

# Overview of Foundations, Causes, Instruction, and Methodology in the Field of Learning Disabilities

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As in the first edition (2003), the authors of the *Handbook* review major theoretical, methodological, and instructional advances in the field of learning disabilities (LD) over the last decade. This second edition updates current research outcomes. Chapters that were not in the earlier edition focus on adults with LD, social cognition, computer technology, single-subject designs, meta-analysis, and advanced statistical models. We have also added chapters on instructional research related to spelling and history. When conceptualizing this second addition, we included many of the previous authors but also added some new authors with extensive research experience in the area of LD. The authors of the chapters have been active researchers in the field for at least 20 years and have clearly established research programs. In many cases, we refer the reader back to some of the chapters in the first edition in order to explicate changes in the research base. We believe that this volume captures important advances on the theoretical, methodological, and instructional front. The central rationale behind the *Handbook* is to provide comprehensive coverage of what is known about LD, as well as where future research should be directed. Because of the diversity of subjects covered, the *Handbook* is divided into five sections.

In this chapter, we provide a brief overview of the content within each chapter.

## Part I: Foundations and Current Perspectives

The foundations and current perspectives in the field of LD are the focus of Part I. Chapter 2 reviews some of the major research-based landmarks in the field. In this chapter, Hallahan, Pullen, and Ward divide the history of LD into five periods. The European Foundation period (1800–1920) is characterized by findings from clinical studies on brain injury and mental impairment, primarily in the areas of spoken language and reading disorders. The U.S. Foundation period (1920–1960) is characterized as focusing on remediation and educational studies. These researchers built upon the work of their European predecessors and focused on diagnostic categories, assessment tools, and remedial interventions. The Emergent period (1960–1975), characterized by the formation of organizations to advocate for children with LD, was characterized by the definitions of LD and intervention programs. Some of these intervention programs are still foundational to the field, whereas others have been criticized and/or dismissed. The Solidification period (1975–1985)

reflects a period of calm for the LD field. These researchers, for the most part, abandoned models of the past in order to focus on empirically validated applied research. Also during this time, key legislation was passed, reiterating the earlier definitions of the field. The Turbulent period (1985–2000) reflects an epidemic increase in the number of students identified with LD, which in turn escalated the intensity of the unresolved issues. Although professional and governmental organizations put forward definitions, these definitions were not necessarily related to intervention practices. Investigations focused on deficits in students' phonological awareness and provided a biological basis for LD. Finally, the authors of Chapter 2 provide a tentative overview of the Current period (2000–present), which focuses on developing integrated research agendas that include neurobiology, genetics, and behavior, and emphasize a prevention-based approach to LD. The authors conclude that although issues in the field are varied, solid empirical findings will continue to direct the future of the field.

In Chapter 3, Fletcher, Stuebing, Morris, and Lyon review approximately 30 years of their research on classification and definitional issues of LD. Although there is controversy related to the classification of LD, one construct is less controversial: unexpected underachievement. LD, which is viewed as unexpected underachievement, needs to be viewed in the context of instructional factors. Fletcher and colleagues briefly review the nature of classification research and suggest the use of a hybrid model for classification. LD is viewed as an unobservable latent construct that therefore can only be identified by the attributes tied to this latent construct. Unfortunately, no single measure captures all of the components of the latent construct, and each measurement that is included obtains error. Additionally, the authors explain that several current identification procedures (cutoff scores, aptitude achievement discrepancy models, cognitive discrepancy models, linking patterns of weaknesses and strengths) suffer from issues of reliability. These authors provide an overview of the inherent weakness found in low achievement models and suggest that the actual level of performance that constitutes low achievement has not

been adequately validated. The authors also suggest that response to intervention (RTI) should not be equated with an identification method because the focus is on enhancing service delivery. Furthermore, reliability and classifications based on an RTI approach are difficult to address because there is no “gold standard” for determining adequate response. The authors' research provides a comprehensive approach to classification, which takes into consideration low achievement and sufficient RTI, as well as exclusionary criteria.

