Please use the following citation when referencing this work:

McGill, R. J., & Ndip, N. (2019). Learning disabilities. In M. J. Prinstein, E. A. Youngstrom, E. J. Mash, & R. A. Barkley (Eds.), *Treatment of disorders in childhood and adolescence* (4th ed., pp. 448-492). New York: Guilford Press

Learning Disabilities

Ryan J. McGill

College of William & Mary

Nadine Ndip

Texas Woman's University

Author Note

Ryan J. McGill, School of Education, College of William & Mary, P.O. Box 8795, Williamsburg, VA 23187.

Nadine Ndip, Department of Psychology and Philosophy, Texas Woman's University, P.O. Box 425470, Denton, TX 76204.

Correspondence concerning this chapter should be addressed to Ryan J. McGill, School of Education, College of William & Mary, P.O. Box 8795, Williamsburg, VA 23187. E-Mail: rmcgill@wm.edu

Table of Contents

Introduction and Overview 3
Symptom Presentation 3
Prevalence and Cultural Factors 9
Age, Developmental Course, and Comorbidity 10
Conceptual Models for Intervention 12
Evidence-Based Practice and the Dissemination of Empirically Supported Treatments 21
Overview of Treatment Outcome Literature 29
Treatment Moderators 64
Course of Treatment 67
Conclusion 72
References 74
Appendix 106

Introduction and Overview

As described in 1963, by Samuel Kirk in a presentation at the conference for the organization that later became the Learning Disabilities Association of America (LDA), learning disabilities (LDs) are veiled disorders in that they reference a large heterogeneous group of individuals who have significant impairments in academic skills (e.g., reading, math, writing) despite possessing a requisite level of cognitive ability to benefit from conventional instructional techniques. Recent advances have shed light on the etiology of this condition and there is now broad consensus that LD is a neurobiological condition with early dysfunctions in cerebral processing and neural efficiency interfering with the acquisition of basic learning skills throughout the developmental course of childhood (Lewandowski & Lovett, 2014). Despite these advances and the frequency with which these problems are encountered across the school-age, attempts to develop a more precise operational definition for LD have not been successful. This is not for a lack of trying, as numerous classification models have been proposed for identifying LD over the last 50 years. Apropos of this dilemma, we begin this chapter by briefly outlining and describing the salient features of LDs, including a review of contemporary classification frameworks, prevalence, and comorbidity with other psychological disorders.

Symptom Presentation

Learning disabilities fall under the broader diagnostic category of neurodevelopmental disorders and are characterized by a host of impairments in personal, academic, social, and/or occupational functioning. Specifically, learning disabilities are marked by developmental deficits that result in significant limitations in the acquisition and performance of academic skills in society. Although definitions for LD differ across clinical settings, all operational definitions for LD share the same fundamental assumption that LDs reflect *unexpected* underachievement.

Thus, it appears that there some consensus in the field as to what constitutes LDs in a general sense. In spite of this agreement, difficulties with LD classification have been well documented in the educational and psychological literature. A unique feature of LDs is that they represent both a clinical condition and an educational policy category (i.e., special education). Thus, there can be large changes to the population of individuals identified as having LDs when applicable laws and regulations change. As noted by Lewandowski and Lovett (2014), this rarely happens with other childhood disorders. Furthermore, the procedures employed within educational systems to identify children with LDs may not be congruent with the procedures employed by clinical practitioners who are not bound to those systems. Therefore, it is suggested that practitioners become familiar with the various systems that are reviewed below and, more specifically, the procedures that are utilized locally for LD identification so that they can better serve as an advocate for their clients within these various networks.

DSM-5

Numerous terms have been employed in various iterations of the *Diagnostic and Statistical Manual for Mental Disorders* (DSM) in reference to LD. These include “learning disorders” and “academic skills disorders.” In the most recent revision, DSM-5 (American Psychiatric Association, 2013), the term has been changed to “Specific Learning Disorder” (SLD). The current diagnostic category makes reference to impairment in three academic domains: reading (marked by deficits in word reading accuracy, reading fluency, and reading comprehension), written expression (marked by deficits in spelling, grammar, and clarity and organization of writing) and mathematics (marked by deficits in number sense, memorization of math facts, calculation, and math reasoning). Additionally, consistent with other diagnostic categories in the DSM-5, clinicians are required to provide a diagnostic specifier rating the severity of the disorder (i.e., mild, moderate, or severe).

Diagnostic features indicate that SLD is a neurodevelopmental disorder with a biological origin that produces cognitive deficits that are associated with the observed behavioral (i.e., academic) symptom presentation. In contrast to previous editions, the potential value of cognitive/intellectual assessment for diagnosis is downplayed. That is, “Individuals with specific learning disorder typically (but not invariably) exhibit poor performance on psychological tests of cognitive processing. However, it remains unclear whether these cognitive abnormalities are the cause, correlate, or consequence of the learning difficulties” (p. 70). Although this linkage for word reading is well documented, their manifestation for more complex academic tasks such as computation and written expression is less understood. As a consequence, evidence for a cognitive processing deficit is not required for diagnosis. Instead, diagnosis is based on the key features of SLD that include: (a) persistent difficulties in learning key academic skills with onset during the formal years of schooling, (b) academic skill performance that is well below expected levels for a person’s age (i.e., 1.0 to 2.5 standard deviations below the population mean on norm-reference tests of achievement), (c) these deficits are “specific” in that there is evidence of otherwise intact academic skills, and (d) deficits that are persistent, as in, they are resistant to well-documented attempts at remediation. The later criteria has been a source of significant criticism within the professional literature, as it seems to move the diagnostic criteria from what was previously a cognitive discrepancy model to one that adheres to a response-to-intervention (RTI) approach, reflecting boarder trends in professional practice (Cavendish, 2013).

In terms of differential diagnosis, it must be demonstrated that the observed academic deficits are not the result of intellectual disability, other neurological or sensory disorders (e.g., Attention-Deficit/Hyperactivity Disorder [ADHD]), or variations in academic achievement due to external factors (e.g., environmental deprivation, inadequate instruction, or mediated by the effects of learning a second language).

ICD-10

Although less widely used than the DSM-5 within the United States, the *International Classification of Diseases* (ICD; World Health Organization, 1992) is a standardized diagnostic tool for epidemiology, health management, and clinical mental-health practice worldwide. Within the ICD-10 LDs are classified under the broader categories of mental and behavioural diseases and disorders of psychological development and are referred to as “specific developmental disorders of scholastic skills” (F81.0). The ICD-10 makes reference to impairment in a number of different categories that include: reading, spelling, arithmetical skills, and a mixed presentation which includes deficits in one or more of the aforementioned categories. Although it is suggested that these disorders are marked by disturbed patterns of normal skill acquisition that are attributable to neurobiological deficits in cognitive processing, no specific diagnostic procedures are recommended or endorsed.

Educational System Approaches

From an educational perspective, LD has been governed by the Individuals with Disabilities Education Act (IDEA) since its enactment in 1975. It should be noted that IDEA was most recently re-authorized in 2001 with final regulations that went into effect in 2004. Nevertheless, the federal operational definition for “Specific Learning Disability” has remained consistent over the last 50 years and bears a strong resemblance to Kirk’s original conceptualization from 1963. This widely disseminated operational definition is as follows: “The term ‘specific learning disability’ means a disorder in one or more of the basic psychological processes involved in the understanding or in using language, spoken or written, which may manifest itself in an imperfect ability to listen, speak, read, write, spell, or do mathematic calculations" (U.S. Office of Education, 1968, p. 34).

Within current federal regulations, several procedures for LD identification are permitted, although two approaches tend to dominant contemporary practice in a majority of school systems. These include the IQ-achievement discrepancy approach in which a significant discrepancy between cognitive ability and academic performance is used as a marker for LD and an alternative procedure in which a child's response to "research-based scientifically validated instruction" is evaluated with inadequate response to instruction serving as a potential marker for the presence of a LD. More recently, another potential alternative has been proposed in which primary consideration is given to a student's observed pattern of intra-individual cognitive-achievement strengths and weaknesses (e.g., Decker, Hale, & Flanagan, 2013). However, the regulatory and evidentiary support for these so-called "pattern of strengths and weaknesses" or PSW approaches has been questioned (e.g., Lichtenstein & Klotz, 2007; McGill, Styck, Palomares, & Hass, 2016). It should be noted that regardless of the approach that is utilized, none of these data are singularly sufficient for determining whether a student is eligible for special education and related services under the category of SLD. That is, this information (i.e., discrepancy, response to instruction, PSW) must be combined with additional sources of data within a comprehensive assessment process. Similar to the DSM-5, federal regulations stipulate that low-achievement cannot be the result of intellectual disability, other sensory or neurocognitive dysfunction, and/or environmental factors.

Due to the fact that a "gold standard" identification method has yet to be established, the National Joint Committee on Learning Disabilities (NJCLD) has warned against the elevated risk of false positives and false negatives when classifying individuals with LDs in the schools. Thus, adherence to a consistent definition of LD is imperative. However, recent surveys indicate that, within the context of special education, there are numerous classification methods used within and between states, illustrating well the problem our field faces with regard to consistent and accurate identification (Williams, Miciak, McFarland, & Wexler, 2016).

Research Domain Criteria (RDoC)

Recent strategic initiatives at National Institute of Mental Health (NIMH) have produced an alternative way of classifying mental disorders based on neurobiology and observable behavior termed *Research Domain Criteria* (RDoC). The fundamental goal of the RDoC framework is to fully integrate the genetic, neurobiological, behavioral, environmental, and experiential signatures of mental disorders such as LD. According to Cuthbert & Insel (2013), "RDoC incorporates an explicitly dimensional approach to psychopathology" (p. 129), requiring the appraisal of symptoms across several empirically supported domains (negative valence, positive valence, cognitive systems, systems for social processes, and arousal/modulatory systems). According to Lovett and Hood (2011), conventional LD classification systems largely employ *operationalist* conceptions of the disorder in which LD represents nothing more than the operational definition employed by each model and is not linked to the latent dimensions thought to underlie the disorder in any meaningful way. Although application of this framework to better understand LD is currently in its infancy, it may prove beneficial given recent research that suggest that LDs may have distinct genetic and neurological signatures (e.g., Skeide et al., 2016).

