as needed (Remer et al., 2017). If everything goes well, competition among neurons for so-called trophic factors in the brain produces winners and losers; the loser cells die, and loser dendrites retract, leaving a TD brain with no learning issues. Recent studies have argued that certain disorders arise because of a hyper-connectivity among regions within a brain network (e.g., Bulthé et al., 2019, in the case of dyscalculia) that seems to be reduced if not eliminated using a particular kind of fluency training (Michels, O'Gorman, & Kucian, 2018).

When anatomical differences in subjects' brains are revealed via MRI (including a newer technique within MRI called diffusion tensor imaging), one can appeal to these eight processes to develop hypotheses as to why these structural differences exist. For example, if there are large differences in the overall size of brains (as would be the case when some children diagnosed with Down syndrome are compared with same-aged peers who are not so diagnosed), then processes such as proliferation, growth, and regressive processes could be implicated. However, if there are regional differences in size (in which some regions are larger than those in a TD brain, but some regions are smaller), then proliferation is an unlikely candidate. Other processes such as migration, apoptosis, axonal retraction, and myelination become possibilities. Once these possibilities are identified, one can then think about what teratogens (e.g., viral infections, toxins, etc.) or genetic anomalies could be responsible if they operated during a sensitive period for these processes. As there are clear age differences in the level of white matter (i.e., myelin) in the brain among children, adolescents, and adults, myelination (indexed by white matter) is a frequent candidate for the explanation of age differences in cognitive abilities among neuroscientists and neuroscientifically oriented psychologists and educators. One meta-analysis showed that white matter abnormalities seem to underlie both reading disability and math disability (Ashkenazi, Black, Abrams, Hoeft, & Menon, 2013).

But, as was the case for studies exploiting localization of function, there are things to keep in mind when one appeals to anatomical studies of brain maturation. The first issue is that it is not at all clear what it means for brain maturation to be a developmental mechanism. Why would increased myelination cause an increase in the ability to understand abstract thought, for example? Abstract thought is not embedded in the

myelin, nor is it an emergent property of myelin. All myelin does is speed up the firing of neurons within a neural assembly. Presumably, it is the assembly itself that subtends an ability. Second, there is a difference between stored representations of our knowledge in the cortex (e.g., particular mathematical facts, the name of your best friend, or how to use the least common denominator method) and the ability of our brains to carry out some task (e.g., hold information in verbal WM). When we learn something, our synaptic connections reorganize into a particular neural assembly (Squire, 1987). When our brain matures, it does not create the assembly corresponding to this item of knowledge. If this occurred, Plato, Socrates, and Chomsky would be right that many important concepts are innate (e.g., “noun phrase” in the case of Chomsky; “beauty” in the case of Plato). What can only emerge are abilities to carry out a task. One still needs exposure to content in order to promote the reorganization of cell assemblies.

The second interpretive problem for the maturation argument is that there is now plenty of evidence that environmental experience “sculpts” the brain (Ansari, 2008; Schlaggar & McCandliss, 2007; Shaw et al., 2008). This was already alluded to when the two regressive processes were discussed. The “wiring” in our brains is not finished at birth. Rather, synapses form or die off depending on how neurons are connected, but also, crucially, because of environmental stimulation sent to the brain. In addition, myelin may be added to neurons not because of some genetic process that is independent of the environment, but because of repeated practicing of skills. In addition, longitudinal studies of children using fMRI or diffusion tensor mapping show that the brains of older children function differently than the brains of younger children because classroom experiences (e.g., learning math, reading) help to sculpt the neural assemblies’ underlying abilities. So, if it were to be found that the brains of older and younger children differ, or those of reading disabled and nondisabled children differ, it cannot be assumed that something genetic is solely responsible for these differences. It could also be the case that the environment played a strong role as well (or instead). One would particularly expect there to be myelination differences for children diagnosed with learning disorders, because children who experience difficulties may be expected not to practice these skills because doing so would be aversive.

The third kind of neuroscientific studies that have the potential to be informative to psychology and education are those that report an intriguing connection between two issues that would not have been anticipated by psychology alone. As one example, neuroscientists gave an intelligence test to children and divided them into three groups: superior intelligence (IQ of 121–149), high intelligence (IQ of 109–120), and average intelligence (IQ of 83–108; Shaw et al., 2006). They then acquired MRI scans from the time they were 6 years old until late adolescence in order to measure cortical thickness and the rate at which thickness increased or decreased over time. They found three different trajectories for the three groups. At 6, those found to have superior intelligence actually had thinner cortices than the other two groups, so there was a negative correlation between overall volume and IQ. But cortical thickness for those with superior intelligence rapidly increased between 6 and 11, where it peaked and then slowly decreased again across adolescence. In contrast, those with average intelligence showed a slow progressive, linear loss of thickness between age 6 and late adolescence (as opposed to a rise and fall). The third group, high IQ, started high with the average group, but, by age 11, had comparably thick cortices to those of the superior group across adolescence and showed similar rates of loss to those of the superior

group. By late adolescence, the negative correlation between IQ and thickness of the cortex now became positive (for some areas). There is clearly something going on with these findings, but it is not clear what. Serendipitous findings such as these could spark new psychological theories but would never have been predicted by purely psychological studies.

That said, because of the complexities and uncertainties related to localization of function, peculiarities of the sample (the kinds of parents and children who would agree to have annual MRI scans), and the role of the environment in sculpting brains, it is not at all clear what to make of serendipitous findings. In the aforementioned IQ study, for example, there was a correlation between IQ and socioeconomic status. Were the three different trajectories due to the kinds of anatomical difference that underlie intelligence or were they due to economic and experiential factors?

Summary of Theory

This general framework for understanding how neuroscience can be informative, and also the limitations of neuroscientific methods, will inform the forthcoming discussion of neuroscientific studies in education and their usefulness for research and practice in special education. Generally, we focus on findings that potentially have relevance for understanding the developmental and individual differences in school-related skills for learners with special needs.

RECENT NEUROSCIENTIFIC STUDIES IN EDUCATION

The proliferation of neuroscientific studies that could have relevance for education (and, indeed, the emergence of the field of educational neuroscience itself) means that a comprehensive review would require at least a book-length treatment. Given space limitations, we will briefly describe studies that appeared since other reviews were published in 2015 and earlier (e.g., Byrnes, 2012; Byrnes & Vu, 2015). Despite some overlap, the needs of learners are often discussed topically, most frequently in the content areas of mathematics and reading; therefore, we begin with an overview of neuroscientific findings in these major academic areas. We then explore neuroscientific studies of three developmental disabilities (ASD, CD, and ADHD). As the findings and implications for special needs students are discussed, the work will also be critiqued using some of the principles of the previous section.

Mathematics

Nonclinical Findings

Earlier reviews lamented the fact that most of the neuroscientific work on mathematics merely provided corroboration of the “double dissociations” that were the basis of Stanislas Dehaene’s triple code model (Dehaene, Piazza, Pinel, & Cohen, 2003) and typically focused on lower-level skills such as comparison of the size of two numbers, retrieval of arithmetic facts, or performance of arithmetic computations (Byrnes, 2011; Byrnes & Vu, 2015). More germane to the present arguments, these studies were also not designed to help decide among competing psychological theories of mathematics and did not use contemporary theories of mathematical problem-solving to guide

their work. As noted earlier, contemporary psychological theories are designed to explain learning successes and difficulties and provide insight into ways to help those who struggle. Several key omissions, for example, were (a) neuroscientific studies that examined the viability of theories of mathematical problem-solving such as those of Mayer (2013) or Anderson (2016), and (b) studies that examined the important role of conceptual knowledge in the acquisition and execution of mathematical procedures. So, whereas it was interesting to learn that mathematical skills and knowledge are widely distributed in the brain, and that the intraparietal sulci (IPS) in the parietal lobes (as part of a frontoparietal network) seem to be implicated in a variety of approximate and exact mathematical procedures, there was something of a disconnect between theorizing in educational psychology and the work of neuroscientists. As a result, this work could not be said to advance theories in the field and, consequently, had little information value regarding the issue of how best to promote mathematical skills in students.

Since 2015, however, there have been some promising developments in the field that suggest neuroscientific work is moving somewhat away from the original focus on individual brain regions and lower-level mathematical skills towards helping to clarify the nature of mathematical competence and its neural underpinnings. One development that is apparent in studies of multiple psychological processes (Nelson, 2016), including mathematics, is the attempt to relate both mathematical achievement and difficulties to functional networks and patterns of interconnectivity among brain regions. This change reflects a general recognition that it can be misleading to focus on a single brain region. This work also tends to be developmental, with a focus on how the formation of networks over time seems to be experience-dependent and progresses from larger, diffuse patterns of connectivity reducing down to more specific networks that seem to be exclusively related to mathematical performance (Amalric & Dehaene, 2018; Matejko & Ansari, 2017; Park, Li, & Brannon, 2014). The identification of these networks was facilitated by advancements in statistical techniques that distilled patterns of correlated brain activity and also methods such as diffusion tensor imagery that identified myelinated tracks that connected brain regions.

Park et al. (2014), for example, showed that, in a sample of children between 4 and 6 years of age, the emergence of, and degree of connectivity within, a network comprised of the left supramarginal gyrus, right precentral gyrus, and right IPS were correlated with mathematical achievement (more connectivity, higher achievement). Although these results are intriguing, the emphasis on the right IPS in Park et al. runs contrary to other studies that found a correlation between activity in the left IPS and mathematical skill in children (e.g., Matejko & Ansari, 2017) and studies that showed bilateral IPS activation in professional mathematicians (Amalric & Dehaene, 2018). In addition, however, it is not clear what kind of experience optimally promotes the development of specialized mathematics networks; the latter information would be crucial for providing insight into how to teach mathematics more effectively and support the development of this network.

A second promising trend in recent research pertains to attempts to examine the role of conceptual knowledge in mathematical problem-solving through a neuroscientific lens. Educational psychologists, developmental psychologists, and mathematics educators are unique in their emphasis on the important role of conceptual knowledge in the acquisition of procedural knowledge, and vice versa (Byrnes, 2008;

Rittle-Johnson, Schneider, & Star, 2015), though it is still not entirely clear which should come first and how to best integrate them. Cognitive psychologists, in contrast, typically limit their analyses to rote-learned declarative knowledge and procedural knowledge. One exception is cognitive psychologist John Anderson. He and his colleagues (e.g., Pyke, Fincham, & Anderson, 2017) have recently developed a technique for parsing fMRI activation into four phases: encode, plan, compute, and respond. They trained college students to learn the meaning of a novel mathematical symbol for performing a new kind of operation in one of two ways: either linking the symbol to a spatial representation (similar to a histogram) or purely computationally. Hence, one condition fostered both conceptual knowledge and procedural knowledge, and the other focused only on procedural knowledge. They then examined brain activations when participants were in an fMRI scanner and given new problems. They found that, during both the encode and compute phases, those trained to link the operation to the spatial representation showed more activation in brain regions associated with semantic processing. Interestingly, had they not subdivided activation patterns into phases, the overall pattern of brain activations would have revealed no differences between the groups.

Zhou et al. (2018) rightly argued that most neuroscientific studies of mathematics have tended to focus on lower-level skills such as comparing numbers or performing arithmetic. They sought to examine the brain regions associated with novel problem-solving, especially problems that place a heavy emphasis on conceptual understanding and number sense. They found that these problems produced activation in all seven regions that had been identified in a prior meta-analysis of the semantic system. These regions extended well beyond the IPS, which had been highlighted in studies of the lower-level skills. Thus, problem-solving seems to recruit a (meaningful) semantic processing system. Incidentally, these findings are consistent with findings from non-neuroscientific studies showing: (a) a high ($r > .70$) correlation between mathematics achievement and reading achievement (e.g., Byrnes, Wang, & Miller-Cotto, 2019), (b) that calculation skills are part of verbal IQ not spatial IQ as determined by factor analysis, and (c) a 40% comorbidity rate for reading disabilities and mathematics disabilities (Willcutt et al., 2013).

However, Amalric and Dehaene (2018), in three studies, attempted to use fMRI to officiate between two competing claims: (1) that there is a considerable overlap between the language system and mathematical system in the brain (comparable to what was found by Pyke et al., 2017; Zhou et al., 2018), and (2) there is no such overlap because mathematical skill is subtended by its own mathematics-specific brain regions. To determine which of these two claims is correct, Amalric and Dehaene recruited a sample of professional mathematicians and gave them a series of both mathematical and nonmathematical tasks. They found that the mathematical tasks did not seem to generate activation in perisylvian language-related areas (the junction where the temporal and frontal lobes meet) or in other temporal lobe areas that have been identified with general semantic knowledge. Rather, they argue that, “mathematical reflection recycles bilateral intraparietal and ventral temporal regions involved in elementary number sense” (p. 1).

Why the discrepancies among the studies that show an overlap between semantic areas and mathematics areas and those that do not? The first explanation pertains to differences among the samples. Nonspecialist undergraduates are different from

professional mathematicians in their level of expertise. If experience promotes increased specialization (Matejko & Ansari, 2017), this fact could explain the lack of overlap only in the mathematicians. Second, the tasks differed in all of these studies. Task differences are a common source of differences in fMRI studies. Thus, additional studies are needed to clarify the discrepancies.