In Chapter 4, Herr and Bateman analyze important legislative influences in the field. They suggest that some legislation and litigation have been detrimental in terms of their effects on the practice of evaluating students suspected of having an LD. Several important cases are reviewed in the chapter, including *Corchado vs. Board of Education of Rochester City School District* (2000). This case revealed that a severe discrepancy between achievement and ability cannot be used as a litmus test of LD. The *Wrowley* case (1982) recognized that free and appropriate education has to be tailored to individual capabilities. An Indiana case (*Neim v. Greater Clark County School Corporation*, 2000) that followed the progress of one student identified in first grade as having an LD is also reviewed. In this case, the school district failed to provide an appropriate education for the student with LD. Other court decisions (e.g., *Cleveland Heights–University Heights City School District v. Boss*, 1998) have challenged the expectation that parents must pay for private school education when public schools fail. A more recent case discussed in this chapter (*M.B. v. South Orange/Maplewood Board of Education*, 2010) resulted in the rejection of a computer software program that provided numerical data on the level of discrepancy. The authors acknowledge that few cases have reached the courts involving RTI as a means to identify a child with a specific LD. However, in the *Joshua Independent School District* (2010) case, the courts ruled that a child is no longer required to be evaluated for special education if he or she made adequate progress in reading through RTI.

After reviewing a number of case studies, the authors of this chapter conclude that Individuals with Disabilities Education

Act (IDEA) criteria for learning disabilities, prior to 2006, led to widespread misuse of standardized test and discrepancy formulas. The authors argue that there is a critical unmet need, however, related to districts' identification of LD within an RTI context. Some trends in the courts have recognized that program effectiveness can be measured by student progress, and that this factor seems as important as whether the child qualifies as having a LD.

In Chapter 5, Lesaux and Harris review their research that focuses on English language learners (ELLs) with reading difficulties. The authors note that 80% of the teacher referrals for special education are for students with reading difficulties, and that there are pressing issues when it comes to ELL students. For example, ELLs who demonstrated weakness in phonological processing tasks are less likely than their native English-speaking peers to be identified as being at risk for a LD. The authors also review issues related to overlooking early intervention services and the lack of adequate tools related to identifying these populations. Previous supportive services have created a wait-and-see situation that many in the field consider to be harmful to overall reading development. Chapter 5 reviews research demonstrating that both "code-based" and "meaning-based" skills contribute to ELLs' reading development. The authors argue that RTI holds significant promise for serving ELL students who are at risk for academic difficulties.

In Chapter 6, Gregg reviews postsecondary difficulties that underlie adults with LD. One of the key constructs discussed in this chapter is resilience. Factors that contribute to resilience are defined in terms of emotional, academic, and occupational well-being. Resilience factors are also analyzed as internal and external influences. Internal factors include temperament, accommodation strategies, and knowledge of ways to advocate for oneself. Sample external manifestations include those that support the person with LD at school, work, and/or in a community setting. Gregg discusses a longitudinal study that examined the effects of gender, socioeconomic status, and race as they related to occupational and postsecondary persistence of LD symptoms. Occupational aspirations were influenced more

by academic achievement than by almost any other variable. Not surprisingly, the results show that high school dropout rates for students with LD occur two to three times more frequently than those for their nondisabled peers.

In Chapter 7, Speece, Palombo, and Burho review instruction that students with LD receive in the public schools. The authors note that the term "service delivery" is no longer in vogue, but issues-related "delivery services," as originally developed by Evelyn Deno's (1970) classic paper on special education, are consistent with today's needs. The authors place RTI within the context of both instructional and identification parameters. They summarize some of the findings from the National Longitudinal Transition Study-2 (NLTS2). The majority of the sample included students with LD, who began receiving services between ages of 5 and 8. Well over 50% of students with LD scored below the cutoff range on measures of passage comprehension. The authors of Chapter 7 also review the research on the following models: pull-out, inclusion, and co-teaching. The majority of researchers found that students educated in a pull-out (vs. inclusive) environment showed no significant difference in overall achievement. The authors suggest that researchers are no longer interested in practices occurring in the name of special education. This is unfortunate because it has not been shown that different delivery methods have an influence on student outcomes. Thus, the authors also provide a critical analysis of research on RTI models. They conclude that results related to student outcomes on the most intensive interventions (as defined by a Tier 3 approach to service delivery for special education) are at best uneven.