For LD in particular, Hale et al. (2016) noted that the RDoC framework may be instrumental in moving the field away from behavioral diagnostic criteria (e.g., DSM-V) and fostering greater recognition of individual differences in the differential diagnosis of LD subtypes. More importantly, it may encourage practitioners and researchers to explore how other domains of psychosocial functioning may help contribute to our understanding of the etiology of LD.

Prevalence and Cultural Factors

Epidemiological surveys indicate that approximately 5% to 15% of school-age children present with learning disorders (Moll et al., 2014). Reading disorder is the most researched and most common variant of LD. Evidence suggests that approximately 70% to 80% percent of individuals with a LDs have primary deficits in reading (Ferrer et. al, 2010). Since the enactment of IDEA, more individuals have received special education services under the category of SLD than any other eligibility category. Whereas, the number of students identified with LD using special education criteria declined by 18% between 2002 and 2011, LD remains the largest category for students receiving services in the schools, representing 42% of all students who are identified across the different eligibility categories (Cortiella & Horowitz, 2014). Compared to reading, prevalence rates for math (5% to 13%) and writing (8% to 15%) difficulties are far less common among individuals with LDs. Whereas there is evidence for distinct LD subtypes, co-occurring difficulties across academic domains are fairly common (Raddatz et al., 2016).

It appears there is a higher incidence rate of LD in males than in females. In fact, epidemiological studies suggest a significant gender disparity with LD occurring more frequently in males than females by a ratio of more than 2:1 (Moll et al., 2014). However, some researchers have questioned the degree to which these differences reflect biological predisposition suggesting that the higher rates among males are mostly attributable to referral bias in the schools (McDermott, Goldberg, Watkins, Stanley, & Glutting, 2006). Although it is suggested in the DSM that prevalence rates are consistent across different languages and cultures, research suggests that students with culturally and linguistically diverse backgrounds are more likely to be over- or under-represented in terms of receiving special education services under the category of SLD in the schools depending upon the particular sample that is examined (Hallahan, Pullen, & Ward, 2013; Morgan et al., 2015). It has long been suggested that over-representation is produced from educational systems that continue to lack the resources that are needed to capably address the diverse needs of what has become an increasingly pluralistic student population (Sleeter, 1986; Vazquez-Nuttall et al., 2007).

Age, Developmental Course, and Comorbidity

The onset and identification of LD usually occurs during the formative school years when children are first required to learn how to read, write, spell, and do math. Although the deficits association with this condition are lifelong, the presentation of symptoms can vary considerably depending on the task demands of the environment and the degree to which an individual is academically impaired. In most circumstances, symptoms follow a developmental trajectory wherein difficulties with prerequisite skills impede the mastery of more advanced academic tasks that are encountered later in development (Lewandowski & Lovett, 2014). Observed difficulties in preschool/kindergarten may include an inability to recognize and write letters, difficulty breaking down spoken words into syllables, recognizing words that rhyme, or connecting letters with their sounds. In the primary grades, symptoms may include difficulty recognizing and manipulating phonemes, sequencing numbers and letters, or remembering number facts or arithmetic procedures. The middle grades are typically marked by the emergence of deficits in fluency, automaticity, and comprehension across academic domains. By contrast, adolescents typically have mastered early literacy and computational skills but oral reading and math calculation remain slow and effortful. Compared to their peers, individuals with LDs are more likely to employ remedial strategies such as finger counting when attempting to solve rudimentary calculation problems. This is also the developmental stage when externalizing and internalizing symptoms are likely to present due to the recursive effect of learning difficulties on psychosocial development (Geary, 2011).

Research has long demonstrated that LDs can co-occur with an array of neurodevelopmental and mental disorders, including attention-deficit hyperactivity disorder (ADHD), anxiety-related disorders, depressive disorders, bipolar disorder, autism spectrum disorder, developmental coordination disorders, language disorders, and communication disorders (Boat & Wu, 2015). To wit, Margari and colleagues (2013) examined the prevalence rate of psychopathology in a sample of 448 individuals with LDs and found that comorbidity occurred in 62% of the sample. Specifically, they most frequent rates of co-occurrence were ADHD (33%), anxiety disorder (29%), developmental coordination disorder (18%), language disorder (11%), and mood disorder (9%). The estimated comorbidity between LD and ADHD varies throughout the literature; however, Barkley (2014) notes that ADHD rarely occurs absent the presentation of significant learning problems further complicating differential diagnosis. Not surprisingly, it has been found that individuals with co-occurring LD and ADHD present with more severe impairments in learning when compared to individuals with only a sole LD diagnosis due to the more pronounced deficits in neurocognitive functioning associated with ADHD (Pastor & Reuben, 2008). Thus it is important to carefully evaluate the degree to which the symptomology associated with LD may be masking underlying issues related to attention and self-regulatory skills more commonly associated with ADHD.

Children with lower levels of cognitive ability can also pose a challenge for differential diagnosis as the exclusionary criteria in virtually all classification systems suggest that academic difficulties cannot be attributed primarily to a broader intellectual disability. Whereas studies have shown that children with LD and those with mild ID present with similar behavioral characteristics, important differences in cognitive and academic abilities have been observed (e.g., Gresham, MacMillan, & Bocian, 1996; Polloway et al., 1997). Brueggemann-Taylor (2014) suggests that differential diagnosis of LD and mild ID requires assessing achievement, intelligence, and adaptive functioning:

> When a child or adolescent displays a significant deficit in one (or several limited) academic area(s), it may be determined that the individual has a *specific* LD. On the other hand, when an individual displays deficits across most academic areas, intelligence and adaptive behavior should be assessed to determine if the individual has mild ID (p. 187).

LDs are domain specific, meaning that impairment in reading, mathematics, and writing have different environmental expressions and require different intervention needs.

Conceptual Models for Intervention

Next, we introduce the conceptual foundations for contemporary treatment approaches and their protocols. Treatment planning and case conceptualization is a complex process that involves the gathering of information beyond that needed for the conferral of a diagnosis (Hunsley & Mash, 2010). In that respect, developing interventions to treat learning disabilities can be viewed as the culminating process in a broader assessment to intervention continuum (Fletcher, Francis, Morris, & Lyon. 2005; Fuchs, Fuchs, & Speece, 2002). In general, conceptual models guide this process by providing an explanation for the development and manifestation of learning disabilities and their symptoms. As such, conceptual models function as a theoretical framework to explain how learning disabilities should be treated in professional practice

(Fletcher et al., 2002; Sheridan & Gutkin, 2000). Consequently, we review several important conceptual models that have guided intervention research in the field of learning disabilities.

Medical Model

Medically oriented approaches suggest that LDs are the expression of underlying biological pathology. That is, academic difficulties are the result of a deficit or dysfunction in a specific region of the brain such as the angular gyrus in the case of reading. According to Hallahan, Pullen, and Ward (2013), the early foundations of the field were heavily influenced by the medical model. For instance, Wernicke (1874) described several case studies of brain-injured patients with language disorders which were he termed “aphasia.” The evidence provided by later case studies converged to suggest that these disorders could be sourced to disruptions in the left frontal-temporal network. In later case studies, it was suggested more specifically that lesions within these areas could produce “word blindness,” later termed “dyslexia” (Anderson & Meier-Hedde, 2001).

Recommended treatments might involve exercises and training designed to develop and stimulate specific areas of the brain where the deficit is thought to reside. Some examples include the use of special lens to enhance visual processing abilities (i.e., developmental ophthalmology), multi-sensory approaches to teaching, and “brain-based” learning techniques. Although the dissemination of these and other related techniques has been widespread, the historical evidence base for their efficacy has been modest (see Swanson & Hoskyn, 1998). As a result, researchers (e.g., Fletcher, Lyon, Fuchs, & Barnes, 2007; Mann, 1979) have long suggested that the medical model may be outdated as a conceptual model for treatment.

Despite the modest outcomes of previous approaches to treatment, the medical model is experiencing a resurgence as a result of the advances in brain imaging technologies over the past

20 years. Well replicated studies have documented the biological underpinnings that seem to underlie reading and mathematics disorders and, more importantly, have provided evidence of post-treatment cortical reorganization (e.g., Ashkenazi et al., 2013; Finn et al., 2014; Richards & Berninger, 2008). As a result, neurobiologically informed approaches for assessment, diagnosis, and treatment of LDs (e.g., Hale & Fiorello, 2004; Miller, 2013) are increasingly becoming more prominent. In fact, a good example of this influence is the RDoC framework.

Psychoeducational-Remedial Model

Although closely aligned with the medical model, the psychodiagnostic-remedial model focuses more specifically on the cognitive processing deficits that are believed to be the root cause for deficits in academic functioning. In contrast to the medical model, the psychoeducational model stresses intervention techniques designed to target academic skills as well as information-processing abilities (not underlying biological processes per se). Assessment procedures focus on the identification of idiographic cognitive strengths and weaknesses using multi-dimensional cognitive/intellectual test batteries such as the Wechsler Scale of Intelligence for Children and the use of that information to guide treatment selection.

Samuel Kirk's (who is also credited with first using the term "learning disabilities") assessment and intervention research using the *Illinois Test of Psycholinguistic Abilities* (ITPA; Kirk, McCarthy, & Kirk, 1961) was particularly persuasive in the rise of the psychoeducational approach. Although this research was later criticized (see Mann, 1971, 1979), it suggested that children with LDs have unique cognitive profiles and that assessment of intra-individual differences was crucial for guiding the remediation of academic deficits. That is, that some instructional strategies or treatments may be more or less effective for particular individuals depending upon their specific cognitive abilities (i.e., aptitude by treatment interaction [ATI], see

Figure 1). Although a comprehensive review of ATI research is beyond the scope of the present chapter, early attempts to validate ATI at the level of the individual were largely unsuccessful (see Cronbach & Snow, 1977 for a comprehensive review). Nevertheless, more recent approaches to treatment informed by psychometric models of intelligence (e.g., Decker, 2008; Mascolo, Alfonso, & Flanagan, 2014) illustrate that the influence of the psychoeducational approach and ATI remains pervasive in the field.