The third promising trend in recent research is the tendency for scholars to attempt to disambiguate previously ambiguous findings. Matejko and Ansari (2017), for example, rightly point out that certain mathematics tasks and visuospatial working memory (VSWM) tasks both seem to activate the same frontoparietal network. This finding suggests that it could be incorrect to assume that the network is math-specific, and it may really reflect the WM demands of the mathematics task. To see which of these possibilities is correct, they administered a VSWM task, a symbolic mathematics task, and a nonsymbolic (dots) mathematics task to a sample of 44 school-aged children. Results showed that symbolic mathematics skill more strongly predicted activation in the IPS than the VSWM and nonsymbolic tasks. Hence, they demonstrated that both domain-specific and domain-general skills predict variability in IPS activation, and that prior results cannot be attributed to VSWM. In an analogous way, the aforementioned Amalric and Dehaene study of professional mathematicians could also be viewed as an attempt to disambiguate and clarify previous results. Two further examples of this trend include: (1) Sokolowski, Fias, Mousa, and Ansari (2017), who attempted to resolve the debate regarding whether activation of the IPS occurs for both numerical and nonnumerical ordinal comparisons and found that numerical comparisons seem to activate brain areas that are involved in any kind of ordinal comparisons, but also activate brain areas that only become active for mathematical comparisons, and (2) Metcalfe, Ashkenazi, Rosenberg-Lee, and Menon (2013), who fractionated WM into its components (verbal, visuospatial, and central executive) to see which was most closely associated with activation of brain areas associated with numerical processing and found it was visuospatial WM. All of these studies are moving the field in a promising direction by showing how to disambiguate possible interpretations of neuroscientific results.

One final study that is worth mentioning that does not fall into the aforementioned trends is that of Ullman and Klingberg (2017). Recent meta-analyses have shown that there is an effect size of about $r = .30$ between WM and mathematics (Peng, Namkung, Barnes, & Sun, 2016), but that this correlation is higher at school entry than in adolescence and early adulthood. Ullman and Klingberg devised a way to use diffusion tensor imaging to establish a child's "brain age," which differed from their chronological age. They found that this brain age was correlated with both WM and mathematics performance in 6-year-olds but not adolescents, thus providing a neuroscientific explanation of the meta-analytic findings.

Clinical Findings

The fourth promising trend in recent research pertains to studies that have capitalized on the focus on networks over individual brain areas and the ability to use diffusion tensor imaging to examine the manner in which the components are connected to each other, in order to provide insight into the nature of mathematics disability. It is well known that performance on many mathematics tasks is associated with activation

of a frontoparietal network (Matejko & Ansari, 2017). Jolles et al. (2016) wondered whether they might find different patterns of connectivity when they compared children diagnosed with mathematics disability (MD) and their TD peers who were matched for age, gender, IQ, WM, and reading ability. Indeed, they found a pattern of bilateral hyper-connectivity in the MD group as well as intrinsic low-level fluctuations in the activity of this network. These findings implicate a possible role for aberrant regressive processes in the pruning of excessive connections. However, given the role of experience in promoting the sculpting of the brain, one cannot rule out environmental influences as well (or instead). Moreover, the notion of hyper-connectivity runs somewhat contrary to certain findings that suggest that, whereas grey matter in the IPS increases then decreases in TD children between ages 8 and 12, it does not increase, and could even decrease, in MD children (Butterworth, 2017). More studies are needed to fully understand the possibly distinct patterns of increases and decreases in grey matter and white matter in TD and MD children.

Early attempts to explain MD appealed to a brain system localized in the IPS that was originally identified by Dehaene in his work on the triple code model: the approximate number system (ANS). Humans share with lower animals the capacity to approximately quantify the number of objects, which can be useful for foraging purposes (e.g., ~7 items of food in this location versus ~15 in another). As noted above, the IPS is activated not only when children and adults are asked to determine which of two large arrays has more dots in it, but also when they are performing calculations and solving problems. Given the apparent centrality of the IPS, it became a likely target for assumed deficiencies in MD students. However, the findings have been very inconsistent across studies as to whether the IPS is implicated in MD, and whether MD and TD children show different levels of activation in nonsymbolic approximation tasks (DeSmedt, Noël, Gilmore, & Ansari, 2013). More recent theorizing has placed an emphasis not on the ANS, but on the ability to precisely quantify magnitudes and link these more precise representations to words (e.g., three) and digits (e.g., 3; Carey, Shusterman, Howard, & Distefano, 2017; Geary & vanMarle, 2018; Morsanyi, Chapter 21, this volume; Price & Ansari, 2013; Tian & Siegler, 2017). Studies also show that the precise locations of activation within or near the IPS differ between children and adults, and between MD and TD children (Kaufmann, Wood, Rubinsten, & Henik, 2011). The normal pattern is to show less activation in an area with increasing expertise and have this activation circumscribed to a particular area. MD children not only show increased activation in areas such as the IPS, they also show more widespread activation in other areas such as the frontal lobe, suggesting the increased effort they are expending and use of compensatory strategies (Howard-Jones et al., 2016). Both TD and MD children also show more anterior activation in the parietal lobe than adults, near areas that are normally activated for real or imagined finger movements, which suggests they may be engaging in finger counting in their heads.

Finally, it is important to recognize that there are several vigorous debates still occurring among educational neuroscientists about the causes of MD. Some have emphasized a single core deficit such as magnitude processing (e.g., Price & Ansari, 2013), whereas others argue that it is more accurate to point to both mathematics-specific problems and domain-general problems related to WM and attention (De Visscher, Szmalec, Van Der Linden, & Noël, 2015; Fias, Menon, & Szucs, 2013). The inconsistent findings have also resulted from the fact that MD is not a homogeneous

disorder. It tends to frequently co-occur with dyslexia and ADHD (Landerl, Göbel, & Moll, 2013), and a recent study identified two distinct groups: those who show deficiencies in serial order learning and those who show a hypersensitivity to interference during recall (De Visscher et al., 2015). In addition, researchers have defined MD using different criteria (e.g., below the 35th percentile in math achievement versus below the 10th percentile), have used different tasks in their studies, and sometimes still have fewer than 30 participants per group. The heterogeneity of the disorder combined with the methodological differences largely explains the inconsistencies.

Summary of Mathematics Research

Collectively, these studies are helping to resolve theoretical debates, resolve ambiguous findings, and explain psychological findings in the field. All of these trends show that more recent work has more information value than the earliest work that focused on identifying brain regions important for mathematics when people perform simplistic mathematical tasks (e.g., the IPS). The shift away from emphasizing the ANS to more precise magnitude representations has been an interesting and important development. In addition, there does seem to be considerable progress in understanding MD, but attaining a complete and accurate understanding requires the field to develop a consensus around: (a) a single versus multiple sources of the problem, (b) the inclusion criteria, (c) the nature of the subgroups, and (c) a common set of tasks and measures. Despite the continuing debates, the valuable information arising from these studies supports our earlier contention that much can be gained from examining MD from the perspective of educational neuroscience.

Reading

Nonclinical Findings

As was the case for mathematics, previous reviews of neuroscientific studies in reading often found that studies did not conform to the suggestions put forth in this chapter; specifically, they were not designed in such a way that they helped to advance psychological theories or instructional practice because they did not support or refute existing theories or have direct implications for educational researchers and teachers.

One main concern evidenced in an earlier review (Byrnes & Vu, 2015) highlighted that much of the ongoing research involved a participant reading single words as opposed to reading sentence-length and multi-sentence passages requiring inference-making. Single-word reading is a component of skilled reading but obviously not the complete process. Note this focus on lower-level reading skills is similar to the point made earlier about neuroscientists focusing mostly on lower-level math skills. Although different processing models of reading exist, experts generally agree that skilled reading is made up of orthographic skills, including alphabet knowledge and decoding, and language comprehension skills, such as phonological processing, semantics, and syntax, combined with prior knowledge and experience (Byrnes & Wasik, 2009). Because single-word reading fails to capture the full phenomena of reading comprehension, these studies primarily implicated the left ventral occipitotemporal cortex, a region many researchers refer to as the visual word form area

(VWFA), as the area most associated with reading tasks (Price, 2012; Schlaggar & McCandliss, 2007). This area is widely accepted to play some role in reading tasks, although its exact function is debated.

One positive trend in the literature is a stronger emphasis on the entire reading network beyond the reading of individual words, much the same as the trend in studies of mathematics that emphasize multiple interacting component abilities. Meta-analyses of fMRI studies of reading have revealed consistent activation in five areas located in the left hemisphere: (1) the inferior surface of where the temporal lobe meets the occipital lobe (the occipital temporal complex, or OTC), including the fusiform gyrus and VWFA; (2) the inferior parietal lobe; (3) medial and superior temporal areas; (4) two subsections of the Broca area in the frontal lobe; and (5) for speakers of shallow orthographies such as Swedish or Italian (where, unlike English, there is a close and consistent mapping between spelling and pronunciation), areas of the precentral gyrus that control the mouth (Martin, Kronbichler, & Richlan, 2016). Collectively, each of these areas has been associated with specific aspects of reading such as orthography, phonology, semantics, and syntax, but the results have also shown that, by virtue of long-distance connections among the five areas, these aspects of reading are fully integrated in TD readers. So, whereas the VWFA and OTC were once thought to be exclusively focused on orthographic processing, findings now show phonological processing can feed back to the VWFA and OTC and activate them.

A second major concern highlighted by previous reviews was the lack of information regarding how brain changes over time might impact reading ability. It was suggested that three kinds of study were underrepresented in the literature: examinations of preexisting anatomical issues that could impact reading, longitudinal studies demonstrating how experience in reading changes the brain over time, and studies that compare different types of reading instruction in terms of activation (Byrnes & Vu, 2015). Findings from these kinds of study would be useful in the development of reading strategies and instructional approaches.

Since 2015, however, as was the case with mathematics, research appears to be moving in a positive direction, and several recent studies seek to correct these issues and support the basic tenets that we propose will increase the usefulness of educational neuroscience. Increasingly, researchers seek to examine neural networks underlying reading skills and involve participants in more authentic reading activities (e.g., Aboud, Bailey, Petrill, & Cutting, 2016; Anderson et al., 2016; Jangraw et al., 2018; Jasińska et al., 2016; Sood & Sereno, 2016). Several studies attempt to extend current knowledge of brain region involvement in reading tasks and examine network connectivity by engaging participants in various reading-related tasks, including word-level and passage-level reading. Often, these studies examine the similarities and differences that emerge in activation networks dependent upon the type of reading task engaged in.

In one example, Aboud et al. (2016) examined patterns of connectivity while adolescents read single words and passages. This study is significant in that the authors sought to address two shortcomings of previous research: (1) in addition to comparing single words with symbols, the study incorporated as a unit of analysis 150-word passages, broken down into syntactic phrases, thereby providing activation patterns that fit a more comprehensive model of reading; and (2) they identified seed regions involved in semantic, orthographic, and executive function regions—namely, the inferior frontal gyrus (IFG), the middle temporal gyrus (MTG), temporal pole (TP),

the dorsolateral prefrontal cortex, and putative visual word form area (pVWFA)—and compared activation patterns across word-reading and passage-reading tasks.

Findings from this study indicated that during both types of task, activation occurred in left-lateralized areas in seed regions that have traditionally been identified as supporting visual word recognition, such as the left occipitotemporal areas and the pVWFA. Activation in these regions supports the previous conclusions of Price (2012), who claims this region is responsible for phonological and semantic processes in addition to its orthographic function. Additionally, however, both types of task resulted in activation in what have traditionally been considered semantic processing areas, namely the left IFG, MTG, and TP regions. Identification of these areas better supports current reading theory by incorporating the role of semantic processing into the neurological model. These findings nicely converge with recent psychological studies, which do not have a neuroscientific basis, that show how phonology, semantics, and syntax are all integrated into a reading system in intact readers (Byrnes & Wasik, 2009).

Another promising finding is that researchers increasingly seek to make connections to psychological theory and elaborate on educational implications (Hartung, Hagoort, & Willems, 2017; Kana et al., 2015; Taylor, Davis, & Rastle, 2017). One such example is the serendipitous finding by Hartung et al. (2017) in a study that sought to explore different activation patterns in the brain initiated by first- or third-person pronouns present in a reading exercise presented to subjects. Building on Brunyé, Ditman, Mahoney, Augustyn, and Taylor's (2009) findings on comprehension effects dependent upon first- or third-person pronoun usage in narrative writing, Hartung et al. (2017) attempted to demonstrate this effect through brain activation using fMRI analysis. Specifically, the fMRI occurred while participants heard an auditory rendition of a story in either the first or third person.