In Chapter 8, Lyon and Weiser review the scientific status of the LD field within the last 10 years. This chapter is especially important because the first version of this chapter, found in the first edition of the *Handbook* by the late Ken Kavale, indicated that although research has advanced within the field of LD, it continued to lag in theoretical development. The earlier review suggested that difficulties within the field were a factor of sociopolitical and economic notions, and the field resembled a scientific discipline very little. Lyon and Weiser

show that the field has made important advances in the last 10 years. The field of LD has been extremely aggressive in using scientific principles and has surpassed many social science fields in the application of the scientific method. To support these conclusions, the authors sample journal articles, chapters, and books in the domains of neurobiology, cognition, linguistics, genetics, and in reading, writing, and math intervention research. Overall, they found increasing scientific rigor in terms of the application of randomized controlled trials, as well as significant improvements in isolating specific cognitive, linguistic, biological, genetic, and instructional factors and their relationship with different types of LD. The authors select a manageable number of studies and provide a website as an additional resource.

## Part II: Causes and Behavioral Manifestations

Part II of the *Handbook* focuses on the causes and behavioral manifestations of LD. Leading researchers highlight their recent work in the areas of attention (Chapter 9), speed and reading (Chapter 10), basic cognitive processing (phonological, semantic, orthographic processing abilities; Chapter 11), memory (Chapter 12), math and problem solving (Chapter 13), language processes (Chapter 14), social cognition (Chapter 15), neurological correlates (Chapter 16), and genetic influences (Chapter 17). These chapters advance the work in earlier chapters that considered the following:

1. What is the operational definition of LD in your research program?
2. What theoretical models provide a framework for your research?
3. What findings have been consistently replicated in your laboratory, school context, and/or fieldwork?
4. What independent researchers have confirmed these findings?
5. How do students with LD differ from controls on the constructs under investigation?
6. What applications does your research have for practice?

In Chapter 9, Denckla, Barquero, Lindström, Benedict, Wilson, and Cutting review

their research on attention-deficit/hyperactivity disorder (ADHD), executive functioning, and reading comprehension. They see executive function and dysfunction as a logical overlap between ADHD and LD. Their studies use a psychological refractory period paradigm to show that children with ADHD have a prolonged bottleneck in response processing. This prolonged processing brings with it certain costs in reading comprehension. In general, children with ADHD often have intact oral language and reading basics, but they suffer from working memory deficits that hinder their comprehension skills. This research suggests that some of the difficulties experienced by children with ADHD are related to some abnormalities of frontal lobe circuitry. Working memory and difficulty processing simultaneous information are prime areas of weakness and have applications to difficulties in reading comprehension.

In Chapter 10, Georgiou and Parrila review their research on rapid automatized naming (RAN) and reading. RAN is defined as the speed with which children can name continuously presented highly familiar visual stimuli, such as digits, letters, objects, and colors. RAN has been found to be a unique construct in predicting reading skills when partialled out by a host of other correlates, such as IQ and phonological awareness. Although there is an important connection between RAN performance and reading, the factors that underlie this connection are still unclear. Some researchers have attributed RAN to the coordination of attention, perception, memory, and lexical processes, whereas others have viewed it as accessing phonological information in long-term memory. Overall, these authors' review and research suggest that reading disabilities cannot be explained by phonological awareness alone.

In Chapter 11, Siegel and Mazabel outline the normal course of development in reading and examine why poor readers fail to develop adequately. They provide a strong theoretical model to aid in our understanding of the basic cognitive processes. Word recognition measures are fundamental to evaluating reading disabilities because these measures are a strong correlate of basic psychological processes. The authors argue that definitions should be at the reading recogni-

tion level, and that a cutoff below the 25th or 20th percentile contributes to the operationalization of the field. Their research has found that when deficits in reading are defined in terms of word recognition skills, children with reading problems have deficits in phonological processing, working memory and short-term memory, and syntactic awareness. They also indicate that there is no reliable evidence that IQ plays a cognitive role in the development of reading skills.

In Chapter 12, Swanson and Zheng review memory research within the last 20 years on samples of children with LD in reading and math. This research focuses primarily on the contribution of working memory to academic performance. Deficits experienced by children with LD in the areas of reading and math are attributed to problems in both the phonological loop and a speech-based representational system, and the processes related to the executive system. The executive system focuses on the monitoring of information, focusing and switching attention, and activating representations from long-term memory. The research is couched within Baddeley and Hitch's (1974) multicomponent model. This chapter reviews problems in the executive system in terms of studies in which researchers manipulated the mental allocation of attention, focusing on how children use strategies to inhibit irrelevant information, and examined how children combine processing and storage demands. Problems in executive processing are described in terms of limitations in attentional capacity rather than processing strategies. Because short-term memory has less direct application to complex academic tasks, the remainder of the chapter considers the relationship between working memory and complex cognition. Recent work linking working memory growth to growth in math and reading disabilities is also reviewed, as is recent work on working memory for ELLs with reading disabilities. Practical applications for instruction are also provided.