Figure 1

Cognitive-Behavioral Model

Cognitive-behavioral models of intervention recognize the complex influence of environmental contingencies and cognitive and affective states on behavior. That is, treatment planning should take into consideration multiple variables for the learner including but not limited to observable behavior, the broader environmental ecology, and internal thoughts and feelings. From this perspective, it is believed that there is a reciprocal relationship between all of these variables as they serve to interact and influence one another. Additionally, Pendergast and Kaplan (2015) stress that it may be important to consider additional mediating factors, such as the role of student motivation and self-regulation, as they relate to learning in an instructional context. In fact, it has long been suggested that conative variables (i.e., variables that relate to intention and personal motivation) such as these may account for comparable portions of achievement variance as IQ (Cattell, 1971). Within this approach, the application of behavior modification principles as well as strategies that target self-regulated and metacognitive behavior (i.e., Zimmerman, 1989) are both viewed as legitimate.

As such, cognitive-behavioral interventions can be viewed as to be eclectic, utilizing a combination of direct instructional strategies to remediate academic skills as well as strategy instruction for enhancing self-regulated learning. As an example, Montague, Enders, and Dietz (2011) utilized the "Solve It!" program to enhance the math problem solving skills of 40 middle school students with and without LD. The intervention was designed specifically to teach a range of cognitive and metacognitive processes, strategies and mental activities to facilitate learning and improved math performance. This involved a combination of direct skill instruction, modeling, problem solving practice sessions, and performance feedback from teachers. Cognitive-behavioral informed interventions have been used to remediate difficulties in a diverse array of academic areas and skills such as reading decoding and comprehension (Roberts, Torgeson, Boardman, & Scammacca, 2008), math problem solving (Montague, Enders, & Dietz, 2011), writing (Graham, McKeown, Kihara, & Harris, 2012), and homework, organization and planning, skills (Langberg, et al., 2012).

Task Analytic Model

Task analytic models situate the actions of a learner within the context of the immediate environment and deemphasize the underlying casual factors (i.e., neurological dysfunction, cognitive processing deficits) that are the primary foci in the medical and psychoeducational-remedial models. Task analytic models utilize many of the core principles of applied behavior analysis (i.e., Baer, Wolf, & Risley, 1968; Bijou, 1970) to develop and monitor treatments to remediate academic skill deficits. Functionally, this approach requires breaking down a complex academic skill into a series of steps; these steps are then organized sequentially, and a student is taught each step in the sequence. A student does not proceed to the next step in the sequence until they are able to demonstrate that they have mastered or acquired the previous step. Criteria for mastery are determined *a priori* based upon the student's baseline level of performance prior to intervention delivery. The task analytic approach relies heavily on the use of formative assessment (e.g., curriculum-based measurement [CBM]) to guide decision-making throughout all steps of the intervention process.

Interventions guided by task analytic models have a rich history in the educational sciences. For example, the Direct Instruction (DI) model developed by Englemann in 1964 at the University of Illinois and later expanded with colleagues at the University of Oregon incorporates many elements of the task analytic approach (Englemann, 2007; Englemann, Becker, Carnine, & Gersten, 1988). Over the last 40 years, use of DI methods have consistently produced favorable intervention outcomes for individuals with LDs in reading, mathematics, and written language (e.g., Coyne, Kame'enui, & Carnine, 2011; Kame'enui, Fein, & Korgesaar, 2013; Lloyd, Forness, & Kavale, 1998; Swanson, 1999). Additionally, the DI model has been featured as a core component of curricula materials utilized in large scale national efforts to remediate struggling learners (e.g., Project Follow Through, Reading First). However, it should be noted that the DI model has been the subject of much criticism due to the prescriptive nature of its curriculum/intervention materials and the theoretical assumptions required for successful adoption of its procedures.

Multi-Tiered Systems of Support (MTSS)/Prevention Model

The MTSS/prevention approach to intervention is an eclectic model that includes a mix of assessment and intervention techniques from the behavioral consultation model outlined by Bergin and Kratochwill (1990) and the cognitive-behavioral and task analytic approaches. The primary goal of this approach is the prevention and treatment of academic difficulties before they manifest into LDs within the context of a multi-tiered system of supports (MTSS) or three-tier model. Although the MTSS/prevention approach is well ensconced in the field of school psychology, its application in other areas of the psychological sciences has been more circumscribed. Though it should be noted that certain aspects of the MTSS approach were inspired more generally by public health models for psychological consultation (Fletcher & Vaughn, 2009).

Proponents of this model suggest that previous psychodiagnostic approaches to the identification and treatment of LD and its various subtypes and profiles (i.e., discrepancy model, medical/psychoeducational models) has not produced beneficial treatment outcomes for learners with academic difficulties and is therefore not useful (Fuchs, Fuchs, & Speece, 2002; Gresham & Witt, 1997; Reschly, 2008). Instead, mental health professionals are encouraged to embrace the use of low-inference screening and formative assessment technologies (i.e., CBM) that produce information that is more directly related to potential intervention targets such as specific academic skills. These data can then be used to identify students in need of remediation, inform intervention selection, and monitor the progress of interventions after they have been implemented (Hosp, Hosp, & Howell, 2016). In this way, the intervention process coheres functionally with the tenets of *short-run empiricism* as described for scientific psychology by Cronbach (1957).

The MTSS/prevention model can be implemented in several ways, but in general the progress of all students are monitored using academic screening measures to evaluate their response to the curriculum delivered in the general education instructional environment (Tier 1). Students may be identified as *at-risk* for academic difficulties (which presumably can include LDs) when their performance on these measures falls below *a priori* benchmark levels that are based on expectations for performance derived from local norms. Students who are identified as at-risk are provided with targeted interventions that vary in intensity (Tiers 2 and 3) and their treatment progress is monitored systematically to evaluate change over time usually using a single-case design evaluation framework (e.g., Riley-Tillman & Burns, 2009; Vannest, Davis, & Parker, 2013). According to Deno (2013), an intervention may be deemed effective when the discrepancy between observed and expected performance is remediated. As should be apparent, data-based decision making is emphasized throughout all three tiers of the MTSS model from initial screening to the provision of more intensive intervention at Tier 3 (Ardoin et al., 2013). Although decisions regarding the allocation of intervention resources in an MTSS model may be systematic, treatment evaluation decisions that determine whether an individual has benefitted from an intervention at Tiers 2 and 3 can be subjective, as the criteria and objectives that are adopted by users may fluctuate across settings (Ball & Christ, 2012; McGill & Busse, 2014).

Theoretical Models Are Not Arbitrary

The conceptual models that we have reviewed differ tremendously in terms of their assumptions about the etiology of LD, the intervention procedures necessary to remediate LD-related symptoms, and how those interventions may be deployed and monitored. As a consequence, it is imperative that mental health professionals take into consideration the conceptual models and/or orientations that underlie various intervention approaches for LDs when evaluating the technical and professional literature. While different approaches may ultimately lead to the same outcome with respect to treatment selection, the path to that treatment can vary. Whereas the medical and psychoeducational-remedial models focus on the within-child biological, cognitive, and neuropsychological sequelae that converge to produce academic difficulties in individuals with LDs, the task analytic and prevention approaches focus more on the identification of treatment needs and the environmental contingencies that are thought to maintain academic underperformance. As such, an adherent of the prevention model is more likely to endorse direct assessment of academic skills and formative progress monitoring of treatment outcomes, whereas advocates of the psychoeducational approach will more likely favor the use of intellectual and neuropsychological tests to determine idiographic or nomothetic strengths and weakness in cognitive processing abilities and then use that information to guide treatment selection.

Additionally, the influence of the prevention/MTSS approach over the last 15 years in the field of learning disabilities cannot be overstated. Multi-tiered systems such as RTI are ubiquitous in education and psychology (Erchul & Martens, 2010). To wit, the use of RTI related assessment and intervention criteria are now enumerated within the diagnostic criteria for LD in the DSM-5 and in the regulatory guidelines that determine special education eligibility in the schools in many states (Cavendish, 2012). This rise has been attributed to a number of factors such as a dissatisfaction with existing classification and intervention models and the influence of implementation science and evidence-based instruction in clinical science. Although a more in depth discussion of these issues are beyond the scope of the present chapter, interested readers are invited to consult Schulte (2015) for a thorough review of the confluence of factors that led to the rise of the RTI/prevention approach.

Finally, we acknowledge that our relatively brief discussion of the conceptual models prevents us from outlining all of the salient features of these approaches and the perspectives that are brought to bear as it relates to LD intervention and, in many circumstances, the assessment procedures that are considered most relevant to very diagnostic process itself. In our discussion we have included the models that we believe have exerted the greatest influence on intervention research over the last decade. Previously, Lyon, Fletcher, Fuchs, and Chhabra (2006) outlined additional models that were not included in the present discussion, as their influence appears to have waned in the intervening years or, in our estimation, they are difficult to disentangle from other closely related approaches. In sum, we believe this discussion illustrates well that conceptual models are not arbitrary as they serve to promote certain assessment and intervention practices at the expense of others (Nickerson, 1998). Consequently, we encourage mental health professionals to carefully evaluate the treatment literature to determine the degree to which available empirical evidence supports the claims made by proponents of each of these approaches. In sum, the models reviewed can be sorted into two tiers. The first tier encapsulates conceptual models (i.e., Cognitive-Behavioral, Task Analytic, Prevention) that are well supported in the professional literature and are likely to be the most useful frameworks from which to develop treatments for individuals with academic disorders. The second tier includes models (i.e., Medical, Psychoeducational) for which there is limited evidence of effectiveness or in some cases, evidence of contraindicated effects.