Interestingly, no significant contrasts emerged in brain activation areas for the separate story groups. However, when participants were asked subjectively whether they engaged in first- or third-person analysis of the story, the three response categories that emerged—first-person preference, third-person preference, or both simultaneously—matched three clearly defined brain activation patterns. Those who preferred the first-person perspective, termed “enactors” (p. 35), showed activation in an area in the right frontolateral pole during action events that was significantly higher than those who preferred a third-person perspective, termed “observers” (p. 35). Observers demonstrated greater activations in bilateral vision areas that have been previously associated with motion processing. Further, participants who demonstrated high scores for both perspectives showed activation regions that overlapped those of both observers and enactors. This research suggests that different reading styles might be supported by different neural networks, which has important implications for teaching and research. For instance, studies investigating the effects of pronoun use in literature may be misguided if students are applying their own perspectives to reading, regardless of the pronouns used. Note that the activation patterns of the “observers” also support the claim of reading researchers that readers construct a “situation model” or imagery-based representation of the events described in a text (Byrnes & Wasik, 2009).

In another study examining how the readers' interpretation of text affects neural activation, Kana et al. (2015) enlisted fMRI analysis to examine activation networks

involved while readers were presented with short action sentences and asked to determine whether the actions depicted were intentional or accidental. This type of analysis demonstrates that readers make assumptions about the agent's thoughts, mental state, and intentions. Findings indicated that several areas of the brain were activated during both types of sentence—namely, left IFG, left superior temporal gyrus (STG), the premotor cortex, supplementary motor area proper, and the presupplementary motor area. These activations are supported by existing theory and are consistent with prior studies that revealed activation of the left language areas during sentence reading (IFG and STG) and areas of the motor cortex when readers process action words (Kana, Blum, Ladden, & Ver Hoef, 2012; Pulvermüller, Hauk, Nikulin, & Ilmoniemi, 2005). However, there were also important distinctions between sentence types, in that accidental sentences were likely to elicit a greater response from the left IFG, medial PFC, and the amygdala, the part of the brain that deals with emotions. Participants were also faster to determine intentional versus accidental actions. These findings provide evidence of increased neural demand for accidental action sentences, which has implications for young readers. Significantly, this study seeks to extend beyond current research to explore higher-level mental processes involved in reading.

One topic in this research area that has not been heavily examined is the role of brain maturation and neural circuitry in reading ability. Previous reviews have asserted that such analysis could provide important insight for researchers and educators (Byrnes & Vu, 2015). Current research increasingly explores the role of brain circuitry and its impact on reading ability (Jasińska et al., 2016). A unique recent study conducted by Jasińska et al. (2016) examined brain maturation and neural activation patterns based on the presence of genetic variations of the brain derived neurotrophic factor (BDNF) gene, which has been associated with brain plasticity, proliferation, and synaptic growth in a previous study (Cotman & Berchtold, 2002). Building on the psychological theory that WM is associated with reading comprehension (Byrnes & Wasik, 2009), the authors theorized that participants with the genotype associated with the highest BDNF levels, val allele carriers (val/val), would be more effective readers than met allele carriers (val/met and met/met). Findings indicated that val allele carriers had significantly better reading comprehension than met allele carriers. Further, significant differences emerged in brain activation, with met allele carriers showing greater activation in the VWFA, left IFG, left STG, and the hippocampus, a brain region commonly associated with memory. The authors attribute the greater activation in met allele carriers to increased effort to complete the tasks. This study elucidates the role of gene variations in the development of reading comprehension skills and is important to the development of a biological model of reading effectiveness.

Clinical Findings

Earlier it was noted that research has identified five areas of the left hemisphere that form themselves into an integrated network via long-distance connections in TD readers. Recent studies have shown aberrant developmental trajectories in the establishment and reorganization of these long-distance connections (Martin et al., 2016; Morken, Helland, Hugdahl, & Specht, 2017; Schurz et al., 2015). The typical pattern is to establish more connections than needed as a protective mechanism, combined with a reduction over time through reading experience. In dyslexic children, in contrast,

there are fewer connections initially, then an increase, and then some later reductions. There are also brain activations in other areas not associated with reading even in the right hemisphere. Such findings suggest compensatory mechanisms in dyslexic readers (Waldie, Wilson, Roberts, & Moreau, 2017). For example, dyslexic readers often show over-activation in areas related to visual processing and spatial images, which can compensate for difficulty in mapping sounds onto printed words.

In addition, a recent meta-analysis of fMRI studies comparing brain activations in TD and dyslexic readers found deviant activation primarily in the left hemisphere around the junction of the occipital and temporal lobes (Paulesu, Danelli, & Berlinger, 2014). Such findings confirm the results of many behavioral studies that show that the core deficit in dyslexia is a problem in phonological recoding (mapping letters to sounds; Byrnes & Wasik, 2009).

One other informative line of research has to do with apparent plasticity in the brains of dyslexic children following an intensive reading intervention. One study showed that an area of the frontal lobe important for reading (Broca's area) showed increased cortical thickness in dyslexic children following a 6-week summer intervention (Romeo et al., 2018).

Summary of Reading Research

As demonstrated here, many of the inconsistencies and usefulness issues lamented in previous reviews seem to be diminishing. Research in neuroscientific studies of reading is moving in a positive direction, increasing emphasis and broadening the field's understanding of neural mechanisms with new technology and less restrictive methods. In this way, studies are focusing increasingly on psychological theory, higher-level reading, reading networks, and increasing consideration of implications for educators. What remains are additional studies that examine how specific kinds of training can help to sculpt problematic kinds of connectivity such that struggling readers can become more proficient.

Autism Spectrum Disorder

Having examined recent research on two academic skills, mathematics and reading, and relevance for learners with related disabilities, we now turn to literatures on three developmental disabilities that are relatively high incidence but also have been studied most prolifically in neuroscience. ASD is a neurodevelopmental disorder, typically understood in terms of deficits in social interaction, communication, and a tendency towards repetitive or stereotyped interests and behaviors (Balsters, Mantini, & Wenderoth, 2017; Chen, Gau, Lee, & Chou, 2016; Turnbull, Turnbull, Wehmeyer, & Shogren, 2013). Additionally, the *Diagnostic and Statistical Manual of Mental Disorders*, 5th edition (DSM-5; American Psychiatric Association, 2013), has diagnostic criteria for ASD that include deficits in social-emotional reciprocity, abnormalities in eye contact and body language or deficits in the understanding and use of gestures, a lack of facial expressions or the ability to comprehend the facial expressions of others, absence of interest in peers, stereotyped or repetitive motor movements, an inflexible adherence to routines, and hyper- or hyporeactivity to sensory input or unusual interests in sensory aspects of the environment (American Psychiatric Association, 2013).

As a result of these deficits, children with ASD often have difficulties in areas including cognition, social behavior, motor skills, and motivation. These issues impact their academic trajectory and long-term outcomes, such as their abilities to hold a job, live alone, and maintain positive relationships. ASD does not only impact the individual, but also presents a substantial challenge for family members, teachers, and other caregivers (Liu et al., 2017). Rightfully, then, a good deal of research has been conducted to improve our understanding of the neuroscience underlying this disorder (see Gillies, Chapter 22, this volume).

Despite a high volume of research, there is generally little consensus on the cause or the overarching neural mechanisms of ASD (Igelström, Webb, & Graziano, 2016). However, several researchers have attempted to identify the brain areas or connectivity issues behind one or another of the basic features of the disorder. Perhaps not surprisingly, the prefrontal cortex is implicated in many studies (Ariza, Rogers, Hashemi, Noctor, & Martínez-Cerdeño, 2016). It is well established that much of what we call “personality” originates in the prefrontal cortex, with research asserting that this region is responsible for many of our social skills, along with executive functions such as cognition and memory (Byrnes, 2001). Findings suggest that the prefrontal cortex of children diagnosed with ASD, compared with that of their TD peers, may have decreased chandelier cells (Ariza et al., 2016), decreased connectivity to the hippocampus—an area of the brain associated with memory tasks (Cooper et al., 2017)—and decreased overall activation patterns (Murphy et al., 2014).

Other areas of interest include the cerebellum, an area that may relate to social perception (Igelström et al., 2016; Jack, Keifer, & Pelphrey, 2017), the fusiform face area, a part of the occipitotemporal cortex that research associates with facial recognition but also reading (Ewbank et al., 2016; Lassalle et al., 2017; Lynn et al., 2018), and the language network, including areas of the left IFG, and STG (Kana et al., 2017; Lee, Park, James, Kim, & Park, 2017). Across the board, differences were found between ASD and TD participants, indicating that individuals diagnosed with ASD have different patterns of brain connectivity and demonstrate different levels of activation compared with their TD peers.

Although the aforementioned studies do seem to confirm psychological theories in the sense that psychologists have identified a particular deficit (e.g., recognition of emotional facial expressions) and an aberrant brain response in an area that seems to be active when a skill is not deficient (e.g., less activation in the fusiform area of the temporal lobes), it is not clear that these studies have substantial information value as discussed earlier. If there were competing psychological theories about the true nature of the disorder, and neuroscientific studies helped to decide among these theories, such studies would have more information value. Or, if the studies helped to identify subtypes of ASD, as we shall see below in the section on CD, such studies would also have information value.

The stand-out issue, however, is that little is occurring in these studies that can help parents, caregivers, and teachers answer the question, “how do I help this child?” Indeed, much of this literature falls short of the expectations put forth in this chapter of informative educational research. Importantly, there are debates in the field regarding which research into the neural mechanisms of ASD could be beneficial for theory building. One such example is the recent change to the DSM-5 that eliminated the diagnosis of Asperger’s syndrome as a separate disorder that referred to people

who exhibit symptoms such as high intelligence but social awkwardness and obsessive focusing on certain topics. This abrupt change in language leaves many formerly diagnosed Asperger's patients with a new diagnosis: ASD. It would be useful to investigate whether there are structural or functional similarities in the brain that support a union of these diagnostic terms.

Several studies have emerged, however, where the goal was to consider whether the brains of children diagnosed with ASD showed any functional changes after children participated in interventions involving applied behavior analysis, social skills training, and pharmacological treatments (e.g., oxycontin). Areas of the brain related to social cognition such as the superior temporal sulcus (human motion detection), fusiform gyrus (face processing), amygdala (emotion processing), and orbital frontal region (planning and anticipation of reactions) all showed increased activity following such interventions compared with before (Ventola, Oosting, Anderson & Pelphrey, 2013). Findings such as these, combined with those identified as informative earlier in this section, once again show that the neuroscience of ASD still has a long way to go, but is moving in a positive direction.

Conduct Disorder

In contrast to ASD, which has been given considerable attention by researchers concerned with neuroscience and educational outcomes, relatively fewer studies have been conducted with children diagnosed with CD. This lack of attention occurs despite the fact that the prevalence of CD is estimated to be 7% of the population (Marsh, 2017). Children diagnosed with CD can be characterized as having considerable interpersonal difficulties that derive from their tendency to manipulate others in a deceitful manner, react in a hostile manner to perceived threats, violate social norms and rules regarding appropriate behavior, and act impulsively (DSM-5; American Psychiatric Association, 2013; Blair, Veroude, & Buitelaar, 2016; Frick, Ray, Thornton, & Kahn, 2014). Children diagnosed with CD are particularly resistant to therapeutic intervention and often run the risk of developing addictions, engaging in delinquent behavior as adolescents, and being diagnosed with antisocial personality disorder as adults (Blair et al., 2016; Marsh, 2017). The heritability of CD has been estimated from twin studies to be about 50%, suggesting an important environmental influence as well. Some psychologists have argued for a link between early adversity, harsh parenting, and later CD (Holz et al., 2017), though some neuroscientists have also encountered well-meaning but exasperated parents who bring their children to labs at agencies such as the National Institutes of Health because they express that they literally have run out of options and consider their children to be incorrigible and impossible to control (Marsh, 2017). In all likelihood, CD probably derives from combination of genetic and epigenetic environmental influences that interact in a reciprocal manner over time (Blair et al., 2016). For example, when one finds harsh parenting associated with CD, it is conceivable that CD traits elicit this parenting out of parents' frustration. However, harsh parenting, in turn, could exacerbate the expression of CD (Marsh, 2017).

A subgroup of children diagnosed with CD have been found to have the aforementioned manipulative, rule-breaking, reactive hostility and impulsive symptoms, but also callous-unemotional traits and a particular deficit in empathic concern for others (Blair et al., 2016; Cohn et al., 2016). Much of the recent neuroscientific work

on CD has attempted to identify possible neurological explanations of this disorder and to see if it is possible to use fMRI and other methods to distinguish between CD children who have the callous-unemotional traits and those who do not.

Blair et al. (2016) reviewed the neuroscientific literature and identified four brain systems that appear to be deficient in CD. The first system undergirds the ability to express empathy. One aspect of empathy is cognitive, where a person can understand the beliefs and intentions of others (put themselves in someone else's shoes). Cognitive and developmental psychologists refer to this ability as theory of mind (Carlson, Koenig, & Harms, 2013). The other aspect of empathy, however, is more affective and supports the ability to understand how someone would feel in a particular situation. When children diagnosed with CD and their TD peers are placed in an fMRI scanner, no differences are observed in activity levels of particular brain regions when they are asked to perform cognitive empathy tasks, but consistent differences are found when they are asked to perform affective empathy tasks (Blair et al., 2016). For the latter, those diagnosed with CD show under-activation in brain regions associated with emotional responding such as the amygdala and insula. Relatedly, there is a well-established finding that those diagnosed with CD show less activation when presented with faces expressing fear, but not other emotions, and also when shown people expressing pain (Blair et al., 2016; Marsh, 2017). When presented with stories that included moral transgressions, CD children not only rated the transgression as less serious, but once again showed less activation in the amygdala.