In Chapter 13, Geary outlines his extensive research over the last 20 years examining the cognitive correlates between children with math LD and those with low math achievement. Math LD appears to be moving toward the 10th percentile cutoff point across multiple grades, whereas lower achievement appears to emerge between

the 11th and 25th percentiles. The majority of Geary's research has focused on basic competencies and understanding numbers, counting, and arithmetic. Children with math disabilities, compared to low achievers, show a deficit in the processing of numbers, learning of arithmetic procedures, and memorizing basic arithmetic facts. Geary also found that children with arithmetic disabilities do not necessarily differ from their academically normal peers in types of strategies used to solve simple arithmetic problems. Differences, however, have been found in the percentage of retrieval and counting errors. These children's long-term memory representations of addition facts are incorrect. Additional difficulties are related to low average working memory capacity and imparted to lower average intelligence scores. A review is provided on the genetic factors, as well as Geary's research outcomes from the Missouri Longitudinal Study. Geary has found that children with math LD have pervasive deficits across all working memory systems, and that understanding the relationship between specific components of working memory and specific mathematical cognition is still in the developmental stages.

In Chapter 14, Schmitt, Justice, and Pentimonti focus on language processing in children with language-learning disabilities. Their research explores the nature of language-learning disabilities from the preschool years through the end of the primary grades. Language impairments are characterized into areas of semantics, morphosyntax, phonology, and pragmatics. The authors suggest that approximately 37% of the children with language impairment respond effectively to remediation. Recent studies suggest that intervention efforts for children with language-learning disabilities may not be sufficient for complete remediation of the underlying language deficits. They discuss a prevention-oriented approach to improving early language skills. Studies that have investigated the efficacy of prevention-oriented programs suggest that children who benefit the most from interventions are those who have the strongest language skills. Although this finding is disheartening, it underscores the need for identifying effective methods for improving language development in the preschool years as a method to prevent future language and learning disabilities.

In Chapter 15, Al-Yagon and Margalit review their extensive research on social cognition within the context of social information-processing models. Their extensive research suggests that children and adolescents with LD evidence higher levels of loneliness, depression, anxiety, and withdrawn behaviors when compared to typical developing children. The authors review several hypotheses concerning the understanding of individual difficulties in these particular domains. Research that identifies some of the social-cognitive skills that predict well-adjusted social-emotional functioning is reviewed. Their research clarifies some of the links between social cognition and social adjustment in individuals with LD.

In Chapter 16, Petrill reviews research showing that both genetic and environmental influences are important in understanding reading and math disabilities. The research base for separating genetic and environmental underpinnings can be estimated by comparing similarities on measured behaviors across family members with different genetic relatedness. The presence of significant genetic covariance in learning outcomes is viewed as a starting point for addressing some of the important theoretical questions concerning the genetic and environmental contributions to LD. Petrill also discusses a fundamental issue referred to as the “missing heritability paradox.” The common disease–common variant model (CDCV) has not been able to identify gene variants that account for a significant proportion of the heritability in educational outcomes. Thus, a considerable proportion of the genetic variants that influence LD may be genes that occur infrequently, are smaller and moderate in effect size, and cluster in subgroups within the particular population. Petrill’s research team suggests that there are multiple genetic pathways and routes through which abilities and disabilities emerge.

In Chapter 17, Berninger and Swanson merge the outcomes from their research programs related to the brain and memory. Berninger and colleagues’ research shows that children with and without dyslexia store and process phonological, orthographic, and morphological word forms in special working memory units. Berninger’s work is unique in establishing, through functional magnetic resonance imaging (fMRI) stud-

ies, the emergence of an orthographic loop during the written portion of word learning. Berninger shows how developmental profiles (five levels of functioning in the domains of cognition, language, sensorimotor performance, attention and executive processing, socioemotional functioning), learning profiles (math writing and reading), and phenotype profiles (behavioral expressions underlying genes) can be used to develop evidence-based treatments relevant to differential diagnosis of specific LDs. Chapter 17 reviews the intervention evidence related to instruction for the type of specific disability. Berninger and colleagues’ research also indicates cautions in the application of the brain in the imaging results to educational practice. The relationship between brain structure and functions within the instructional context are complex. Additionally, the authors explain that instruction probably changes the behavioral expression of gene variations.