Evidence-Based Practice and the Dissemination of Empirically Supported Treatments

In the following sections of the chapter, we review developments in intervention outcome research that have culminated in the emergence of the evidence-based practices movement in the educational and psychological sciences. We then discuss the viability of proposed guidelines for application of evidence-based criteria in selecting interventions for children with LDs and introduce readers to several repositories that have been developed to promote guidance in selecting evidence-based interventions to ameliorate the symptoms associated with LDs.

Methodological Quality of Treatment Research

In the field of learning disabilities, the methodological quality of treatment/intervention studies have long been a source of concern. Several of these concerns have been highlighted in great detail in previous editions of this chapter (Lyon & Cutting, 1998; Lyon et al., 2006). For instance, Lyon and colleagues (2006) noted that many of the studies that they reviewed suffered from methodological shortcomings such as failure to employ random assignment, not examining the extent to which relevant ecological variables (i.e., individual differences, socioeconomic status, etc.) potentially mediate intervention outcomes, descriptions of intervention procedures that omit key details, failing to account for the effects of prior interventions, and the use of multi-modal intervention packages without unpacking which particular aspects of a treatment may be more effective than others.

Although large scale randomized controlled trials (RCT) have been referred to as the "gold standard" in the social sciences (Shavelson & Towne, 2002), single-case intervention designs have also been featured as an important methodology in the evidence-based practice movement. Given the frequent use of single-case design (SCD) to evaluate treatment outcomes in special education, Horner and colleagues (2005) proposed a series of quality indicators for evaluating the methodological rigor of single-case studies. Whereas they concluded that single-case design was a powerful and useful methodology for identifying potentially effective treatment for children and adolescents with disabilities, professional standards were needed in order for these procedures to inform evidence-based practice in special education treatment research. It is worth noting that many of these standards were later incorporated into the SCD technical documentation for the What Works Clearinghouse (Kratochwill, 2010), which allowed for single-case studies to be included in the pool of scientific evidence available for review. However, more recently, Burns (2014) argued "It is not always necessary to implement an experimental design that meets the current SCD standards (Kratochwill et al., 2013), because the design being made may not warrant such an effort or the behavior may not allow for reversing or withdrawing the intervention” (p. 341).

More recently, Lyon and Weiser (2013) found that intervention research in the field of learning disabilities had increased in rigor with the application of more robust experimental designs such as RCTs and regression discontinuity designs (RDD). They attributed these improvements to the growth of the evidence-based practice movement in psychology and education and the development of online repositories such as the What Works Clearinghouse for mathematically aggregating intervention research outcomes. Despite these improvements, Makel and colleagues (2016) argue that replication is a central tenet of the scientific research process that has largely been ignored in special education research[1]. To wit, “It is only when the results from experimental studies are replicated, and more than once, that a practice can truly be considered evidence based” (Makel et al., 2016, p. 205). In a comprehensive analysis of 36 special education journals, they found that only 0.5% of all articles reported seeking to replicate a previously published study. Although these estimates were comparable with those that have been reported in other disciplines, the paucity of replication of treatment findings is concerning given the implications from the so-called ‘reproducibility crisis’ that has been much discussed in scientific psychology (Johnson et al., 2016). As a consequence, we look forward to more research in the future that is aligned with open science movements that promote replication such as the reproducibility project (Open Science Collaboration, 2012).

Applying Evidence-Based Criteria in Selecting Interventions

Consonant with the broader trends in health care, the evidence-based practice (EBP) movement has gained tremendous momentum in the educational and psychological sciences over

[1] Replication is also consistent with the broader EBP movement in psychology and thus it can be applied as a standard for other psychological interventions.

the last decade (Cook & Odom, 2013; Kratochwill, 2007). EBP has been defined as the "conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996, p. 71). Additionally, Stoiber and DeSmet (2010) suggest that the purpose of the EBP movement is to educate mental health professionals in "criteria that should be considered for evaluating interventions and to promote the implementation of effective practices" (p. 215). Despite the laudable goals of the EBP movement, critics have suggested that to some extent these *criteria* are arbitrary, will differ across disciplines, and will emphasize certain treatments at the expense of others (Wampold & Bhati, 2004). As a result, there is a considerable amount of professional judgement that is required when conferring the term "best practice" to a particular treatment.

Despite these limitations, we believe that it is important for clinicians to use some kind of systematic criteria to evaluate the quality of the treatment literature in order to determine which practices they consider to be most effective and/or promising for the treatment of LDs (see Stoiber & DeSmet, 2010 for a useful framework). Such an evaluation should take into consideration both the quality of the individual studies as well as the strength of the scientific evidence base for a particular practice as a whole. That is, not all "evidence" is created equal (Lilienfeld, 2011). As an example, a single quantitative meta-analysis (synthesis of multiple outcome studies) suggesting modest treatment outcomes should be ascribed more weight than several case studies that suggest more robust treatment effects (Youngstrom & Prinstein, in press). Fortunately, there are number of clearinghouses and online resources that are available to aid clinicians in their appraisal of available evidence. We describe some of these resources in more detail below.

What Works Clearinghouse (WWC). After the passage of the No Child Left Behind Act (NCLB, 2001), the United States Department of Education (USDOE) took action to promote scientifically-based research in the educational sciences with the funding of the What Works Clearinghouse (WWC). The purpose of the WWC is to evaluate the methodological rigor of treatment studies in education and the quality of the evidence-base to support the treatment claims made in the professional literature. According to Malouf and Taymans (2016), "during the past decade, the WWC has undertaken over 500 syntheses of impact research on over 400 different educational interventions, releasing practitioner friendly 'intervention reports' on the findings" (p. 454). Since its inception, the WWC has also published 22 "practice guides," two of which are devoted to assisting students struggling in reading and math within the context of a multi-tiered prevention/intervention framework (i.e., RTI; Gersten et al., 2008, 2009).

Despite the promise of the WWC, its utility for informing evidence-based practice has been questioned. In their review, Malouf and Taymans found that most interventions on the WWC website were found to have no or little support based on the studies that were included in the intervention reports and that the effect sizes associated with positive interventions were of a questionable magnitude. For children and youth with disabilities, the WWC provides users with seven reports for intervention outcomes related to the remediation of academic difficulties. Five of the seven interventions yielded positive albeit small effect sizes. For example, only two studies met WWC inclusion criteria for Read Naturally®, with one study indicating potentially positive effects. However, according to the intervention report 42 Read Naturally® outcome studies were located in the professional literature but were not included in the synthesis. In fact, Malouf and Taymans (2016) found in the aggregate that approximately 76% of studies failed to meet WWC evidence standards given the preference for randomized designs. They concluded that “This policy tends to perpetuate the chronic weaknesses of the evidence base as well as endorsing evidence with questionable relevance to practice” (p. 458). Whereas this high bar may underuse the hulk of available research, we argue that the WWC reports should be given credence by practitioners given the rigorous standard for evaluating evidence that is employed.

Evidence-Based Intervention (EBI) Network. In 2007 the Evidence-Based Intervention (EBI) Network began as the EBI project under the direction of Chris Riley-Tillman at East Carolina University. In 2011 the site (http://ebimissouri.edu/) was moved to the University of Missouri and the network has expanded to include additional university partners throughout the United States. The primary goal of the EBI network is to “provide guidance in the selection of evidence-based interventions in the classroom setting” (Riley-Tillman, 2014). The site contains numerous intervention briefs for reading and mathematics interventions. While the interventions briefs were not developed specifically for children with LDs in mind, many of the interventions outlined on the site are consistent with those outlined in our discussion of domain-specific intervention strategies and outcomes later in the chapter. Each brief contains a description and rationale for the intervention, the specific academic component skills which it is designed to remediate, a step-by-step description of intervention procedures, the materials needed for implementation, and a list of references that document empirical support for its effectiveness. Additionally, modeling videos are also available for specific intervention strategies.

To guide intervention selection, the EBI network utilizes a framework proposed by Daly, Witt, Martens, and Dool (1997) which suggests that academic difficulties can generally be classified as a *can’t do* problem or a *won’t do* problem. For students who cannot do the academic skill that is expected of them in the environment, interventions should focus on remediating the underlying skills needed to successfully complete that task. For students who refuse to perform the skill that has been previously learned, interventions should address modification of the instructional environment in such a way that it motivates the student to perform. All of the interventions on the EBI network or organized along this framework so that once the hypothesized reason for the academic problem(s) is identified, that behavioral function can be used to select from a menu of interventions.

Intervention Central. Intervention central (http://www.interventioncentral.org/) is a popular website created by Jim Wright designed to provide mental health professionals and educators with access to free academic and behavioral intervention and assessment resources that closely align with the MTSS/prevention model. Like the EBI network, intervention briefs are categorized by academic domain/skill area and each contain a step-by-step procedural description of the technique as well as references to articles that provide evidence of its potential effectiveness. Additionally, the website contains numerous articles on effective academic interventions and several apps that can be used to plan interventions and assess intervention outcomes.

Treatment Settings

Interventions to remediate learning disabilities are delivered in a variety of treatment settings ranging from schools and out-patient treatment centers to hospitals and research settings (cf., Kumon, Learning Rx). In spite of this diversity, school systems have historically served as the primary location for the delivery of interventions to children. For instance, in a meta-analysis of learning disability treatment outcomes by Swanson and Hoskyn (1998), almost all of the 180 intervention studies analyzed were delivered in school-based settings. More recent surveys (e.g., Lyon & Weiser, 2013; Suggate, 2016; Swanson, 2008) have produced similar findings, indicating that little has changed in contemporary practice. In summarizing the state of science in learning disabilities, Lyon and Weiser (2013) note that "the field is now 44 years old, deeply embedded in the education culture internationally, and codified in federal law" (p. 119). Thus, it is anticipated, that school systems will continue to serve as the primary setting for the development and delivery of new and promising intervention systems and techniques to treat LD in the educational and psychological literatures.