Besides the subtypes of CD who have or do not have callous-unemotional traits, there is also a distinct subgroup who have an associated high level of anxiety (Blair et al., 2016; Cohn et al., 2016). These children show a hyperreactivity to fear and lingering fear responses even after threats are removed and classical conditioning methods of extinction are used. These children show high levels of hostility in response to perceived threats. Findings suggest that these children often develop addictions as teenagers and adults, presumably to deal with their anxiety (Blair et al., 2016).

One additional research direction pertains to investigations of brain responses when CD children and their TD peers are engaged in decision-making tasks that include both rewards and punishments. Such tasks are frequently employed to study the apparent inability to learn and risk-taking tendencies of children diagnosed with CD and other disorders, such as ADHD. In this case, the key brain areas are the ventral striatum, the ventromedial frontal cortex, and the aforementioned amygdala and insula (Blair et al., 2016). Based on discrepant activation patterns in these regions, findings suggest a reduced sensitivity to rewards and a dysfunctional processing of punishment. The latter causes them to engage in activities that should be avoided because they lead to undesirable consequences. Regular encounters with these undesirable consequences, in turn, lead to high levels of frustration as well (Marsh, 2017).

Whereas all of these studies have produced informative results and helped to identify subgroups of children diagnosed with CD, none have really provided any new information about the cognitive and behavior problems exhibited by these children. In other words, we already knew these children broke rules, often lacked empathy, and reacted with hostility to perceived threats. The studies reviewed above simply report confirming evidence of prior non-neuroscientific studies in that one would expect to find exactly what these researchers did find: that, for example, brain areas associated with psychological traits such as empathy were less active. Moreover, the

studies, as yet, do not provide insight into more effective forms of treatment, and the incorrigibility of CD children's problematic behavior would lead some to interpret that there is nothing one can do with these children because of alleged hard-wired neurological defects. That said, many of the authors of neuroscientific articles on CD have argued that identifying the brain regions associated with CD symptomatology may eventually lead to pharmacological treatments that target the types of neuron that predominate in these brain regions (e.g., those that utilize norepinephrine as a neurotransmitter).

As noted above for ASD, dyslexia, and dyscalculia, research that reveals plasticity in the brain following effective treatments would be particularly informative for practitioners. Why is it, for example, that studies of interventions of dyscalculia and ASD have shown at least increases in functional connectivity, but little is known about effective treatments for CD and the plasticity associated with these effective treatments?

Attention-Deficit/Hyperactivity Disorder

As one further illustration of the potential utility and limitations of an educational neuroscience perspective, we consider ADHD. ADHD is defined in the DSM-5 as a disorder that can be manifested in three possible clusters of symptoms: (1) age inappropriate, debilitating symptoms of inattention and distractibility; (2) age-inappropriate, debilitating symptoms of hyperactivity and impulsivity; or (3) both sets of symptoms (American Psychiatric Association, 2013). This symptom-based definition can be contrasted with the more theoretical approach of Russell Barkley and others in which ADHD is defined as the inability to be self-regulated in pursuit of important goals (Barkley, 2006). ADHD is also no longer considered to be solely a childhood disorder, because longitudinal studies show that many individuals diagnosed with ADHD as children continue to manifest self-regulatory deficits as adults (Barkley, 2012; DuPaul, Weyandt, O'Dell, & Varejao, 2009; Shaw et al., 2013). Children and adults cannot be successful in high school or college if they have difficulty with being organized, thinking ahead, meeting deadlines, remembering appointments, inhibiting inappropriate or impulsive responses, staying focused, and avoiding being distracted. These tendencies could also affect social relationships if they are combined with several other symptoms of ADHD, such as the tendencies to interrupt others and exhibit lower levels of emotion regulation (Barkley, 2012).

The suggestion that the core deficit of ADHD pertains to self-regulation has prompted neuroscientists to conduct studies that focus on brain areas that have been associated with executive function (Rubia, 2018). Executive function is said to have three core components (i.e., WM, inhibition, and cognitive flexibility), and these core components could help people do such things as remember their goals, suppress inappropriate responses, and manage their attention (Barkley, 2012). In support of this claim, meta-analyses have shown that individuals diagnosed with ADHD show less activation in frontoparietal networks associated with both WM and sustained attention, and have also shown under-activation in fronto-striatal pathways related to behavioral inhibition (Rubia, 2018). It has also been shown that the structural and functional patterns associated with ADHD are distinct from the structural and functional patterns associated with obsessive-compulsive disorder (Norman et al., 2016). Nevertheless, many of the neuroscientific studies of ADHD merely report

such structural and functional patterns that essentially confirm the behavioral evidence. For example, if people diagnosed with ADHD have difficulties with being distracted, it is not particularly informative to show that brain areas associated with sustained attention are not strongly activated in individuals diagnosed with ADHD (Thomas, Ansari, & Knowland, 2018). What would be surprising was if these areas were strongly active.

An example of a study that provided new insights about ADHD is Shaw et al. (2013). These researchers wondered whether it was possible to find a neuroscientific explanation for the fact that attention problems persist into adulthood for only half of people who were diagnosed with ADHD in childhood or adolescence. To address this question, they conducted repeated MRI scans of the brains of participants who were diagnosed with ADHD and matched control participants from late adolescence until early adulthood. They found that for persisters, the level of severity of ADHD symptoms was linked to thinning in the medial and dorsolateral prefrontal cortex. In contrast, cortical thickening or less thinning was observed in the ADHD participants who remitted.

As was the case for other disorders described in this chapter, however, research findings and clinical outcomes for ADHD are complicated by problems in the diagnostic criteria used and the fact that ADHD can be comorbid with other diagnoses such as dyslexia, anxiety, and depression (Anastopoulos et al., 2018). So, when college students struggle academically, their problems may not only be due to self-regulatory problems, but may also be due to reading and emotional difficulties. Moreover, the emotional difficulties need not be assumed to have a common neurological basis shared with ADHD, because dysregulated people often find themselves panicking about missing deadlines and performing poorly in school. Such failure experiences could lead to anxiety, depression, and other factors related to school performance such as lower self-efficacy (Martin, Chapter 16, this volume; Martin, Burns, & Collie, 2017).

On the intervention side, studies have shown that certain medications can be effective for some children and adults with ADHD, but cognitive behavioral therapy (CBT) that focuses on self-management and self-perceptions has been effective for college students as well (Safren et al., 2010). What is needed are additional studies to see if long-term participation in CBT and other programs could lead to the development of functional brain systems that are more similar to those of non-ADHD children and adults. Medications, at present, only treat the symptoms, not the underlying structural and functional abnormalities.

Summary of ASD, CD, and ADHD

The foregoing summary of three disabilities suggests that recent neuroscientific research seems to be moving in promising directions for understanding reading and mathematics skills, but this does not appear to be the case for neuroscientific studies of disabilities such as ASD, CD, and ADHD. Studies of the latter more often focus on structural and functional abnormalities rather than only combining their neuroscientific results with behavioral results to test theories and contribute to scientific progress. What is particularly needed are neuroscientific studies that provide insight into more effective forms of intervention.

IMPLICATIONS FOR PRACTITIONERS AND RESEARCHERS

Although the field of neuroscience has moved beyond studies that simply identified brain regions that are active when TD and those diagnosed with a disability perform simple tasks such as reading single words, comparing the size of two digits, or looking at fearful expressions, there is still something of a “bridge too far,” as identified by John Bruer way back in 1997 (Bruer, 1997), when it comes to deriving clear implications for how to teach reading, how to teach math, or how to help children diagnosed with ASD, CD, or ADHD. We know, for example, *that* experience seems to sculpt the brain in ways that promote the development of functional brain networks to support reading skills, mathematics skills, and adaptive social interaction skills, but we do not know *how* the brain manages to pull off this feat. We need to know the optimal or typical initial state of the functional networks prior to the time that experience starts the sculpting process, and the processes within the brain that respond in optimal ways to this stimulation in order to know how to intervene to promote more favorable outcomes for both TD children and their disabled peers. If we find, for example, that three brain areas have to start out with a particular cortical thickness (an indicator of the number of neurons) and have particular ratios of short-distance connections within each area (3:1) and long-distance connections among the areas prior to instruction, and that practice of particular kinds (how often a skill is taught per week and in what manner) seems to sculpt the function network most efficiently, we can then have improved insight into how brain development differs for TD and non-TD children. If brain regions are too thick or too thin, or if pruning processes do not have their typical effects, more needs to be known about the biochemical processes that promote optimal pruning and interconnectivity so that medical interventions can be created. Such research may take years to complete (Thomas et al., 2018), but having this kind of mechanistic insight is crucial for knowing how neuroscience can contribute beyond statements about the nature and status of functional networks that support mathematics skills, reading skills, and social interaction skills.

Moreover, it is important to reemphasize the potential problems of looking, at the present time, to neuroscience for insight into educational successes and failures. When differences are observed between the brains of highly successful individuals (e.g., good readers) and their less successful peers (e.g., average readers or children with dyslexia), it can be easy to fall into the trap of determinism and conclude that there is nothing that can be done to eliminate performance differences or help children with disabilities.

As we wait for increased insight into mechanistic processes that sculpt the brain into functional networks, several kinds of intermediary study could move the field in promising new directions. For example, we know that heterogeneity exists for each of the disorders described in this chapter, and that it is possible to identify subtypes within each category that correspond to different brain system configurations (Blair et al., 2016; Byrd, Hawes, Burke, Loeber, & Pardini, 2018; Thomas et al., 2018). In line with response-to-intervention (RTI) strategies, it should be possible to determine whether responsiveness to particular kinds of treatment can be predicted from different brain system configurations. In fact, Byrd et al. (2018) found that it was possible to distinguish between children diagnosed with CD whose brains responded more

robustly to punishment and children diagnosed with CD whose brains did not respond to punishment so robustly. The former more readily responded to an effective form of intervention called “Stop Now and Plan” than the latter.

We also encourage researchers to continue to combine traditional, non-neuroscientific studies of learning and motivation with neuroscientific studies in order to help officiate between competing claims of psychological theories. For each of the disorders described in this chapter, there are ongoing debates about the underlying causes and manifestations of the disorder, as well as debates about whether the DSM-5 diagnostic criteria accurately capture each disorder. Much can be learned from synergistic cycles of studies in which the results of psychological studies could lead to hypotheses for neuroscientific studies, and vice versa (Thomas et al., 2018). Over time, we will gain a deeper understanding of the true nature of a given disorder.

CONCLUSION

We have come a long way since the 1960s and 1970s when it was argued that psychologists and special educators could learn little from neuroscientific research. A promising development has been to understand that psychological research and neuroscientific research can serve to constrain each other as well as open up new hypotheses about the causes and consequences of disorders that would not have been proposed prior to utilizing a combined psychological and neuroscientific approach (Thomas et al., 2018). Neuroscientific studies can not only serve to confirm the claims of a psychological theory (e.g., that the core deficit of ADHD is difficulty in self-regulation), but also open up new hypotheses regarding subtypes, new ways to think about a disorder, and RTI. It is remarkable how much has been learned over the past 30 years, and the field of educational neuroscience seems to be growing exponentially. There is still much to learn, but we remain optimistic that it is only a matter of time before a combined approach leads to new, effective forms of intervention.