### Part III: Domain-Specific Instruction/ Intervention Research

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Part III of this *Handbook* includes chapters from leading researchers who have examined effective instruction in the areas of word skills (Chapter 18), reading comprehension (Chapter 19), reading comprehension in adolescents (Chapter 20), mathematics (Chapter 21), writing (Chapter 22), spelling (Chapter 23), science and social sciences (Chapter 24), and history (Chapter 25). The authors of these chapters were asked to address the following questions:

1. How are students with LD operationally defined?
2. What does research indicate to be the most important components of instruction?
3. What behaviors or targets of instruction show the largest or weakest gains?
4. What is the magnitude of treatment outcomes (effect sizes)?
5. What evidence is provided on transfer and generalization?
6. Is there evidence that students with LD respond similarly or differently from their counterparts under treatment conditions?

7. What principles of instruction emerge from the research?
8. What results relate to the transfer of findings to classroom practice?

In Chapter 18, Lovett, Barron, and Fritters provide a rich historical context for intervention research on reading disabilities. Despite enormous advances in our understanding of the nature of reading disabilities, we still have a limited knowledge base on how to effectively remediate the most severe forms of reading disabilities. The research reveals mixed results for severely disabled older child and adolescent readers. In general, the positive studies seem to indicate that gains in reading comprehension are typically much smaller than those seen in other reading-related areas. The authors' research suggests that phonologically based approaches alone are not sufficient to achieve optimal remedial outcomes. They suggest a multidimensional approach that includes a combination of phonological and strategy instruction. Results indicate that a combination of the two intervention programs rather than either program in isolation enhances generalization.

In Chapter 19, Williams and Pao review their extensive research on teaching expository text comprehension to struggling readers. Unlike narrative text, which tends to follow a predictable structure in which plots and events are sequenced along a causal temporal line, expository text is difficult because it is structured in different ways. The authors review studies that focus on developing and evaluating second- and third-grade interventions that feature expository text and text structure training. They also describe three modules designed to focus on different text structure: compare–contrast, cause–effect, and sequencing. They describe, in detail, evaluation studies that examine each of the three program areas and show positive outcomes for struggling students.

In Chapter 20, Vaughn, Swanson, and Solis address the complex issues related to reading for understanding of secondary grade students with severe reading difficulties. This chapter, along with Chapters 18 and 19, provides an excellent overview of scientific progress related to remediating reading disabilities. Vaughn et al. review data from their RTI studies to show how

one might conceptualize effective reading comprehension interventions for secondary grade students. Interestingly, their randomized studies show that neither adaptive nor standardized interventions played a major role in the outcomes. This is rather groundbreaking research because there has been very little systematic evaluation of manipulation interventions based on individualized versus standardized approaches. Although individualized approaches are consistent with practice, the evidence to support this approach is unclear. The authors' review highlights that one of the challenges of Tier 1 intervention is designing a multicomponent-strategy instructional program that allows coverage across a number of content areas.

In Chapter 21, Fuchs, Fuchs, Schumacher, and Seethaler provide an extensive review of experimental interventions for students with math LD. Their evidence suggests that calculation and word problem-solving difficulties are distinct forms of math LD. Some of their extensive research has focused on instructional interventions for students with difficulties in calculating and solving word problems. The authors provide an excellent summary of randomized controlled trials investigating remediation methods for children at risk and/or performing below the 26th percentile on a standardized math test. They also review data on three approaches to basic fact remediation. An interesting finding is that conceptual instruction is not necessarily more valuable than intensive drill and practice. They found that additional practice with counting strategies influences fact fluency, and that students provided with the additional practice outperformed those who were taught counting strategies and not provided the additional practice. They also review research on developing word problem-solving skills within a theoretical model related to schema activation. From their extensive research, these authors developed general evidence-based instructional principles for remediation.

In Chapter 22, Graham, Harris, and McKeown review their extensive research on self-regulated strategy development (referred to as SRSD), such as an intervention procedure to improve writing in children with LD. The SRSD model has yielded large effect sizes for students with and without LD, including strong positive effects on the qual-

ity, structure, and length of writing by students with LD. Although the authors raise questions about what components provide the largest effect sizes, the full SRSD model powerfully relates to measures of grammar, maintenance, and generalization. The authors review the stages of instruction used to teach writing and self-regulation strategies. They report over 23 studies examining the effectiveness of their intervention program, all of which have yielded extremely high effect sizes. They review more recent research yielding positive outcomes related to professional development.