Additionally, we must note that LDs are different from many of the other disorders covered in this text, in that psychologists and other related mental health service providers are rarely the source of direct interventions to children. More often, a psychologist acts as a consultant to help recommend and facilitate the provision of such treatments through a highly trained third-party (i.e., teacher, interventionist or paraprofessional, educational therapist). Nevertheless, a conceptual understanding of the LD treatment literature is needed whether one is serving in a direct or indirect capacity to help ameliorate academic dysfunction.

As schools are nested social systems, it is also important for clinicians to consider the dimensions of school context, culture, and climate when functioning as consultants to facilitate interventions. That is, being able to identify an evidence-based intervention is a small, albeit important, part of the consultative process. When selecting interventions, Forman, Olin, Hoagwood, Crowe, and Saka (2009) suggest that several additional areas need to be addressed prior to delivery including: (a) development of administrative support; (b) development of financial resources to sustain practices; (c) provision of high quality training to ensure fidelity; and (d) alignment of intervention with institutional philosophy, goals, policies, and programs. As noted by (Fixsen et al., 2010), "effective interventions on a scale sufficient to benefit society requires careful attention to implementation strategies as well. One without the other is like serum without a syringe, the cure is available but the delivery system is not" (pp. 447-448).

Summary

As previously mentioned, the EBP perspective emphasizes the scientific evaluation of available research evidence in order to determine which psychological interventions are most likely to “work.” To be sure, science is not perfect, but it can help to protect us from inferences which may lead us down unproductive paths and blind alleys (Lilienfeld et al., 2013). The influence of the EBP movement in education has resulted in the creation of several clearinghouses and repositories (i.e., WWC) that serve to promote best practice in the field. These are important resources that can also be utilized by clinicians to help inform treatment selection for individuals with LDs. Nevertheless, we encourage practitioners to keep in mind that EBP evolves in accord with new evidence. This, a treatment that is regarded as best practice today may later be found to be less useful as more evidence is acquired.

Overview of Treatment Outcome Literature

Given the prevalence rate of children diagnosed with a learning disability and/or receiving compensatory services (i.e., special education and related services) to address LD-related symptoms in public schools in the United States and beyond, research on the treatment of LD has become a major focus of scientific investigation in several academic disciplines (Swanson, Harris, & Graham, 2013). These include but are not limited to psychology, neuroscience, and education. A recent Google Scholar search for material produced in the professional literature since from 2016 to 2017 using the terms *Learning Disabilities*, *Treatment*, and *Children* produced over 54,000 results. In fact, the very size of the treatment literature is now one of several factors that complicate the identification and dissemination of evidence-based treatments (Cook & Odom, 2013; Kilgus, Riley-Tillman, & Kratochwill, 2016; Vaughn & Linan-Thompson, 2003). Nevertheless, in the remaining portions of this chapter, our goal is to provide a selective overview of domain-specific empirically supported learning disability treatment strategies with a particular focus on key findings that have emerged and/or been replicated since the previous edition of this chapter (Lyon et al., 2006).

In constructing this review, we gave preference to treatment strategies with well-established research bases supported by quantitative meta-analyses and individual studies that employed more rigorous designs such as RCTs. We realize that some may view this as unnecessarily restrictive, however, we agree with Kazdin and colleagues (2008; McFall, 1991; Straus et al., 2011) that greater confidence can be placed in treatments that are supported by evidence that aligns with higher levels of the scientific hierarchy.

Impairment in Reading

Reading disability (RD) is the most common subtype of LD, occurring in approximately 5% to 10% of all children and adolescents (Lewandoski, & Lovett, 2014). As such, it has received a disproportionate amount of attention in the LD treatment literature. Research has long suggested that the causal deficits underlying RD appear to be concentrated in the abilities needed to accurately identify and decode individual words (Henbest & Apel, 2017). Long ago, Stanovich (1986) described the reciprocal relationship between early word identification difficulties and the development of the cognitive processes that facilitate efficient decoding and higher-order comprehension skills. Given their importance, it was suggested that these early deficits in basic word reading skills produces a gap between *slow starters* and *fast starters* that continues to widen over time absent intensive intervention, a phenomenon referred to as the “Matthew Effect” (i.e., the rich get richer and the poor get poorer). As a result, a substantial amount of research has been devoted to the early identification and remediation of the emergent literacy skills that are thought to produce these difficulties in kindergarten and the early grades.

Phonemic Awareness/Phonics Instruction. Within the scientific literature, there is consensus that a deficit in a domain of linguistic competence known as "phonological awareness" is highly predictive of early reading failure and a core deficit in individuals with RD (Kudo, Lussier, & Swanson, 2015). Phonological awareness (PA) is a multifaceted metalinguistic set of processing skills that generally refers to the ability to encode and manipulate the sound structure of language. Deficits in these skills can impede a child's ability to internalize the letter-sound relationship in written words resulting in dysfluent oral reading. Although several controlled and comparative studies in the late 1990s suggested that both garden variety poor learners and children with RD benefitted tremendously from direct approaches to the remediation of phonemic skills (e.g., Foorman et al., 1998; Vellutino, et al., 1996), the results produced from a quantitative meta-analysis conducted by the National Reading Panel (NRP, see Ehri, et al., 2001 for a summary of these results) was particularly instrumental in making PA instruction a core feature of many commercial intervention products that were developed in response to subsequent large scale nationwide efforts to remediate reading difficulties (i.e., Reading First). Although some have criticized these efforts as having a singular focus on PA and phonics-based instruction, it is important to note that many of the PA/phonics interventions in the literature are accompanied with instruction that involves other aspects of reading development. In general, the NRP found that PA interventions were most effective when they were delivered in small group settings (5-8 students), over a relatively brief period of time (15-30 minutes), and consisted of systematic direct instruction and feedback on multiple phonemic skills (e.g., rhyming, blending, and segmentation words). These core findings have been well replicated in the treatment literature over the last decade (Vaughn & Wanzek, 2014).

Positive treatment effects associated with instructional approaches that incorporate PA/phonics instruction for struggling readers have been long documented in the professional literature. In previous reviews, a variety of approaches have been associated with improvement, including commercial programs (Lindamood-Bell, Reading Mastery, Voyager Passport) as well as research-based approaches (PHAST Reading, RAVE-O). The consistency of these findings has led some researchers to suggest that positive treatment gains are more attributable to the way in which a treatment is delivered rather than the particular program that is selected. For instance, more impressive gains have long been associated with treatments that are delivered systematically and with greater intensity. As an example, Vernon-Feagens and colleagues (2012) examined the effectiveness of teacher-led word identification strategies in decoding and fluency in a randomized controlled trial of 276 children. Individualized interventions were delivered 1:1 for 15 minutes a day four times a week for implementation periods that ranged from 4 to 9 weeks depending on the level of impairment for each child. The difference in word attack gains between the treatment and control students was sizable (10.01 points), and there was evidence for a significant main effect on both word attack and letter-word identification. In a comprehensive synthesis of 22 RCTs, Galuschka, Ise, Krick, and Schulte-Korne (2014) examined the effectiveness of treatment approaches for children and adolescents with reading disabilities. They found that phonics instruction was the most intensively investigated treatment approach in the empirical literature; as a result, it was the only treatment approach whose effects on reading skills could be "statistically confirmed." Nevertheless, the aggregate effect size associated with the PA/phonics instruction was .32, which is indicative of a small to moderate effect. Similarly, Wanzek, Wexler, Vaughn, and Ciullo (2010) found that the effects of word recognition interventions on struggling readers delivered at upper elementary grades were consistently small to moderate.

However, recently it has been argued that the moderate effect sizes associated with PA/phonics interventions may be an artifact of recent attempts to standardize treatment outcome research in education (i.e., WWC). In a replication study, Scammacca, Roberts, Vaughn, & Stuebing (2015) found that the mean effect associated with reading interventions in general was .49, considerably smaller than the .95 mean effect reported in 2007. Additionally, there is research to suggest that treatment effects may be more robust when PA/phonics strategies are incorporated within the context of a multicomponent intervention framework designed to address reading development from a bottom-up perspective (Steacy, Elleman, Lovett, Compton, 2016). As an example, Frijters, Lovett, Sevcik, and Morris (2013) reported outcomes from implementation of *PHAST Reading*, a research-based multiple component reading intervention that includes both PA/phonics instruction and fluency training, to 270 participants in grades 6-8. Compared to control group participants, students who received the intervention demonstrated moderate to large gains (.39-.79) on standardized reading measures. In fact, PHAST Reading is one of several comprehensive treatment packages that have been developed by Maureen Lovett and colleagues for students with RDs in the Learning Disabilities Research Program (LDRP) at the Hospital for Sick Children (SickKids) in Toronto. The efficacy of these programs has been well documented in numerous independent evaluations and multi-site RCTs (e.g., Lovett, Lacerenza, De Palma, & Frijters, 2012; Lovett; Lacerenza, Steinbach, & De Palma, 2014).

Suggate (2016) found that PA interventions showed good long-term maintenance of effect that also transferred to non-targeted skills (e.g., comprehension) in comparison to other treatment targets. This finding should not be surprising, as neurobiological research has found that exposure to intensive remedial phonics-based intervention can facilitate the development of impaired neural systems that underlie skilled reading. For example, Shaywitz et al. (2004) found that post-intervention fMRIs for 77 children with reading difficulties revealed increased activation in left hemisphere regions, including the inferior frontal gyrus and the middle temporal gyrus. Follow-up analyses indicated that these children continued to activate occipitotemporal cortical regions that were previously impaired. Nevertheless, despite their popularity, PA interventions should not be considered a “quick fix” for RD as they are likely to be ineffective in isolation and tend to be less effective as first-line treatment when implemented at later grades (Compton, Miller, Elleman, & Steacy, 2014).