REFERENCES

- Aboud, K. S., Bailey, S. K., Petrill, S. A., & Cutting, L. E. (2016). Comprehending text versus reading words in young readers with varying reading ability: Distinct patterns of functional connectivity from common processing hubs. *Developmental Science*, 19, 632–656. doi:10.1111/desc.12422
- Amalric, M., & Dehaene, S. (2018). Cortical circuits for mathematical knowledge: Evidence for a major subdivision within the brain’s semantic networks. *Philosophical Transactions of the Royal Society of Britain*, 373(1740). doi:10.1098/rstb.2016.0515
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5)*. Washington, DC: American Psychiatric Publications.
- Anastopoulos, A. D., King, K. A., Besecker, L. H., O’Rourke, S. R., Bray, A. C., & Supple, A. J. (2018). Cognitive-behavioral therapy for college students with ADHD: Temporal stability of improvements in functioning following active treatment. *Journal of Attention Disorders*. doi:10.1177/10870547177499
- Anderson, A. J., Binder, J. R., Fernandino, L., Humphries, C. J., Conant, L. L., Aguilar, M., ... Raizada, R. D. (2016). Predicting neural activity patterns associated with sentences using a neurobiologically motivated model of semantic representation. *Cerebral Cortex*, 27, 4379–4395. doi:10.1093/cercor/bhw240
- Anderson, J. R. (2016). A unified theory of mind. In R. J. Sternberg, S. T. Fiske, & D. J. Foss (Eds.), *Scientists making a difference: One hundred eminent behavioral and brain scientists talk about their most important contributions* (pp. 163–166). New York: Cambridge University Press.
- Ansari, D. (2008). Effect of development and enculturation on number representation in the brain. *Nature Reviews Neuroscience*, 9, 278–291. doi:10.1038/nrn2334

- Ariza, J., Rogers, H., Hashemi, E., Noctor, S. C., & Martínez-Cerdeño, V. (2016). The number of chandelier and basket cells are differentially decreased in prefrontal cortex in autism. *Cerebral Cortex*, 28, 411–420. doi:10.1093/cercor/bhw349
- Ashkenazi, S., Black, J. M., Abrams, D. A., Hoeft, F., & Menon, V. (2013). Neurobiological underpinnings of math and reading learning disabilities. *Journal of Learning Disabilities*, 46, 549–569.
- Baddeley, A. D., & Hitch, G. J. (1994). Developments in the concept of working memory. *Neuropsychology*, 8, 485–493.
- Balsters, J. H., Mantini, D., & Wenderoth, N. (2017). Connectivity-based parcellation reveals distinct cortico-striatal connectivity fingerprints in autism spectrum disorder. *NeuroImage*. doi:10.1016/j.neuroimage.2017.02.019
- Barkley, R. A. (2006). A theory of ADHD. In R. A. Barkley (Ed.), *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment* (3rd ed., pp. 297–334). New York: Guilford Press.
- Barkley, R. A. (2012). *Executive functions: What they are, how they work, and why they evolved*. New York: Guilford Press.
- Blair, R. J. R., Veroude, K., & Buitelaar, J. K. (2016). Neuro-cognitive system dysfunction and symptom sets: A review of fMRI studies in youth with conduct problems. *Neuroscience & Biobehavioral Reviews*. doi:10.1016/j.neubiorev.2016.10.022
- Bruer, J. T. (1997). Education and the brain: A bridge too far. *Educational Researcher*, 26, 4–16. doi: 10.2307/1176301
- Brunyé, T. T., Ditman, T., Mahoney, C. R., Augustyn, J. S., & Taylor, H. A. (2009). When you and I share perspectives: Pronouns modulate perspective taking during narrative comprehension. *Psychological Science*, 20, 27–32. doi:10.1111/j.1467-9280.2008.02249.x.
- Bulthé, J., Prinsen, J., Vanderauwera, J., Duyck, S., Daniels, N., Gillebert, C. R., ... DeSmedt, B. (2019). Multi-method brain imaging reveals impaired representations of number as well as altered connectivity in adults with dyscalculia. *NeuroImage*, 190, 289–302.
- Butterworth, B. (2017). The implications for education of an innate numerosity-processing mechanism. *Phil. Trans. R. Soc. B* 373: 20170118. <http://dx.doi.org/10.1098/rstb.2017.0118>.
- Byrd, A. L., Hawes, S. W., Burke, J. D., Loeber, R., & Pardini, D. A. (2018). Boys with conduct problems and callous-unemotional traits: Neural response to reward and punishment and associations with treatment response. *Developmental Cognitive Neuroscience*, 30, 51–59.
- Byrnes, J. P. (2001). *Minds, brains, and learning: Understanding the psychological and educational relevance of neuroscientific research*. New York: Guilford Press.
- Byrnes, J.P. (2008). *Cognitive development and learning in instructional contexts* (3rd ed.). Needham Heights, MA: Allyn & Bacon.
- Byrnes, J. P. (2012). How Neuroscience Contributes to Our Understanding of Learning and Development in Typically Developing and Special Needs Students. In K.R. Harris, S. Graham, & T. Urdan (Eds.), *APA Handbook on Educational Psychology* (pp. 561–595). Washington, DC: American Psychological Association.
- Byrnes, J. P., & Fox, N. A. (1998). The educational relevance of research in cognitive neuroscience. *Educational Psychology Review*, 10(3), 297–342. doi:10.1023/A:1022145812276.pdf
- Byrnes, J.P. & Vu, L.T. (2015). Educational neuroscience: Definitional, methodological, and interpretive issues. *Wiley Interdisciplinary Reviews: Cognitive Science*, 6(3), 221–234.
- Byrnes, J.P., Wang, A., & Miller-Cotto, D. (2019). Children as mediators of their own cognitive development in kindergarten. *Cognitive Development*, 50, 80–97.
- Byrnes, J. P., & Wasik, B. A. (2009). *Language and literacy development: What educators need to know*. New York: Guilford Press.
- Carey, S., Shusterman, A., Haward, P., & Distefano, R. (2017). Do analog number representations underlie the meanings of young children's verbal numerals? *Cognition*, 168, 243–255.
- Carlson, S. M., Koenig, M. A., & Harms, M. B. (2013). Theory of mind. *WIREs Cognitive Science*, 4, 391–402.
- Chen, P., Gau, S. S., Lee, S., & Chou, T. (2016). Differences in age-dependent neural correlates of semantic processing between youths with autism spectrum disorder and typically developing youths. *Autism Research*, 9, 1263–1273.
- Cohn, M. D., van Lith, K., Kindt, M., Pape, L. E., Doreleijers, T. A., van Den Brink, W., ... Popma, A. (2016). Fear extinction, persistent disruptive behavior and psychopathic traits: fMRI in late adolescence. *Social Cognitive and Affective Neuroscience*, 11, 1027–1035. doi:10.1093/scan/nsv067

- Cooper, R. A., Richter, F. R., Bays, P. M., Plaisted-Grant, K. C., Baron-Cohen, S., & Simons, J. S. (2017). Reduced hippocampal functional connectivity during episodic memory retrieval in autism. *Cerebral Cortex*, 27, 888–902. doi:10.1093/cercor/bhw417
- Cotman, C. W., & Berchtold, N. C. (2002). Exercise: A behavioral intervention to enhance brain health and plasticity. *Trends in Neurosciences*, 25, 295–301. doi:10.1016/S0166-2236(02)02143-4
- De Visscher, A., Szmalec, A., Van Der Linden, L., & Noël, M. P. (2015). Serial-order learning impairment and hypersensitivity-to-interference in dyscalculia. *Cognition*, 144, 38–48.
- Dehaene, S., Piazza, M., Pinel, P., & Cohen, L. (2003). Three parietal circuits for number processing. *Cognitive Neuropsychology*, 20, 487–506. doi:10.1080/02643290244000239
- DeSmedt, B., Noël, M. P., Gilmore, C., & Ansari, D. (2013). How do symbolic and non-symbolic numerical magnitude processing skills relate to individual differences in children's mathematical skills? A review of evidence from brain and behavior. *Trends in Neuroscience and Education*, 2, 48–55.
- DuPaul, G. J., Weyandt, L. L., O'Dell, S. M., & Varejao, M. (2009). College students with ADHD: Current status and future directions. *Journal of Attention Disorders*, 13, 234–250.
- Ewbank, M. P., Pell, P. J., Powell, T. E., von Dem Hagen, E. A., Baron-Cohen, S., & Calder, A. J. (2016). Repetition suppression and memory for faces is reduced in adults with autism spectrum conditions. *Cerebral Cortex*, 27, 92–103. doi:10.1093/cercor/bhw373
- Fias, W., Menon, V., & Szucs, D. (2013). Multiple components of developmental dyscalculia. *Trends in Neuroscience and Education*, 2, 43–47.
- Frick, P. J., Ray, J. V., Thornton, L. C., & Kahn, R. E. (2014). Can callous-unemotional traits enhance the understanding, diagnosis, and treatment of serious conduct problems in children and adolescents? A comprehensive review. *Psychological Bulletin*, 140, 1–57. doi:10.1037/a0033076
- Geary, D. C., & vanMarle, K. (2018). Growth of symbolic number knowledge accelerates after children understand cardinality. *Cognition*, 177, 69–78.
- Hartung, F., Hagoort, P., & Willems, R. M. (2017). Readers select a comprehension mode independent of pronoun: Evidence from fMRI during narrative comprehension. *Brain and Language*, 170, 29–38. doi:10.1016/j.bandl.2017.03.007
- Henson, R. (2005). What can functional neuroimaging tell the experimental psychologist? *The Quarterly Journal of Experimental Psychology Section A*, 58(2), 193–233. doi:10.1080/02724980443000502
- Holz, N. E., Boecker-Schlier, R., Buchmann, A. F., Blomeyer, D., Jennen-Steinmetz, C., Baumeister, S., ... Schmidt, M. (2017). Ventral striatum and amygdala activity as convergence sites for early adversity and conduct disorder. *Social Cognitive and Affective Neuroscience*, 12, 261–272. doi:10.1093/scan/nsw120
- Howard-Jones, P. A., Varma, S., Ansari, D., Butterworth, B., De Smedt, B., Goswami, U., ... Thomas, M. S. C. (2016). The principles and practices of educational neuroscience: Commentary on Bowers (2016). *Psychological Review*, 123, 620–627.
- Igelström, K. M., Webb, T. W., & Graziano, M. S. (2016). Functional connectivity between the temporoparietal cortex and cerebellum in autism spectrum disorder. *Cerebral Cortex*, 27, 2617–2627. doi:10.1093/cercor/bhw079
- Jack, A., Keifer, C. M., & Pelphrey, K. A. (2017). Cerebellar contributions to biological motion perception in autism and typical development. *Human Brain Mapping*, 38, 1914–1932. doi:10.1002/hbm.23493
- Jangraw, D. C., Gonzalez-Castillo, J., Handwerker, D. A., Ghane, M., Rosenberg, M. D., Panwar, P., & Bandettini, P. A. (2018). A functional connectivity-based neuromarker of sustained attention generalizes to predict recall in a reading task. *NeuroImage*, 166, 99–109. doi:10.1016/j.neuroimage.2017.10.019
- Jasińska, K. K., Molfese, P. J., Kornilov, S. A., Mencl, W. E., Frost, S. J., Lee, M., ... Landi, N. (2016). The BDNF Val66Met polymorphism influences reading ability and patterns of neural activation in children. *PloS One*, 11(8). doi:10.1371/journal.pone.0157449
- Jolles, D., Ashkenazi, S., Kochalka, J., Evans, T., Richardson, J., Rosenberg-Lee, M., ... Menon, V. (2016). Parietal hyper-connectivity, aberrant brain organization, and circuit-based biomarkers in children with mathematical disabilities. *Developmental Science*, 19, 613–631. doi:10.1111/desc.12399
- Kana, R. K., Ammons, C. J., Doss, C. F., Waite, M. E., Kana, B., Herringshaw, A. J., & Ver Hoef, L. (2015). Language and motor cortex response to comprehending accidental and intentional action sentences. *Neuropsychologia*, 77, 158–164. doi:10.1016/j.neuropsychologia.2015.08.020
- Kana, R. K., Blum, E. R., Ladden, S. L., & Ver Hoef, L. W. (2012). "How to do things with words": Role of motor cortex in semantic representation of action words. *Neuropsychologia*, 50, 3403–3409. doi:10.1016/j.neuropsychologia.2012.09.006