In Chapter 23, McLaughlin, Weber, and Derby review classroom spelling interventions for students with LD. They indicate that one-third of students with LD have difficulties in written communication. Previous studies have indicated that spelling interventions including explicit instruction, multiple practice opportunities, and corrective feedback all have consistently improved spelling accuracy. In their synthesis of the literature, the authors found that effective spelling instruction includes procedures referred to as cover, copy, and compare (CCC), self-error correction, and the use of computer technology.

In Chapter 24, Scruggs and Mastropieri review their research on social science and science education. Their extensive research has shown positive outcomes for students with LD through procedures that enhance the curriculum. Their initial investigations involved particular strategies, such as text processing and mnemonic strategies, that have also been validated for helping students with LD meet the demands of text-based learning related to science and social studies. The authors provide an excellent overview of their research related to laboratory experiments, classroom applications, and teacher applications. The reported effect sizes are substantial. Their research has been effective in identifying a number of treatments associated with positive outcomes for science and social studies education for students with LD.

In Chapter 25, Okolo and Ferretti indicate that although a rich literature highlights the teaching of history, few studies have focused directly on the area of LD. This chapter identifies the features that make for effective history education, providing a review

of history education and suggesting that teaching history to students with LD should be in a manner similar to how historians engage in inquiry. They review the research on enhancement procedures, content enhancement procedures, domain strategies, graphic organizers, enhanced text, and text reconstruction. They also review their research related to developing a technology-supported history learning environment or what is referred to as the “virtual history museum.” They conclude that history education for students with LD is fragmentary, and view the growing interest in comprehension research as one means to unify some of the research and history education for students with LD.

#### Part IV: General Instructional Models

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Part IV of this *Handbook* focuses on general instructional models. This differs from previous parts due to its focus on models that are considered to be general heuristics of effective instruction regardless of instructional domain. These chapters focus on research in the areas of direct instruction (Chapter 26), cooperative learning (Chapter 27), and curriculum-based measurement (Chapter 28) and constructivist models (Chapter 29). Part IV also addresses the influence of instructional technology (Chapter 30). The authors in this section were asked to consider the same questions listed in Part III.

In Chapter 26, Kame'enui, Fien, and Korgesaar describe the historical roots of direct instruction, Project Follow Through, and direct instruction principles with application to RTI. The chapter clarifies the meaning of direct instruction and how it was initially intended to be used. One of the most unappreciated but critical features of direct instruction is the notion of instructional design. Design and architecture of content in direct instruction program lessons are predicated on the assumption that the structure of taught information is of paramount importance. The authors contend that RTI for determining specific LDs cannot occur unless there is high-quality instruction in Tier 1 and Tier 2 aspects of the general education classroom. Their data suggest that instructional design features are key to the performance outcomes.



In Chapter 27, O'Connor and Jenkins review research on "cooperative learning," defined as instructional use of small groups such that students work together to maximize their own and each other's learning. Cooperative teaching is viewed as a blunt instrument that, depending on its form of implementation, may or may not help students with LD. The research on cooperative learning and its impact on students with LD remains inconsistent in the areas of reading, math, and writing. Research on cooperative learning has been confounded with other programs and in some cases has not been viewed as an independent variable. O'Connor and Jenkins cite one of the many studies in which they observed negative side effects of this program (e.g., nondisabled students doing most of the work). Thus, the authors conclude that although cooperative learning is an extremely popular approach used in the classrooms, its effectiveness for children with LD is unclear.

In Chapter 28, Fuchs, McMaster, Fuchs, and Al Otaiba provide an extensive review of the research on RTI. Methods to identify risk are critically reviewed (median split, normalization, benchmark, dual discrepancy, slope discrepancy), and the authors conclude that regardless of the classification procedure, a number of children are viewed as nonresponsive. They argue for procedures for dealing with nonresponders as a detailed process of finding effective individualized instruction. Given the strong psychometric features of curriculum-based instruction, the authors outline a procedure referred to as "data-based individualization," which includes identifying interventions designed to address students' needs and monitor their progress toward the goals. These changes are related to not only more intensity but also qualitatively different forms of instruction.