Repeated Reading. One of the hallmark symptoms of individuals with RD is reading rate or fluency performance that falls below age-appropriate benchmarks (Al Otaiba & Foorman, 2008). Reading fluency refers to the ability to read with efficiency and ease. For fluent readers decoding is less effortful, which frees up cognitive resources for comprehension of text. It has long been thought that fluency develops following the automatization of word identification processes (e.g., PA). Given the relationship between early literacy skills and fluency, it is not surprising that many tertiary intervention packages target both skills for remediation. However, there are interventions that have been developed that specifically target fluency skills in isolation. One of the most commonly recommend procedures for improving reading fluency for students with RD is repeated reading (RR). RR intervention is derived from a theory of automatic word processing that suggests that the development of automaticity allows students to focus more on the meaning of text (Ardoin, Morena, Binder, & Foster, 2013). In general, RR instruction requires students to continuously re-read passages until they meet an established fluency criterion.

Begeny, Krouse, Ross, and Mitchell (2009) used an alternating treatments design with four second-grade participants to examine the effectiveness of three reading fluency interventions (RR, listening passage preview, and listening only) delivered in a small-group setting. Across the intervention conditions, the RR condition was most effective at producing gains in words read correctly per minute. However, for two of the students, listening passage preview was just as effective as RR, although, the later intervention condition resulted in better retention of the gains made immediately post-intervention as measured through oral reading probes. Subsequent research has suggested that RR interventions may be more effective when paired with goal setting and feedback (Ardoin et al., 2013; Morgan, Siderdis, & Hua, 2012) and greater maintenance of gains when re-readings were increased from three to six (Ardoin, Williams, Klubnik, & McCall, 2009).

Despite the frequent use of these methods in clinical practice, the outcome research for RR has not been univocal. The WWC intervention report concluded that there were not significant effects on reading fluency for students with RD. However, this conclusion was based on an evaluation of one study that met the inclusion criteria for evaluation. Wexler, Vaughn, Roberts, & Denton (2010) conducted an experimental study in which RR reading was administered to high school students with RD. Participants were 96 students with RD in grades 9-12. Students were paired and randomly assigned to one of three groups: RR, wide reading (facilitating exposure to different types of text usually during the course of a class-wide free reading period), or typical instruction. Those assigned to the intervention conditions were provided approximately 15-20 minutes of supplemental instruction daily for 10 weeks. Results indicated no statistically significant differences for any of the three conditions, with effect sizes ranging from -.31 to .27. As a result, use of RR for severely impaired readers at the high school level was not supported. Additionally, Chard and colleagues (2009) conducted a systematic review of quasi-experimental and single-case research RR intervention research and concluded that many studies failed to contain quality indicators indicative of rigorous research. As such, they questioned whether RR was an evidence-based practice based on those criteria.

However, the results of more recent systematic reviews have been more positive. Strickland, Boon, and Spencer (2013) conducted a descriptive review of intervention studies examining the effects of RR on the fluency and comprehension skills of students with LD. Moderate to large effect sizes were observed in studies that reported RR as a primary intervention or as part of a multi-component treatment package. In general, results of the studies reviewed suggest that RR has been shown to increase students’ fluency skills and may be beneficial to promote reading comprehension. In a more comprehensive study, Lee and Yoon (2017) conducted a quantitative synthesis of 34 RR intervention studies published between 1990 and 2014. The weighted mean effect size was 1.41, which is indicative of large effects overall. However, several moderator variables were found to be statistically significant. Significantly larger effects were associated with interventions with four or more re-readings. However, the effects associated with studies that incorporated goal setting and/or extrinsic rewards was not statistically significant compared to those that did not. Nevertheless, these results of both of these syntheses indicate that RR may be more effective when it is paired with an additional form of reading intervention (e.g., vocabulary instruction) or included as part of a multi-component intervention packages (e.g., Read Naturally).

Rapid Automatized Naming/RAVE-O. In contrast to developmental theories of reading which posit that fluency is mediated by deficits in phonological processes, Wolf and Bowers (1999) have proposed an alternative conceptualization of RD known as the Double-Deficit

Hypothesis (DDH). The DDH suggests that deficits in naming speed (a.k.a., rapid automatized naming [RAN]) represent a second core deficit in RD that is largely independent of PA. From this perspective, individuals with RD can be classified into one of three subtypes: phonological deficit readers without naming speed problems, readers with a deficit in RAN but not in PA or basic decoding skills, and a double-deficit subtype with a co-occurrence of naming speed and phonological deficits (this subtype is characteristic of severely impaired readers). The validity of the DDH is further buttressed by neuroimaging evidence that suggests that phonological and RAN abilities may have different neural substrates (Maisog et al., 2008; Norton et al., 2014).

Wolf, Miller, and Donnelly (2000) developed an experimental fluency-based approach to reading intervention for readers with impairments in naming speed which they termed Retrieval, Automaticity, Vocabulary Elaboration, Orthography (RAVE-O). RAVE-O was designed as small group, intensive pull-out program for elementary aged students. RAVE-O was also designed to be supplemented with a systematic phonologically based program focusing more specifically on basic decoding skills, making it distinctive compared to other comprehensive treatment packages. In a multi-site RCT of 279 children with RDs funded by the National Institute of Child and Human Development (Morris et al., 2012) it was found that students who received RAVE-O in combination with a direct instruction-based program designed to remediate basic phonological analysis produced statistically significant improvements in word attack and oral reading skills compared to treatments that targeted phonological skills in isolation and control group participants. In fact, in a previous RCT, RAVE-O produced better reading outcomes than PHAST for individuals with RD (Fletcher et al., 2007).

Despite these positive outcomes, RAVE-O has not been widely utilized in clinical practice. We suggest that this is probably due to the cost (both monetary and time) associated with the program. For example, in the study produced by Morris et al. (2012), remediation was delivered in one hour sessions, five days a week for a total of 70 hours. It is also important to bear in mind that RAVE-O has generally been found to be more effective when it is paired with additional intervention curriculum designed to address PA and word recognition/decoding skills. While we agree with Norton and Wolf (2012) that a comprehensive approach to remediation using multiple intervention techniques and/or programs corresponding to the different subtypes of RD may be best practice, an inverse relationship between implementation fidelity and treatment complexity has long been noted in the school-based intervention literature (see Forman et al., 2013).

Peer Assisted Learning Strategies (PALS). Developed by Doug and Lynn Fuchs, Peer Assisted Learning Strategies (PALS) is a supplemental peer tutoring program in which paired students perform a set of structured activities in reading or math. Instructional sessions last approximately 30-35 minutes, 3-4 times per week, with students taking turns acting as a tutor to one another as they complete academic problems. Students are paired together by an instructor based upon perceived student needs and abilities. The WWC has rated PALS-Reading (PALS-R) as a potentially effective intervention for reading fluency (improvement index +14 [expected change in percentile rank compared to controls for students receiving the intervention]) and reading comprehension (+26) for students with LDs. In contrast to other reading interventions, PALS-R can be delivered as both a targeted intervention of whole class intervention depending on the context of the instructional environment. Due to its flexibility, PALS-R interventions have been implemented effectively in a variety of educational settings ranging from preschool to high school (Saenz, McMaster, Fuchs, & Fuchs, 2007).

Rafdal and colleagues (2011) examined the effectiveness of K-PALS (a variant of PALS-R modified to use in kindergarten classrooms). Eighty-nine kindergarteners with individualized education plans (IEPs) from 47 classrooms were randomly assigned to a level 1 PALS intervention, a level 2 PALS intervention, or to a control group (matching based on similar ranking of reading level by teacher). Treatment sessions lasted approximately 20-30 minutes and were delivered four times per week for 18 weeks. Results indicated that students who were assigned to PALS treatments outperformed controls on several alphabetic and oral reading measures with moderate effect sizes ranging .30 to .50, although, no meaningful differences were observed between the level 1 and level 2, groups suggesting that level of support was not a moderating factor in treatment outcomes. Additionally, Rafdal et al. (2011) examined the treatment integrity and found that average fidelity ranged from 80% to 86% for levels 1-2 respectively.

In a quantitative synthesis, Berkeley, Scruggs, and Mastropieri (2010) evaluated the efficacy of reading comprehension treatments for students with LDs. Forty studies published between 1995-2006 were included in their analyses with 16 outcome studies using PALS-R or a related peer mediation component (e.g., Collaborative Strategic Reading). The weighted mean effect size for those treatments was .65, indicating moderate to strong effects on comprehension skills. The effect size (.72) for other treatments that did not employ peer mediation (e.g., cognitive strategy instruction) was slightly higher; however, this difference was not statistically significant. Conversely, in an RCT (Sporer, Brunstein, & Kieschke, 2009) examining the effects of strategy instruction, peer mediated teaching, and instructor-led groups on reading comprehension skills, it was found that peer-led interventions outperformed the instructor-led interventions.

Peer mediated instruction may be less effective for older students with LDs (Faggella-Luby & Deshler, 2008). In a synthesis of reading comprehension outcomes for older students Edmonds and colleagues (2009) found that effect sizes associated with PALS were mixed. Whereas implementation in an inclusive setting on a biweekly basis produced a small to moderate effect (.31), implementation in a smaller self-contained classroom was more beneficial (1.18). As with any intervention, PALS will not benefit all students. Fuchs, Fuchs, Mathes, & Martinez (2002) suggest that up to half of students with disabilities may not respond to PALS treatment. However, optimum outcomes have been obtained consistently in studies where PALS was implemented at least three times a week, for 15-20 weeks in elementary and middle school settings.

Cognitive Strategy Instruction. Reading comprehension is a diverse set of skills that allow for students to interact with and derive meaning from text. It is frequently said that from kindergarten to grade 3 students “learn to read” and that from grade 4 on the curriculum shifts to emphasize “reading to learn.” As a result, it is not surprising that comprehension difficulties tend to affect older students, with middle school students in particular appearing to be the most vulnerable (Edmonds et al., 2009). Interventions typically involve a combination of specific skills training (i.e., vocabulary; Kennedy, Deshler, & Lloyd, 2015) and/or strategy instruction. Positive effects associated strategy instruction have been well documented in the empirical literature (e.g., Swanson et al. 1996, 1999). As noted by Fletcher et al. (2007), “Strategies based on cognitive concepts…appear to be the most effective methods of intervention for reading comprehension and have provided the best results to date for improving disabled readers’ comprehension” (p. 199).