- Kana, R. K., Sartin, E. B., Stevens, C., Jr, Deshpande, H. D., Klein, C., Klinger, M. R., & Klinger, L. G. (2017). Neural networks underlying language and social cognition during self-other processing in autism spectrum disorders. *Neuropsychologia*, 102, 116–123. doi:10.1016/j.neuropsychologia.2017.06.008
- Kaufmann, L., Wood, G., Rubinsten, O., & Henik, A. (2011). Meta-analyses of developmental fMRI studies investigating typical and atypical trajectories of number processing and calculation. *Developmental Neuropsychology*, 36, 763–787.
- Krieger-Redwood, K., & Jefferies, E. (2014). TMS interferes with lexical-semantic retrieval in left inferior frontal gyrus and posterior middle temporal gyrus: Evidence from cyclical picture naming. *Neuropsychologia*, 64, 24–32.
- Landerl, K., Göbel, S. M., & Moll, K. (2013). Core deficit and individual manifestations of developmental dyscalculia (DD): The role of comorbidity. *Trends in Neuroscience and Education*, 2, 38–42.
- Lassalle, A., Åsberg Johnels, J., Zürcher, N. R., Hippolyte, L., Billstedt, E., Ward, N., ... Hadjikhani, N. (2017). Hypersensitivity to low intensity fearful faces in autism when fixation is constrained to the eyes. *Human Brain Mapping*, 38, 5943–5957. doi:10.1002/hbm.23800
- Lee, Y., Park, B. Y., James, O., Kim, S. G., & Park, H. (2017). Autism spectrum disorder related functional connectivity changes in the language network in children, adolescents and adults. *Frontiers in Human Neuroscience*, 11, 418. doi:10.3389/fnhum.2017.00418
- Liu, T., Liu, X., Li, Y., Zhu, C., Markey, P. S., & Pelowski, M. (2017). Assessing autism at its social and developmental roots: A review of autism spectrum disorder studies using functional near-infrared spectroscopy. *NeuroImage*. doi:10.1016/j.neuroimage.2017.09.044
- Lynn, A. C., Padmanabhan, A., Simmonds, D., Foran, W., Hallquist, M. N., Luna, B., & O’Hearn, K. (2018). Functional connectivity differences in autism during face and car recognition: Underconnectivity and atypical age-related changes. *Developmental Science*, 21, n/a, e12508. doi:10.1111/desc.12508
- Marr, D. (1982). *Vision: A computational investigation into the human representation and processing of visual information*. San Francisco, CA: Freeman.
- Marsh, A. (2017). *The fear factor: How one emotion connects altruists, psychopaths, and everyone in-between*. New York: Basic Books.
- Martin, A., Kronbichler, M., & Richlan, F. (2016). Dyslexic brain activation abnormalities in deep and shallow orthographies: A meta-analysis of 28 functional neuroimaging studies. *Human Brain Mapping*, 37, 2676–2699.
- Martin, A. J., Burns, E. C., & Collie, R. J. (2017). ADHD, personal and interpersonal agency, and achievement: Exploring links from a social cognitive theory perspective. *Contemporary Educational Psychology*, 50, 13–22.
- Matejko, A. A., & Ansari, D. (2017). How do individual differences in children’s domain specific and domain general abilities relate to brain activity within the intraparietal sulcus during arithmetic? An fMRI study. *Human Brain Mapping*, 38, 3941–3956. doi:10.1002/hbm.23640
- Mayer, R. E. (2013). Problem solving. In D. Reisberg (Ed.), *The Oxford handbook of cognitive psychology* (pp. 769–777). New York: Oxford University Press.
- McCarthy, R., & Warrington, E. K. (1990). *Cognitive neuropsychology: A clinical introduction*. San Diego, CA: Academic Press.
- Metcalf, A. W., Ashkenazi, S., Rosenberg-Lee, M., & Menon, V. (2013). Fractionating the neural correlates of individual working memory components underlying arithmetic problem-solving skills in children. *Developmental Cognitive Neuroscience*, 6, 162–175. doi:10.1016/j.dcn.2013.10.001
- Michels, L., O’Gorman, R., & Kucian, K. (2018). Functional hyperconnectivity vanishes in children with developmental dyscalculia after numerical intervention. *Developmental Cognitive Neuroscience*, 30, 291–303.
- Molfese, D. L., Molfese, V. J., & Kelly, S. (2001). The use of brain electrophysiology techniques to study language: A basic guide for the beginning consumer of electrophysiology information. *Learning Disability Quarterly*, 24, 177–188.
- Morken, F., Helland, T., Hugdahl, K., & Specht, K. (2017). Reading in dyslexia across literacy development: A longitudinal study of effective connectivity. *NeuroImage*, 144, 92–100.
- Murphy, C. M., Christakou, A., Daly, E. M., Ecker, C., Giampietro, V., Brammer, M., ... Murphy, D. G. (2014). Abnormal functional activation and maturation of fronto-striato-temporal and cerebellar regions during sustained attention in autism spectrum disorder. *American Journal of Psychiatry*, 171, 1107–1116. doi:10.1002/hbm.23718
- Neisser, U. (1967). *Cognitive psychology*. New York: Appleton-Century-Crofts.

- Nelson, C. A. (2016). Introduction to special issue on the role of connectivity in developmental disorders: Genetic and neural network approaches. *Developmental Science*, 19, 523.
- Norman, L. J., Carlisi, C., Lukito, S., Hart, H., Mataix-Cols, D., Radua, J., & Rubia, K. (2016). Structural and functional brain abnormalities in attention-deficit/hyperactivity disorder and obsessive-compulsive disorder: A comparative meta-analysis. *JAMA Psychiatry*, 73, 815–825. doi:10.1111/desc.12477
- Park, J., Li, R., & Brannon, E. M. (2014). Neural connectivity patterns underlying symbolic number processing indicate mathematical achievement in children. *Developmental Science*, 17, 187–202. doi:10.1111/desc.12114
- Paulesu, E., Danelli, L., & Berlinger, M. (2014). Reading the dyslexic brain: Multiple dysfunctional routes revealed by a new meta-analysis of PET and fMRI activation studies. *Frontiers in Human Neuroscience*, 8, 1–20. article 830.
- Peng, P., Namkung, J., Barnes, M., & Sun, C. (2016). A meta-analysis of mathematics and working memory: Moderating effects of working memory domain, type of mathematics skill, and sample characteristics. *Journal of Educational Psychology*, 108, 455–473. doi:10.1037/edu0000079
- Price, C. J. (2012). A review and synthesis of the first 20 years of PET and fMRI studies of heard speech, spoken language and reading. *NeuroImage*, 62, 816–847. doi:10.1016/j.neuroimage.2012.04.062
- Price, G. R., & Ansari, D. (2013). Dyscalculia: Characteristics, causes, and treatments. *Numeracy*, 6, 1–16. doi:10.5038/1936-4660.6.1.2
- Ptito, M., Kupers, R., Lomber, S., & Pietrini, P. (2012). Sensory deprivation and brain plasticity. *Neural Plasticity*, 2012. doi:10.1155/2012/810370
- Pulvermüller, F., Hauk, O., Nikulin, V. V., & Ilmoniemi, R. J. (2005). Functional links between motor and language systems. *European Journal of Neuroscience*, 21, 793–797. doi:10.1111/j.1460-9568.2005.03900.x
- Putnam, H. (1973). Reductionism and the nature of psychology. *Cognition*, 2, 131–146. doi:10.1016/0010-0277(72)90033-9
- Pyke, A. A., Fincham, J. M., & Anderson, J. R. (2017). When mathematics operations have visuospatial meanings versus purely symbolic definitions: Which solving stages and brain regions are affected? *NeuroImage*, 153, 319–335. doi:10.1016/j.neuroimage.2017.03.046
- Remer, J., Croteau-Chonka, E., Dean, D. C., III, D'arpino, S., Dirks, H., Whiley, D., & Deoni, S. C. (2017). Quantifying cortical development in typically developing toddlers and young children, 1–6 years of age. *NeuroImage*, 153, 246–261. doi:10.1016/j.neuroimage.2017.04.010
- Rittle-Johnson, B., Schneider, M., & Star, J. R. (2015). Not a one-way street: Bidirectional relations between procedural and conceptual knowledge of mathematics. *Educational Psychology Review*, 27, 587–597. doi:10.1007/s10648-015-9302-x
- Romeo, R. R., Christodoulou, J. A., Halverson, K. K., Murtagh, J., Cyr, A. B., Schimmel, C., ... Gabrieli, J. D. E. (2018). Socioeconomic status and reading disability: Neuroanatomy and plasticity in response to intervention. *Cerebral Cortex*, 28, 2297–2312.
- Rubia, K. (2018). Cognitive neuroscience of attention deficit hyperactivity disorder (ADHD) and its clinical translation. *Frontiers in Human Neuroscience*, 12, 1–23.
- Safren, S. A., Sprich, S., Mimiaga, M. J., Surman, C., Knouse, L., Groves, M., & Otto, M. W. (2010). Cognitive behavioral therapy vs relaxation with educational support for medication-treated adults with ADHD and persistent symptoms: A randomized controlled trial. *JAMA: Journal of the American Medical Association*, 304, 875–880.
- Schlaggar, B. L., & McCandliss, B. D. (2007). Development of neural systems for reading. *The Annual Review of Neuroscience*, 30, 475–503. doi:10.1146/annurev.neuro.28.061604.135645
- Schurz, M., Wimmer, H., Richlan, F., Ludersdorfer, P., Klackl, J., & Kronbichler, M. (2015). Resting-state and task-based functional brain connectivity in developmental dyslexia. *Cerebral Cortex*, 25, 3502–3514.
- Shaw, P., Greenstein, D., Lerch, J., Clasen, L., Lenroot, R., Gogtay, N. E. E. A., ... Giedd, J. (2006). Intellectual ability and cortical development in children and adolescents. *Nature*, 440(7084), 676–679. doi:10.1038/nature04513
- Shaw, P., Kabani, N. J., Lerch, J. P., Eckstrand, K., Lenroot, R., Gogtay, N., ... Giedd, J. N. (2008). Neurodevelopmental trajectories of the human cerebral cortex. *Journal of Neuroscience*, 28, 3586–3594. doi:10.1523/JNEUROSCI.5309-07.2008
- Shaw, P., Malek, M., Watson, B., Greenstein, D., de Rossi, P., & Sharp, W. (2013). Trajectories of cerebral cortical development in childhood and adolescence and adult attention-deficit/hyperactivity disorder. *Biological Psychiatry*, 74, 599–606.

- Smith, E. E., Jonides, J., & Koeppe, R. A. (1996). Dissociating verbal and spatial working memory using PET. *Cerebral Cortex*, 6, 11–20. www.ncbi.nlm.nih.gov/pubmed/8670634
- Sokolowski, H. M., Fias, W., Mousa, A., & Ansari, D. (2017). Common and distinct brain regions in both parietal and frontal cortex support symbolic and nonsymbolic number processing in humans: A functional neuroimaging meta-analysis. *NeuroImage*, 146, 376–394. doi:10.1016/j.neuroimage.2016.10.028
- Sood, M. R., & Sereno, M. I. (2016). Areas activated during naturalistic reading comprehension overlap topological visual, auditory, and somatotomotor maps. *Human Brain Mapping*, 37, 2784–2810. doi:10.1002/hbm.23208
- Squire, L. R. (1987). The organization and neural substrates of human memory. *International Journal of Neurology*, 21, 218–222.
- Steinberg, L. (2008). A social neuroscience perspective on adolescent risk-taking. *Developmental Review*, 28, 78–106. doi:10.1016/j.dr.2007.08.002
- Taylor, J. S. H., Davis, M. H., & Rastle, K. (2017). Comparing and validating methods of reading instruction using behavioural and neural findings in an artificial orthography. *Journal of Experimental Psychology: General*, 146, 826–858. doi:10.1037/xge0000301
- Thomas, M. S. C., Ansari, D., & Knowland, V. C. P. (2018). Annual research review: Educational neuroscience: progress and prospects. *Journal of Child Psychology and Psychiatry*. doi:10.1111/jcp.12973
- Tian, J., & Siegler, R. S. (2017). Fractions learning in children with mathematics difficulties. *Journal of Learning Disabilities*, 50, 614–620.
- Turnbull, A., Turnbull, R., Wehmeyer, M. L., & Shogren, K. A. (2013). *Exceptional lives: Special education in today's schools*. Boston, MA: Pearson.
- Ullman, H., & Klingberg, T. (2017). Timing of white matter development determines cognitive abilities at school entry but not in late adolescence. *Cerebral Cortex*, 27, 4516–4522. doi:10.1093/cercor/bhw256
- Ventola, P. E., Oosting, D., Anderson, L. C., & Pelphey, K. A. (2013). Brain mechanisms of plasticity in response to treatments for core deficits in autism. *Progress in Brain Research*, 207, 255–272.
- Waldie, K. E., Wilson, A. J., Roberts, R. P., & Moreau, D. (2017). Reading network in dyslexia: Similar, yet different. *Brain and Language*, 174, 29–41.
- Willcutt, E., Petrill, S. A., Wu, S., Boada, R., DeFries, J. C., Olson, R. K., & Pennington, B. F. (2013). Comorbidity between reading disability and math disability: Concurrent psychopathology, functional impairment, and neuropsychological functioning. *Journal of Learning Disabilities*, 46, 500–516.
- Zhou, X., Li, M., Li, L., Zhang, Y., Cui, J., Liu, J., & Chen, C. (2018). The semantic system is involved in mathematical problem solving. *NeuroImage*, 166, 360–370. doi:10.1016/j.neuroimage.2017.11.017

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CONCLUSION

Future Directions in the Application of Educational Psychology to Students with Special Needs

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INTRODUCTION

The bulk of educational psychology theory, research, measurement, and practice has been directed to what we might refer to as “mainstream” or “typically” developing learners. Far less of educational psychology’s attention has been directed to at-risk students and students with special needs. Because educational psychology is centrally concerned with the factors and processes implicated in learning, this dearth of scholarly attention to students with special needs is a major gap in current understanding. This handbook directly addresses this gap and thus seeks to provide researchers and practitioners with timely and important knowledge and insights into the factors and processes relevant to learning for students with special needs. As demonstrated by the chapters in this volume, educational psychology can substantially augment current understanding of students with special needs. Indeed, in many chapters, it is evident that a psycho-educational lens on special needs can also contribute to knowledge and practice in developmental psychology, school psychology, and counseling psychology—as well as educational (e.g., special education), rehabilitation, and medical (e.g., pediatric) fields.

The chapters in this volume provide substantial direction for future theory, research, measurement, and practice. This being the case, in this closing chapter, we take the opportunity to look ahead at what we believe educational psychology suggests for future researchers and practitioners as they seek to optimize the educational outcomes of students with special needs. We explore these future directions from a number of perspectives. Initially, we consider future conceptualization and measurement. Here, we address theoretical, definitional, diagnostic, and assessment issues. Following this, we consider research and practice issues. This encompasses guidance for future samples, factors, and processes relevant to psycho-educational research into special needs. It also encompasses considerations for future practice and intervention in this space.