In Chapter 29, Englert and Mariage review research related to sociocultural instructional models. A key assumption is that higher mental functions have their beginning within the social interactions. Thus, social context has to be arranged to maximize the student's knowledge base of understanding and competence. The authors discuss five teaching processes that provide instruction and work within the student's zone of proximal development. The authors

review research suggesting that sociocultural theory has enormous potential for advancing instructional efficiency in special education programs. In the previous edition of this volume, the authors discussed landmark work of reciprocal teaching as a viable model area, and within the last decade there has been an extension of this reciprocal model. The authors review several programs, such as concept-oriented reading instruction and guided inquiry supporting multiple literacies. The specific emphasis of the chapter is on the cognitive strategy instruction and writing. The authors provide a contrast with the self-regulation strategy development model in terms of the theoretical foundation of their program to show that there is some overlap in sociocultural principles and their design and implementation.

In Chapter 30, MacArthur provides an extensive, comprehensive review of instructional research using technology to improve reading and writing skills of students with LD and others who struggle. He reviews computer-assisted instruction in the areas of phonological awareness, decoding, and word reading. The results are quite mixed. Although a large majority of the studies have some positive effects, these effects, in many cases, were nonsignificant findings. Controversial programs (e.g., Fast Forward), such as an assistive technology that uses synthesized, digitized speech; enhanced electronic text (e.g., the use of graphics animations); and sound and interactive questions are also reviewed. Additionally, a well-known procedure entitled READ 180 is reviewed. In general, MacArthur concludes that the research is quite limited in quality and existing research is uneven. Although some programs are popular and widely used, What Works Clearinghouse (WWC) suggests that the outcomes are mixed. Although the author finds that new technologies create dramatic changes in communication, he suggests that they also create some barriers for students with LD.

## Part V: Measurement and Methodology

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The final part in this volume focuses on methodology. Research practice in LD today bears scant resemblance to that in the field 20 years ago. Since the field's inception,

the body of knowledge concerning LD has been influenced by the sophistication of the research process. In this section, authors identify how methodologies illuminate our understanding about the causes and/or correlates of LD. The areas covered include group design and statistical models (Chapter 31), single-subject-design models (Chapter 32), a meta-analysis (Chapter 33), neuropsychological indices (Chapter 34), and qualitative research (Chapter 35). Research by the authors of each chapter exemplifies a particular methodological approach. The authors review their research using the targeted methodology with LD participants. In addition, these authors were asked to consider the following questions when writing their chapters:

1. What has this methodology told us about LD that is not apparent in other methodologies?
2. What are the strengths and limitations of this methodology?
3. How does this methodology complement or refine traditional comparisons (e.g., analysis of variance) in the literature between students with LD and those without disabilities?
4. What parts do context, error, and complexity play in the applications of these methods?
5. What variations exist within the methodological approach, and why is a particular variation used in your research?

In Chapter 31, Willson and Rupley indicate that the field of LD has recently focused on randomized clinical trials; propensity analysis; structural equation modeling; and various methods of hierarchical, logistic multinomial, and quartile regressions. The authors also discuss some recurring statistical themes plaguing the field (e.g., imputation procedures, handling non-normally distributed data, different covariance and correlation matrices between LD and non-LD groups). A key point is that in comparisons between groups, one cannot assume homogeneity in the analysis simply because the groups are randomly assigned and evaluated. The authors also discuss recent advancements in procedures related to estimating parameters within mixed-model designs, latent class analyses, and item

response theory. A discussion covers power analysis within hierarchical linear model (HLM) designs and some of the advantages of using structural equation modeling rather than multiple analysis of variance (MANOVA). The authors also discuss the rise of regression discontinuity designs. One of the most significant advances in modeling between LD and non-LD groups in the last decade is the capability to compare complex models across groups, with every parameter available for comparison. There is the untapped potential to develop different models for LD versus non-LD groups.

In Chapter 32, Kratochwill, Altschaeffl, Bice-Urbach, and Kawa discuss a renewed interest in evidence-based practices within single-subject-design (SSD) research. SSDs are viewed as an important complement to existing quantitative databases for the development of interventions for children with LD. The authors review previously established standards from the American Psychological Association and WWC related to evidence-based practices with SSD research. What is unique about SSD research is that it allows for characterization of client outcomes in terms of variability trends, change in level from baseline to treatment, score overlap, and other features of the data analysis. The chapter details sample designs that meet evidence-based standards. The authors provide examples of using various designs with learning-disabled samples for studies that meet the standards. They discuss how randomization within SSDs can be applied within ABAB, multiple baseline, as well as alternating treatment designs. When combining and synthesizing single-case designs, it is recommended that evidence criteria be met (e.g., five single cases meeting WWC standards, at least three independent research teams from three different institutions, and the combined number of cases [i.e., participants, classrooms, etc.] must be at least 20). The chapter highlights WWC standards and how they can be applied in summarizing research within the field of LD.