Cognitive strategy instruction involves teaching readers a diverse set of metacognitive skills that allow for them to actively engage with text using psychological frameworks or "schemas." A host of effective strategies have been developed including comprehension monitoring, graphic and semantic organizers, mnemonics, question and summarization strategies, and instruction in story structure. As an example, one of the most popular strategies is a summary or main idea strategy which teaches students to express the information from a body of text into a distilled form. In a recent meta-analysis of middle school students with LDs, Solis and colleagues (2012) reported a mean effect size of 1.77 for summarization—main idea on comprehension outcomes. Antoniou and Souvignier (2007) also reported positive effects for an experimental program on reading comprehension, strategy knowledge, and reading self-efficacy where 5-8 graders were taught self-regulation strategies by in a whole-class context by a teacher. Participants who received the experimental program outperformed control group participants on all three outcomes measures with effect sizes ranging from .62-.80. Additionally, follow-up analyses indicated that these gains were maintained during the entire academic year.

Collaborative strategic reading (CSR; Klingner et al., 2001) is a multi-component reading program that is theoretically grounded in cognitive psychology that includes elements of both peer mediated and strategy instruction. In CSR, students use before, during, and after reading strategies to access text. Before reading, teachers preview the text and present key vocabulary concepts. During reading, students employ monitoring strategies while reading text aloud in small groups such as generating questions and using context clues to figure out word meanings. After reading, students then ask and answer each other's questions and relate answers to the text. Most recently, Boardman et al. (2016) employed a RCT to evaluate the effect of CSR on reading comprehension in fourth and fifth grade students. Treatment was delivered twice per week for 14 weeks in a general education classroom. Treatment group participants made significantly greater gains in reading comprehension (.52) compared to the control group participants who did not receive CSR instruction. However, fidelity checks revealed that the majority of the teachers consistently only implemented three of the five CSR components[2]. Nevertheless, it was concluded that CSR was a potentially beneficially method for improving the performance of students with LDs in the general education classroom.

Table 1

Similar to PA/phonics instruction, it appears that as long as strategy treatments involve explicit instruction, multiple opportunities for instruction, and carefully sequenced lessons they can be employed by practitioners with confidence as positive outcomes have been documented the empirical literature for virtually all methods. In a comprehensive evaluation of the quality of the evidence-base for cognitive strategy instruction, Jitendra, Burgess, and Gajria (2011) reported an average weighted effect size of 1.46 across methods with a 95% confidence interval that exceeded one. As such, it was concluded that as a general course cognitive strategy instruction for individuals with LDs can be considered evidence-based practice. Nevertheless, it should be noted in other studies the use of graphic organizers, although popular, has not been associated long-term maintenance and generalization of comprehension gains (Gajria, Jitendra, Sood, & Sacks, 2007). A list of useful tips for teaching cognitive strategies to children are

[2] Drifts from protocol are common in the academic intervention literature and are frequently encountered in applied practice (see Gresham, MacMillan, Beebe-Frankenberger, & Bocian, 2000). Thus, it is important for clinicians to monitor integrity throughout the course of treatment and ensure that intervention procedures are well documented in treatment plans prior to delivery. A useful rule of thumb is that a random observer should be able to clearly discern whether each step of the treatment has been implemented as designed based on the step-by-step descriptions described in the protocol (A link to a sample protocol for direct instruction is available at http://www.rtinetwork.org/images/content/downloads/treatment_integrity/di_loi.pdf).

provided in Table 1. Regardless of the strategy that is employed, it is important to make sure that each strategy is taught and modeled systematically by the interventionist and that sufficient opportunities to practice are provided for the student, with corrective feedback on performance given after each opportunity to respond until the point at which automaticity develops. Practitioners interested in potentially implementing cognitive strategy instruction are directed to a website operated by the University of Nebraska-Lincoln (http://cehs.unl.edu/csi/) which contains a sample lesson plans and teaching strategies.

Multi-Tiered Prevention Models. As a result of recent changes in federal regulations and funding priorities schools have increasingly employed multi-tiered frameworks (i.e., MTSS/RTI) for the prevention and intervention of reading and other academic and behavioral difficulties over the last decade. These frameworks are not interventions in and of themselves; they simply provide an organizing framework for the delivery of targeted interventions to students who are struggling academically (Barnes & Harlacher, 2008). In fact, many of the interventions that we have previously reviewed are included as core components of most MTSS/RTI reading intervention models. Thus, the efficacy of these systems for individuals with LDs is mediated by the quality and the fidelity of the interventions that are delivered in Tiers 2 and 3 (Reynolds & Shaywitz, 2009). Furthermore, it is also important to highlight that a prevention approach is focused more generally on the remediation of reading difficulties for all students before they manifest and/or develop into the more intractable learning difficulties associated with RD. That is, it is assumed that students with RDs will benefit from the targeted interventions delivered in these models even though these models were not explicitly developed for the treatment of LD.

Griffiths and colleagues (2006) also stress that the underlying approach to intervention buttressing an MTSS/RTI framework is also important to consider. Multi-tiered models employ either a standard protocol or problem solving approach to intervention. In the standard protocol approach, students typically receive the same standardized multi-component instructional package (e.g., Reading Recovery, Voyager Passport) that varies in intensity at Tiers 2 and 3 whereas in the problem solving approach, interventions are individualized and matched more specifically to a student's needs. Thus far, research has not indicated that one approach is preferred to other, although in our experience, it is rare for schools to employ more than one or two targeted interventions at each tier; thus, outcome data on the problem solving model are lacking. As the evidence-base for effective reading interventions and the assessment of reading outcomes using formative assessment tools such as CBM is well developed, best practices for reading MTSS/RTI have been widely disseminated in the professional literature and positive outcomes have been documented for the implementation of these models in a multitude of contexts (e.g., Fletcher & Vaughn, 2009; Lovett, et al., 2008; Wanzek et al., 2016; Weddle, Spencer, Kajian, & Peterson, 2016; VanDerHeyden, Witt, & Gilbertson, 2007). However, the effectiveness of these models at the secondary level has been less consistent (Vaughn & Fletcher, 2012; Wanzek et al., 2013).

Of greater concern, a recent large scale Institute of Educational Sciences (IES) outcome study (Balu, et al., 2015) purporting to evaluate the effectiveness of MTSS/RTI models found that assignment to a targeted intervention in Tiers 2 or 3 had little effect on reading performance in elementary schools nationwide and in some cases the intervention outcomes were contraindicated (i.e., students' performance worsened in response to treatment). The methodological quality of this report has been criticized (see Shinn and Brown, 2016). Can the

RTI/MTSS model be considered an EBI? That is a difficult question to answer. Although there is clearly a well-developed body of empirical evidence supporting the use of these procedures, emerging evidence suggests that a more careful appraisal of the outcome literature may be needed.

Reading Summary. As previously noted, there is a tremendous body of literature that supports the need for systematic and explicit instruction of reading skills for individuals with RD. Our findings indicate that practitioners would do well to consider the heterogeneity of deficits underlying RDs and that individuals with RD are most likely to benefit from multi-component interventions that simultaneously address a spectrum of core deficits in phonology, vocabulary, comprehension, and naming speed. Again, the overall quality of many of the treatments delivered in clinical settings has been questioned. In a synthesis of reading instruction research from 1980-2005, Swanson (2008) found that reading instruction for students with LDs was generally of poor quality. As an example, her findings revealed that instructional approaches were delivered in whole-class settings, rarely provided explicitly instruction in phonics or comprehension strategies and that the time students spent reading orally or silently was low. More troubling, these patterns of flaws still characterized studies produced more recently. Vaughn and Wanzek (2014) suggest that reading instruction for students with RD continues to be diluted by excessive amounts of low level tasks unlikely to meaningfully impact progress in reading skill development. Practitioners should consider the infrastructure and resources that are required to implement the intensive interventions needed to remediate severe reading impairments (i.e., Gersten, 2016).

Impairment in Mathematics

Although current estimates of prevalence suggest that mathematics learning disability (MD) occurs in approximately 5% to 7% of the school-aged population (Lewandowski & Lovett, 2014), MD has often been treated as an afterthought in the field of intervention research on students with LDs. In view of the widespread research attention devoted to RD, it is not surprising that RD remains better understood than MD. Previous estimates suggest that studies on RD have outnumbered MD by a ratio of 16:1 (Gersten, Clarke, & Mazzocco, 2007), although, an emergent body of research describing the cognitive characteristics of individuals with MDs in concert with a host of experimental intervention outcome research has started to reduce this gap in recent years (Watson & Gable, 2013).

Using multivariate profile analysis, Fuchs et al. (2008) were able to elucidate two distinct subtypes of MD, each with its own set of cognitive predictors. One subtype is marked by deficits in basic math facts or calculation and the other, with primary difficulties in math problem solving (i.e., word problems). Unlike the linear relationship that has been established between early literacy skills and comprehension for individuals with RDs, the correlation between computation and word problem skills is only moderate, suggesting that difficulty in calculations does not always result in commensurate difficulties in word problems (Shin & Bryant, 2015). As a result, much of the intervention research is partitioned along these lines.

Number Sense, Math Calculation and Math Fact Fluency. According to Geary (2013), human beings have an inherent sense of quantity that can be sourced to a sub region of the parietal cortex called the intraparietal sulcus that allows for the discrimination for the ability to recognize and name quantities in small collections of item sets without counting. This process, known as *subitizing*, has been implicated as a key component in the development of early numeracy skills (i.e., number sense). Several recent studies have suggested that individuals with

MDs, may have less precise representations of magnitude and the ability to discriminate between increasingly more difficult ratios between two sets of items (e.g., Mazzocco, Feigenson, & Halberda, 2011; Piazza et al., 2010). Clements and Sarama (2009) posit that early numeracy development depends on the development of four foundational skills: (a) subitizing, (b) conventional counting in a stable order, (c) rapid discriminating of quantity in a group of objects, and (d) basic number skills (i.e., calculation).