CONCEPTUALIZING TO BETTER UNDERSTAND STUDENTS WITH SPECIAL NEEDS

Many researchers agree that there is a relative dearth of psycho-educational theorizing brought to students with special needs. It is worth recognizing that seminal educational psychology theories were not initially developed with special needs or disability central to their formulation. These theories are, thus, more organically connected to “mainstream” populations; there is a need to interrogate the theories’ key tenets and assess the extent to which they can be applied to students with special needs.

As an example, O’Donnell and Reschly (Chapter 23) note that the meta-construct of “engagement” and the specific subtypes of engagement have received little attention from a special needs perspective. There is a need to collect engagement data from multiple sources, including from students with special needs, and to examine the extent to which engagement is universal and where it may have a particular construction or application for students with special needs. Additionally, whereas engagement trajectories and pathways have been quite well articulated in research among mainstream students, O’Donnell and Reschly emphasize that we cannot be sure whether the same developmental pattern holds for students with special needs. Knowing whether the same pattern holds has important implications for when and how to implement engagement interventions for students with special needs.

Notwithstanding this history, there are some more recent conceptual positions that have drawn on special needs populations in their development. Wehmeyer and Shogren (Chapter 12), for example, identify causal agency theory as one such framework. Building on self-determination theory, causal agency theory was developed and evaluated within a special needs context. Such theories may thus have particular merit when one is attempting to research and support the psycho-educational development of students with special needs.

There are new and emerging psycho-educational theories and conceptual frameworks that offer promise for further understanding students with special needs. However, as these conceptual perspectives develop and are refined, there is a need for research to establish their validity and explanatory power on the special needs landscape. Thus, for example, Pekrun and Loderer (Chapter 18) identified control-value theory (CVT) as an emerging theory that has merit in assisting research and practice among students with special needs. They rightly note that, as this research unfolds, it is important to establish the boundary conditions of CVT as relevant to disability and what unique space CVT occupies compared with other psycho-educational theories. Cassady and Thomas (Chapter 3) share the emotion information processing framework, an extension of existing cognitive and social cognitive models, to illuminate the cognitive and emotional processing of students with academic anxieties. Similarly, Panlilio and Corr (Chapter 9) present an expansion of Zimmerman’s self-regulated learning model to convey direct and indirect effects of early adversity and maltreatment on academic achievement. These frameworks provide opportunities for important theoretical expansion and testing as explanatory tools for future research.

Major educational psychology theories also identify specific learning effects that offer some promise for research among students with special needs. For example, Tricot, Vandenbroucke, and Sweller (Chapter 15) point to the need for further research

into the modality effect, the transient information effect, and the working memory resource depletion effect among students with dyslexia. There is also the potential for formulating instructional frameworks based on psycho-educational theory. Tricot et al. and Martin (Chapter 16), for example, describe “load reduction instruction” as an instructional approach harnessing key elements of cognitive load theory that has potential for improving research and practice among students with special needs.

Finally, there has been notable theoretical heterogeneity for some constructs that undermine the ability of researchers to explain and understand areas of special needs. Follmer and Sperling (Chapter 5) identify this as the case for executive functioning, and they urge more research into gaining better clarity on key constructs and better identifying their distinctiveness to gain clearer conceptual and operational frameworks. This kind of clarity can assist researchers in understanding the role of executive functions for specific disorders and disabilities.

MEASUREMENT, ASSESSMENT, AND DIAGNOSIS

There are also diagnostic challenges requiring attention. There can be a lack of consensus on the precise nature of children’s difficulties, which has implications for how effectively we can assist these children. For example, Cassady and Thomas (Chapter 3) identified that a lack of consensus in relation to students’ emotional and affective disorders can hamper collaboration among researchers and practitioners and can also hamper targeted intervention. Hue (Chapter 10) also noted challenges in defining, identifying, and assessing behavioral disorders, while recognizing that these challenges influence the potential supports and interventions for students identified with emotional and behavioral disorders.

At the same time, future research and practice must guard against overly broad definitions and conceptualizations of special needs and ensure that appropriate nuance and differentiation are applied when appropriate. As one example, Sigafoos, Green, O’Reilly, and Lancioni (Chapter 8) note the definitional challenges corresponding to developmental disabilities. Although defined as severe and chronic, specific conditions included within the umbrella of developmental disability diagnosis vary considerably. Such definitional challenges impact identification and research on the specificity of effective interventions. Similarly, in relation to attention-deficit/hyperactivity disorder (ADHD), there are distinct presentation subtypes, and there are distinct psycho-educational implications relevant to each subtype. In addition, as research in areas of disability progresses, new dimensions and subtypes of some disabilities will be identified. For example, Martin (Chapter 16) notes “concentration deficit disorder” (or “sluggish cognitive tempo”) as an emerging diagnosis cognate to ADHD. In the case of new or emerging disability subtypes, researchers will need to ensure rigorous methods to enable valid diagnosis and identification. At the same time, to stay abreast of the research, practitioners will need to be made aware of these research and diagnostic developments as relevant to student learning.

In diagnostic efforts, it is suggested that, alongside formal and clinical criteria, such as under the *Diagnostic and Statistical Manual of Mental Disorders*, Version 5 (DSM-5) and the International Classification of Diseases—10, 2016 version (ICD-10), educational psychologists are well placed to offer approaches for formative assessment

of disability or aspects of disability. Perry, Mazabel, and Yee (Chapter 13), for example, report psycho-educational possibilities for formatively assessing self-regulation problems for students with learning disability, and these would no doubt also apply to students with (related) executive function disorders.

In addition, educational psychology offers somewhat unique opportunities to consider otherwise neglected disorders and disabilities on the academic landscape. For example, Pekrun and Loderer (Chapter 18) identified achievement emotion disorder as a possible line of diagnosis and intervention. They make the point that extreme levels of maladaptive achievement-related emotion may be considered an achievement-related emotion disorder. Thus, for example, extreme levels of anger, frustration, and boredom that significantly impede academic functioning may constitute achievement emotional disorders. In advancing this thesis, Pekrun and Loderer posit the need for further research into major dimensions of anger, frustration, and boredom—particularly with regard to prevalence, comorbidity, juxtaposition with general emotional disorders, personal and social factors that give rise to them, relative universality, and successful interventions and educational practices.

There are exciting breakthroughs in neuropsychology that have potential for assisting in the diagnosis of some disabilities and in mapping the development of particular disorders. For example, alongside traditional assessments of ADHD (e.g., teacher report, parent report, executive functioning assessment, etc.), neural imaging can offer some additional insight into regions of the brain that are (or are not) implicated in the condition. Byrnes and Eaton (Chapter 27) have also identified how neuroscience can be used to identify different brain system configurations that are responsive to different educational interventions.

However, Byrnes and Eaton rightly note that there is still a good way to go in both brain-based measurement and interventions following from it. Byrnes and Eaton also observe that we need to know more about the biochemical processes implicated in optimal pruning and interconnectivity so that medical interventions can be created; but, even then, the effects on academic development need to be established so we know the place of these medical interventions in theory and practice in education and educational psychology.

Byrnes and Eaton also advise that we guard against seeing any brain-based or biochemical differences between students as evidence that not much can be done to improve the learning of students with special needs. In this handbook, substantial evidence has been provided to show that there is much that can be done to assist these students' academic outcomes. When conducting neuroscientific research, Byrnes and Eaton suggest it is critically important to combine traditional non-neuroscientific studies of learning with neuroscientific studies in order to disentangle key factors implicated in both that can assist students with special needs.

PARTICIPANTS TO INCLUDE AND INVESTIGATE

It is important to investigate special needs among critical minority groups where services are likely to be limited and when their minority status may amplify the negative effects of their special need (or vice versa). English language learners are one such group. Swanson (Chapter 2; see also Dockrell & Lindsay, Chapter 6; Hall, Capin,

Vaughn, & Cannon, Chapter 7), for example, identifies the fact that these students have lower reading and mathematics scores, and there is a need for investigations separating working memory deficits from deficits related to their language acquisition. Other directions include assessing the extent to which cognitive (and other) processes, as relevant to learning, generalize across special needs or learners. For example, Swanson posed the question as to whether memory processes implicated in reading extend beyond the phonological domain, and whether these processes are the same or different for monolingual and bilingual students with learning difficulties.

Twice-exceptional students also need additional attention. Twice-exceptional students are those who are identified as gifted but also have special needs. As noted by Follmer and Sperling (Chapter 5), gifted students can have executive function difficulties. Similarly, Martin (Chapter 16) identified twice exceptionality as relevant to students with ADHD. With proper supports or accommodations (e.g., extended time), these students may excel academically. Inevitably, twice exceptionality presents a complex picture, and understanding these students may provide insight into psycho-educational theories and constructs. For example, neural imaging research comparing students with dyscalculia to mathematically gifted students with executive function impairments may help clarify the role of executive functions in academic achievement.

The bulk of research into special needs quite reasonably focuses on students with formally identified clinical conditions. Indeed, as relevant to educational psychology, more knowledge about these students is needed. However, a somewhat under-investigated group comprises those students with subclinical (or subthreshold) levels of a special need. Subclinical students do not quite make the threshold of clinical diagnosis, yet are likely to experience some degree of difficulty on key psycho-educational factors and academic outcomes. Thus, for example, there will be students with subclinical levels of ADHD (e.g., mild self-regulatory and executive function difficulties), and, to the extent that educational psychology can assist students with formally diagnosed ADHD (see Martin, Chapter 16), it can also assist subclinical students. This is true, too, for those with varied degrees of behavioral difficulties, as noted by Hue (Chapter 10).

There are some dimensions of special need receiving relatively less research attention than others. For example, dyscalculia seems to have received less attention than dyslexia. Thus, Morsanyi (Chapter 21) points to the need for further empirical attention to be paid to students with dyscalculia, including the roles of different reasoning skills, spatial skills, and manipulatives (alongside training in mathematical concepts). There is also a need for larger and more representative samples. Although often difficult to achieve, larger and more representative samples will better ensure that we are deriving findings and making recommendations that represent the population of students with a specific special need, and that we are making appropriate generalizations to these students.

A good deal of research into psycho-educational phenomena has been conducted among college samples and, thus, may not seem relevant to students with special needs. However, there are significant numbers of college students with special needs—indeed, some of these disorders (e.g., emotional or affective disorders) may manifest for the first time during students' college years (late teens and early 20s). Or, for the first time in their life, a college student may be ready to seek information (and possible

diagnosis of) a condition that has been affecting their life to this point. Future research and practice might, thus, further attend to students with special needs in post-school pathways.

Finally, there is too little research deeply and broadly including the voices of students with special needs. Much research into students with special needs still relies on others' reports and observations of these students. As noted by Strnadová (Chapter 4), although this approach has been informative, greater research participation by students with special needs is critical for full understanding of these students' opinions, expectations, perspectives, and lived experiences. Indeed, moving beyond these students being the objects of psycho-educational research, investigations might include students with special needs in co-researcher (or advisory) roles. This type of research is happening in fields such as special education; inclusive research along these lines is now important for educational psychology to extend its insights into learning among diverse students.

FACTORS AND PROCESSES TO RESEARCH AND TARGET

Alongside future efforts directed at theory, diagnosis, and samples, there are many specific psycho-educational factors and processes deserving of more conceptual and practical attention. For example, there is a need to better understand how psycho-educational moderators and mediators affect the academic development of students with special needs. We know that disability can often negatively impact students' academic outcomes, but there may be factors that can buffer these negative effects. For example, perhaps intervention around self-efficacy and social-emotional competence may buffer the negative effects of anxiety or depression on learning. Related to this, Wigfield and Ponnock (Chapter 17) point to the challenges of relatively low uptake of psycho-educational intervention in schools. They suggest that, in part, there is low uptake because psycho-educational intervention may successfully target a disability or disorder, but may not assist educational outcomes. That is, the psycho-educational intervention may reduce anxiety but not enhance achievement. Thus, identifying factors that can also promote educational outcomes for these students is important.

In a related vein, investigating proximal factors that impact distal outcomes is an avenue for further research. The issue of situational specificity may be relevant here, with some immediate factors (e.g., school subject, relationships in the classroom, etc.) promoting or inhibiting subsequent academic outcomes for students with special needs. Panlilio and Corr (Chapter 9), for example, point to different school subjects and the distinct self-regulatory processes involved in them that may affect learning for students with special needs.

Similar to the idea of proximal factors, Perry et al. (Chapter 13) describe micro-level factors that are important to address for students with special needs. These relate, for example, to specific processes and instructional strategies that can enhance the self-regulation of students with special needs. Importantly, Perry et al. highlight that these micro efforts ought to be directed to larger macro imperatives, such as adaptive co-regulated classrooms and a broader sense of belonging.