In Chapter 33, Swanson reviews some of the advantages of meta-analysis. The primary rationale is that this method overcomes biases associated with a reliance on single studies. The many different metrics for calculating effect size are briefly dis-

cussed. Overall, meta-analysis should best be motivated by theoretically driven questions. Briefly reviewed are the meta-analytic studies that have attempted to find the best instructional models for students with LD, that identify some of the cognitive variables that underlie LD, and that assess the potential role that IQ might play in the identification of LD and treatment outcomes. Overall, there appears to be some support that (1) a combination of direct and strategy structure provides the best evidence as a general heuristic for improving academic performance in students with LD, (2) children and adults with LD in reading and math have identifiable cognitive difficulties that are pervasive across age, and (3) IQ is not irrelevant in terms of understanding treatment outcomes. Swanson also discusses the practical significance of effect sizes and the lack of consensus in the field as to what constitutes a meaningful effect size.

In Chapter 34, Shaywitz and Shaywitz outline significant advances in the last decades on the neurobiology of understanding LD, specifically in the area of dyslexia. Their chapter reviews the definition, epidemiology, etiology, and cognitive theory of dyslexia. IQ and reading is viewed as developing concurrently over time in typical readers, whereas there is an “uncoupling” between IQ and reading in children with dyslexia. Their research clearly indicates that dyslexia is primarily a language disorder. The authors provide a detailed overview of functional brain imaging. Outcomes of brain imaging are viewed as fairly reliable at the group level but not reliable at the level of the single subject. There is strong evidence to support how the central occipitotemporal region underlies development of reading fluency, but there is controversy over the neural mechanisms involved. The authors’ work shows that parts of the left-hemispheric posterior brain systems fail to function properly during reading for individuals with dyslexia. Recent studies have begun to focus on age-related changes in the neural system of reading. The authors also consider diffusion tensor imaging (DTI), showing correlations between reading measures in white brain matter areas. In general, the brain imaging research provides neurobiological evidence that clarifies our understanding of the nature of dyslexia treatment.

In the final chapter, Moore, Klingner, and Harry review methodologies related to qualitative research in the field of LD. Such research derived from attentive observation, knowledge of individual perspectives, settings, and multiple techniques generates valid evidence about the physical, material, and social world under investigation. Qualitative research includes families of methodologies such as ethnography, naturalistic studies, phenomenology, narrative inquiry, case studies, and advocacy-participatory research. Qualitative research is seen to complement and supplement quantitative studies, and also to inform work of educators and policymakers. For example, the authors examine evidence-based practices by delving more deeply in the contextual factors to examine why individual treatments do or do not work. Other topics reviewed include reactions to the traditional diagnosis of LD, the experience of professionals in negotiating the special education process, as well as the perceptions of individuals with LD. Studies of students have focused on inclusion, special education resource rooms, self-efficacy, protective factors, transition planning, employment opportunities, and experience with law enforcement agencies, as well as independent living. Particularly interesting are qualitative studies that explore teachers’ beliefs about instructional practices, ultimately seeking to improve outcomes for students with LD.

In summary, the authors of these chapters review significant advances of the knowledge base in the field of LD. Although the chapters are diverse in terms of research programs reviewed, some clear themes emerge. First, in comparison to the first edition, there is an emphasis, in several chapters, on RTI. The purposes of RTI (instructional model and/or identification procedures) and the research base in comparison to other models is an emerging trend. Second, not unlike the previous point, there is reliance on operational definitions of LD that do not rely on discrepancy criteria. Third, solid evidence demonstrates the biological and cognitive bases of LD. There is a clear biology to LD, the correlates of which are reflected in a number of psychological processes. Likewise, a number of methodological approaches have converged, showing that students with LD have qualitatively and quantitatively distinct

tive characteristics that vary from those of their normally achieving peers. Fourth, several instructional programs, with critical commonalities, have been effective across a broad array of academic areas. Finally, strong, theoretically based, rigorous scientific research has emerged in multiple areas. There remain, of course, many unresolved areas within the field. Some of the issues continue to relate to consensus on a definition, whereas others relate to isolating in a parsimonious fashion those components of instruction necessary for effective outcomes. Though each chapter fleshes out the details

of various research programs, the reader discovers numerous and important directions for future research.

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