There is also relatively little research into major psycho-educational processes among students with special needs. As a case in point, Bergin and Prewett (Chapter 14) identify goal-setting as an area lacking in research among these students. They also

report that, in major meta-analyses of goal orientation interventions, there is very little attention given to effects as a function of disability. Bergin and Prewett emphasize the importance of studying goals in real curricular situations and, in particular, “if-then” interventions: that is, for students with special needs, if they experience a particular barrier, then what can they do to navigate it? Research identifying specific “then” responses would be very helpful for students and practitioners. Bergin and Prewett also raise the issue of transfer and how there is a need for research and practice to assist students with special needs to transfer what they learn in relation to one psycho-educational factor to other aspects of their lives. For example, if students are taught effective goal-setting or are encouraged to pursue mastery goals in one facet of their academic life, how can they apply what they learn here to other parts of their academic life?

Whereas the bulk of educational psychology focuses on within-school academic factors, the needs of students with special needs extend well beyond the school. Indeed, how out-of-school factors play out in their lives will have significant bearing on their in-school experiences. Hall et al. (Chapter 7), for example, emphasize the importance of understanding English language learners’ out-of-school experiences in order to better help these students at school. They identify home-based intervention as being a critical part of out-of-school support. Schunk and DiBenedetto (Chapter 11) suggest much the same for enhancing self-efficacy among students with special needs, with the input of out-of-school mentors and role models being vital for optimizing the self-efficacy of students with special needs.

Just as there are the challenges of comorbidity for students with special needs, aspects of their culture and socio-demography may present challenges. For example, some students with special needs are from cultures that are historically socioeconomically disadvantaged, limiting access to high-quality resources and support needed to assist them and manage their disability as relevant to home and school learning. As Dockrell and Lindsay (Chapter 6) note with respect to language difficulties, children from lower SES homes may lack exposure to high-quality language and may also be under-identified in their communities. Thus, from a research perspective, there is a need to better understand how some cultural and socio-demographic factors may exacerbate the effects of disability on students’ learning. There is also a need for research to determine if different interventions (or refinements of interventions) are needed to effectively target different socio-demographic groups within a special need category.

Most research has been conducted among language majority learners from Western cultures. This research has been important, but there are significant gaps to address if we are striving to optimize the educational outcomes of students with special needs who are from different contexts and cultures. Without question, there are psycho-educational factors that are pan-human, regardless of special need status. For example, Schunk and DiBenedetto (Chapter 11) note self-efficacy as one factor implicated in all students’ academic development. But, as they also note, students with special needs can experience different levels of self-efficacy, and there may be factors distinct to these students that also undergird their self-efficacy. For instance, Schunk and DiBenedetto observe that different cultures may have different orientations and constructions of self-efficacy for students with special needs. That is, different cultures may have different beliefs about the efficacy of students who have special needs and

different beliefs about the causes and treatments of these special needs. There are, thus, sociocultural differences in how seminal psycho-educational factors are conceived and considered for students with special needs.

Indeed, Macfarlane, Macfarlane, and Mataiti (Chapter 25) focus specifically on cultural and sociocultural factors (using Māori culture as a case in point), and how disability intersects with issues in and around culture. They identify the importance of investigating mechanisms at play in how disability impacts outcomes in different cultural communities and how to address this within distinct cultural contexts. Interestingly, they also identify how core constructs within educational psychology have clear alignments with constructs distinct to culture—for example, because autonomy and self-determination are so central to children’s development in the Māori culture, there is a Māori lexicon around the concept of “self-determination.” Further understanding of alignments and distinctions across cultures will better assist educators addressing special needs among different cultures.

Arguably, one of the greatest shifts in education over the past two decades has occurred via the increasing application of technology. Computers and mobile devices are major presences in today’s classroom. According to Okolo and Ferretti (Chapter 26), “new literacies” are also a reality, including multimedia, networked, digital texts. On the one hand, this technology must be used expertly and carefully so as not to disrupt learning. For example, there are features of technology that may be distracting to students with attentional disorders. There is also risk that some applications create excessive cognitive burden on students, violating core principles of cognitive load theory. Okolo and Ferretti also identify the need to ensure that students have the self-regulatory skills for monitoring a path through digital text and for sustaining attention in the face of many potential distractions.

On the other hand, Okolo and Ferretti recognize how technology can assist students’ learning. An obvious example is its use among students with sensory disabilities (e.g., “talking books” for students who are visually impaired). Game-based learning is another avenue for research into learning and academic outcomes. This approach can capture learners’ attention, involve cognitive flexibility and strategizing, and be developed to target learning goals. Mobile technology can also be used for reminders for due dates of assignments and exams, planning, study timetables, and self-monitoring of progress. As relevant to self-determination theory and also causal agency theory, Wehmeyer and Shogren (Chapter 12) discuss the role of technology in assisting personalized and autonomous learning. But even for these technological applications, psycho-educational factors are important to address. For example, Schunk and DiBenedetto (Chapter 11) identify the importance of computer self-efficacy, and how students who perceive themselves to be efficacious in using technology achieve more positive educational outcomes.

There is a distinct lack of information in theory, research, and practice related to disability and new literacy environments. Okolo and Ferretti (Chapter 26) urge more research into new representations of media for students with special needs. They cite the widespread adoption of the Dyslexie font and the associated risks with uncritical application of it. They recognize that it is unrealistic to expect research to keep pace with rapid advances in technology, but they also emphasize that, when there are new developments in practice, it is best to be cautious until the evidence base is established. This will also require researchers to ensure that their research methods

develop and evolve as new technologies and applications emerge. It will also require them to ensure they are communicating their findings to practitioners in an accessible and timely way.

APPROACHES TO DATA ANALYSIS AND MODELING

As there are developments in our understanding of students with special needs, there are also developments in analytical methods that can provide greater insights into psycho-educational factors and processes in these students' lives. With this in mind, there is a need for more longitudinal data, as the analytical opportunities these data present are substantial. Tracey, Merom, Morin, and Maïano (Chapter 24), for example, identify the reciprocal relationships and the cycles of psycho-educational processes that are a reality in at-risk students' lives (e.g., the relationship between their academic self-concept and their achievement). As researchers seek to assess these reciprocal relationships, longitudinal data can help better pinpoint what factors are "causal" and, thus, help to direct intervention. Along similar lines, Hall et al. (Chapter 7) identified the need for experimental and quasi-experimental research that can pinpoint intervention efforts (in their case, specifically targeted at understanding vocabulary acquisition among English language learners with learning difficulties).

Similarly, the dynamic nature of psycho-educational factors may warrant attention. Panlilio and Corr (Chapter 9) point to the dynamic and temporal nature of self-regulation and how it can affect students with special needs. As a case in point, they identify growth modeling and polynomial functions as a means of better understanding these dynamic and potentially nonlinear effects. Relatedly, Wigfield and Ponnock (Chapter 17) point to the need for analytical approaches that account for different psycho-educational trajectories among students with special needs. They also suggest more person-centered research in order to identify distinct profiles of students with special needs in terms of their relative levels of expectancy, valuing, and any emotional disorders that may be present (e.g., anxiety and depression in Wigfield and Ponnock's discussion). Indeed, Sigafoos and colleagues (Chapter 8) share the critical role of motivational variables for students identified with developmental disabilities. Person-centered approaches to research with these students is essential for testing the benefits of intervention.

Multilevel modeling is also needed. The reality is that students with special needs are nested within contexts that affect them. Tracey et al. (Chapter 24) address issues of classroom (and school) contexts and how they affect the academic outcomes of students with special needs. Multilevel modeling is vital to understand the relative variance in academic outcomes explained by student factors and the relative variance attributable to class or teacher factors; again, answers here provide direction for more targeted intervention.

INTERVENTIONS AND PRACTICES

It is important that researchers identify ways that findings can be readily harnessed and built into the school day at a classroom level and also any potential school-wide, systemic practices that can support learners with special needs. Hall et al. (Chapter 7),

for example, noted the need for research to identify what classroom and school practices can better assist English language learners with learning difficulties. Indeed, psycho-educational research into instructional practices that optimize learning of students with special needs is critical. It is likely that different instructional practices address different aspects of special needs and distinct functions within special needs areas. Although the bulk of educational psychology has focused on effective instructional practices for “mainstream” students, this handbook has identified how instruction can greatly assist many at-risk students. For example, Tricot et al. (Chapter 15) identified cognitive load theory as an important guiding framework for instructing students with dyslexia. Martin (Chapter 16) identified load reduction instruction as having potential for students with ADHD.

The issue of multimodal intervention requires further attention. For instance, although some disabilities or disorders may benefit from pharmacological intervention to alleviate symptomology, this does not necessarily directly improve learning. In relation to ADHD, for example, Martin (Chapter 16) observes that medication can manage symptoms and assist some aspects of executive functioning, but additional psycho-educational intervention is needed for targeting self-efficacy, fear of failure, and disengagement among students with ADHD. Similarly, in assisting English language learners’ reading, Hall et al. (Chapter 7) make the point that intervention may also need to target executive functioning, working memory, and self-regulation.

Comorbidity is a major theme in the special needs space. It is often the case that aspects of a special need are (problematically) correlated with other aspects of academic and psycho-educational functioning, and that many students will have dual or multiple diagnoses. Indeed, most chapters in this volume each deal with more than one special need. Comorbidity presents significant challenges to the student, as well as to researchers and practitioners. In the first instance, it obviously compounds the challenges experienced by the student. However, it also presents challenges in terms of where to target intervention efforts. There will be a need to disentangle special needs in order to know which ones are present in the student’s life and what aspects of each special need are presenting significant problems for their academic development. Then there is the dilemma of where to direct efforts. Do practitioners target the most salient (e.g., in terms of severity) special need or symptoms? Or, do they target the special need that is affecting academic development the most? Or, do they target the special need likely to be most immediately responsive to intervention? Research is needed to offer direction here.

There is also a need to examine effects and interventions that seem to be robust in “mainstream” student populations but that have not been fully tested among samples with special needs. For example, Jordan, Barbieri, Dyson, and Devlin (Chapter 19) recognize that worked examples are effective in classroom learning and call for research into worked examples among students who struggle academically (they also identify the split-attention effect, interleaved practice, spaced practice, gesturing, and embodied cognition as requiring further research). They further note that there are nuances in effects that have been found among typically developing learners and advise more research to see if these nuances occur for students with special needs. Taking cognitive load theory as a case in point, it has been found that particular applications of worked examples are more effective for students with low prior knowledge; Jordan et al. ask

whether this qualification applies for students with special needs as well. If so (or if not), there are implications for intervention.

Identifying the most efficient means of conducting intervention is also important. The reality is that there is limited time available to conduct intervention during school hours. Is it possible that (effective and efficient) intervention can target more than one academic difficulty experienced by students with special needs? Graham and Harris (Chapter 20), for example, identify the possibility that reading intervention may be helpful in improving the writing of students with learning difficulties. Or, integrating intervention strategies may be helpful. Graham and Harris report that combining reading and writing instruction assists both readers and writers.

Ongoing professional learning is also key to supporting students with special needs. Typically, trainee teachers will not receive a great deal of instruction about students with special needs. Thus, when they are in the workplace, (ongoing) professional learning will be essential to help them deal with the diverse students in their class. Given the reality that teachers will encounter students with quite different disabilities and disorders, professional learning will no doubt need to be quite specific to the respective disability or disorder. Macfarlane et al. (Chapter 25) make the point that there will also be a need for professional learning on how to address disability within specific cultural contexts. According to them, “culturally responsive,” evidence-based professional learning material is critical to enhance these students’ academic outcomes. They also suggest a cultural mentor or intermediary to connect to at-risk students in culturally responsive ways.

Much psycho-educational intervention is directed at academic functions that are directly related to learning. However, for some disabilities and disorders, the focus may not be on academically based functions, but instead on other functions that are critical in the path and process to learning. Gillies (Chapter 22), for example, emphasizes social skills training for students with autism spectrum disorder. Similar to Byrnes and Eaton (Chapter 27), Gillies further suggests the need for research into how to optimally integrate social skills training with neuroscientific insights. Currently, there is a disconnect between neuroscientific and non-neuroscientific research domains, and students with special needs will be better assisted through cross-fertilization of these research paradigms.

Finally, further and ongoing vigilance is needed for researchers to inform practice. There are some intuitively appealing practices that may resonate with educators, but that researchers might suggest be implemented cautiously. Tracey et al. (Chapter 24) connect with this issue when they explore inclusive educational practices for students with special needs. There are many educational systems implementing inclusive education, and Tracey et al. address the effects of this practice on the self-concept of students with special needs. They suggest this practice may not be universally adaptive for students with special needs, and there are important psycho-educational and social psychological factors and processes that are important to recognize and address if this practice is to be implemented. This underscores the importance of continued connections and conversations between researchers and practitioners and policymakers, as we seek to successfully address the educational development of students with special needs.

CONCLUSION

When we consider the range of students with special needs, or who are at risk of disorders and disabilities, it is evident they represent a sizeable proportional presence in schools. This handbook comprises a set of chapters showing how educational psychology addresses the factors and processes centrally implicated in these students' learning. Each chapter represents an up-to-date, comprehensive account of educational psychology's contribution to the special needs space. It is also evident there is still much to do in theory, research, measurement, and practice to assist these students—and much more that educational psychology can contribute in the years to come. There are, thus, exciting and important times ahead for educational psychology and educational psychologists.

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