Several recent studies have found beneficial outcomes for early intervention and the remediation of early numeracy skill deficits in kindergartners. Dyson, Jordan, and Glutting (2013) examined the effectiveness of an 8-week number sense intervention designed to develop number competencies in at–risk kindergartners. The intervention targeted whole number concepts related to counting, and comparing and manipulating number sets. Results indicated that the intervention children grew more in frequency of strategy use with medium to large effect sizes on story problems and number combination outcomes. Dyson, Jordan, Beliakoff, and Hassinger-Das (2015) reported on the efficacy of a research-based number-sense intervention for low-achieving kindergartners who were randomly assigned to 1 of 3 conditions: a number-sense intervention followed by number-fact practice session, an identical number-sense intervention followed by a number-list practice session, or a control group who received standard mathematics instruction in the classroom. The study utilized multiple intervention curricula including *Investigations in Number, Data, and Space* and *Math Connects*. Experimental interventions occurred over 8 weeks with lessons carried out daily for approximately 20 to 30 minutes. For number sense, the number-list condition outperformed the control group at posttest with moderate effect sizes (.26 to .32); however, the effect size differences between number-fact condition and control were more robust (.52 to.82) suggesting that number sense interventions may be a promising first-line treatment for the remediation of math difficulties.

Approaches to intervention that involve direct/explicit instruction and/or massed practice of math facts have consistently produced beneficial outcomes for individuals with MDs (e.g., Bryant, Bryant, & Pfannenstiel, 2015; Powell et al., 2009 Schutte, et al., 2015). As an example, Powell and colleagues found that implementation of a multicomponent intervention that involved flash card practice and calculation practice with feedback on performance provided by tutors, produced large effect size gains (.96 to 1.11) for individuals with MDs. Additionally, Fuchs, Fuchs, & Powell et al. (2008) found that participants who received *Math Flash* significantly increased their math fluency skills (.88) when compared to controls. The math flash protocol relies on scripts that provide tutors a concrete model for implementing direct instruction-based math fact lessons. Additionally, multiple outcome studies (Burns, Zaslofksy, Kanive, & Parker, 2012; Codding, Archer, & Connell, 2010) have also supported the use of incremental rehearsal (IR) for bolstering math fact fluency. IR is a commonly used flashcard intervention that uses a high percentage of known items (i.e., 10% of the items in a deck are unknown) to produce many opportunities to respond at a high success rate.

The use of computer-based interventions has also been found to be effective at remediating math fact/calculation difficulties. Burns, Kanive, and Degrande (2012) examined the effects of a computer-based math fluency intervention on the math skills of students with math difficulties. Participants were 442 students in third and fourth grade who received intervention using the MFF program from *Renaissance Learning*. MFF is a software program designed to enhance fluency in four mathematics operations. Students spend approximately 5 to 15 minutes working on math problems during each intervention session for at least three sessions per week.

Results indicated that intervention students significantly outperformed controls with moderate effect sizes.

In an attempt to evaluate the state of the evidence, Gersten and colleagues (2009) conducted a meta-analysis of 42 RCTs of interventions for students with MD. Found that in the aggregate, the most consistently effective approach to instruction and/or curriculum design with individuals with MDs were approaches that involved explicit/direct instruction of math skills. In 11 studies, explicit instruction was used to tach a variety of strategies and topics. The mean effect size for these outcomes was 1.22. Furthermore, data from multiple regression analyses indicated that explicit instruction consistently contributed to the magnitude of effects regardless of whether it was paired with other instructional approaches. However, the strong effect sizes associated with peer mediation strategies and cognitive strategy instruction suggest that it should not be considered the only mode of instruction for individuals with MDs.

Problem Solving/Cognitive Strategy Instruction. A major approach in the research literature for developing math problem solving skill for students with MDs relies on cognitive strategy instruction. Similar to reading comprehension, a litany of strategy-based approaches has been developed and implemented in the treatment literature. In an RCT Fuchs and colleagues (2009) found that implementation of *Pirate Math*, an individual tutoring program based on schema-broadening instruction (SBI), produced beneficial math achievement outcomes. Specifically, moderate to large effect size increases on word problem measures were found for intervention participants when compared to controls. From a cognitive perspective, a schema is a way to organize information into a structured framework. For word problems, this involves teaching student’s explicit skills which allow to identify the type of problem which can then be solves using a previously taught organizational pattern. More recently, Jitendra, Dupuis, Star, &

Rodriguez (2016) examined the effects of SBI on the problem solving performance of 260 seventh grade students with MD. Results indicated that students in the SBI condition significantly outperformed students in the control condition in posttest problem solving measures (.40). More importantly, SBI instruction produced treatment gains that were maintained up to six weeks post-treatment (.42). As a result, it was concluded that students with MD "can make important gains in mathematical problem solving when instruction is used appropriately to develop both conceptual and procedural knowledge" (p. 364).

Other strategy-based programs have been found to be effective at the secondary level. Montague, Enders, & Dietz (2011) reported outcomes for middle school students from a RCT of *Solve It!* (SI). SI is an instructional methodology that focuses on teaching children a range of cognitive metacognitive processes and strategies (i.e., read, paraphrase, visualize, hypothesize, estimate, compute, and check). Students are taught these procedures using explicit instruction characterized by structured lessons and corrective feedback on learner performance. Students were matched and assigned to either a treatment or control condition. The results indicated that students who received the intervention showed significantly higher growth in in math problem solving compared to controls, however, effect sizes were not reported. These results were later replicated in a study examining the effects of SI on students with varying degrees of math difficulties with a large effect (.88) associated with the Bayesian growth trajectory for the treatment group participants (Montague, Krawec, Enders, & Dietz, 2014).

Nevertheless, conflicting results have been reported in meta-analytic studies examining aggregate outcomes of CSI as a whole in the literature. In a review of seven outcome studies, Montague (2008) concluded that "cognitive strategy instruction to improve mathematical problem solving for students with LD appears to qualify as an evidence-based practice" (p. 43).

However, later, Montague and Dietz (2009) evaluated the quality of the CSI literature and noted that many studies failed to report the reliability of outcome measures, procedures for ensuring treatment integrity, and the effect sizes associated with treatment gains. Due to these shortcomings, they concluded “Neither the single-subject studies not the group design studies supported cognitive strategy instruction as an evidence-based practice for improving mathematical problem solving for students with disabilities” (p. 298).

Multi-Tiered Prevention Models. As noted by Fuchs, Fuchs, and Hollenback in 2007, less work had been conducted on math RTI, and the focus of early investigations has been relatively narrow. Thus, the emergence of outcome studies for Math RTI/MTSS models over the last decade has been a welcome addition to the literature. Bryant et al. (2008) reported the effects of a Tier 2 mathematics intervention delivered to 161 first grades students who were identified as at-risk for math difficulties. Tier 2 students received 20-minute intervention lessons in number and operational skills for 23 weeks. Results showed a significant main effect for the intervention, although effect sizes associated with those gains were moderate. These results were also replicated in a model that included both first and second grade students (Bryant, Bryant, Gersten, Scammaca, & Chavez, 2008). More recently, Bryant and colleagues (2016) evaluated the effectiveness of Tier 3 interventions for second grade students with severe math difficulties using a multiple baseline design across settings and found that an intervention delivered with greater intensity (five days a week) produced meaningful gains on a math outcome measure with large effects (omnibus Tau-U = .99, CI_{95} = .70, 1.29). Additionally, evidence furnished from a recent RCT by Powell et al. (2015) suggest that a multi-tier model may also be an effective framework for delivering targeted interventions to address calculation and word problems difficulties.

Salient differences have also been noted between effective reading and math RTI/MTSS models. As previously mentioned, the use of CBM is a prerequisite for decision-making within a multi-tiered context. In contrast to the oral reading fluency probes used for R-CBM, many M-CBM probes typically evaluate multiple computational and problem solving skills. However, VanDerHeyden, Codding, and Martin (2017) found that use of multi-skill M-CBM probes for screening students at-risk of math difficulties produced a high number of false-negative errors (i.e., students failed end of the year high-stakes test but were not found to be at-risk via screening measures administered at the beginning of the year) at all grade levels. As a remedy they encouraged practitioners to rely on single skill probes for decision-making in math RTI. A more targeted approach to screening and intervention may be more useful when adopting an RTI/MTSS decision-making framework (Fuchs, Fuchs, Craddock, et al., 2008; VanDerHeyden, 2013). Given the complexity inherent in mathematical skill development, it seems these recommendations would be especially germane for multi-tier models in this academic domain. Codding et al. (2016) recently demonstrated that successful remediation of computational deficits may require more intensive small-group treatments (e.g., four to five times per week) than are typically delivered in most multi-tier reading intervention models. Because a disproportionate amount of the RTI/MTSS literature has been devoted to reading, practitioners should bear these findings in mind when developing multi-tier models for math intervention in applied practice.

Mathematics Summary. The last decade has produced tremendous advances for our understanding of effective principles of the remediation of math difficulties for students with LDs. A number of potentially effective interventions have been identified and rigorous large-scale studies and meta-analyses are beginning to emerge in the professional literature. In contrast to reading, math interventions tend to produce domain-specific gains that fail to generalize to other areas. As an example in a study of 1,102 children in 127 second-grade classrooms in 25 schools, Fuchs et al. (2014) found that calculation intervention tended to improve calculation but not word-problem outcomes, and word-problem interventions enhanced word-problem outcomes but not calculation. However, multilevel modeling suggested a hierarchical organization of skills with word problem intervention providing a stronger route than calculation to the development of pre-algebraic knowledge. Thus, it is imperative that clinicians take into consideration the source of the skills deficits underlying MD when developing interventions. Problem solving and strategy-based interventions for individuals with more basic calculation and fact deficits are not likely to be effective.

Additionally, it has long been noted in the professional literature that RD and MD co-occur in approximately 30-70% of individuals. This finding may have implications for the treatment of LD symptoms as higher levels of academic and behavioral impairment have been associated with individuals who present with co-morbid LD (MDRD; see Willcutt et al., 2013). This suggests that a subtyping scheme in which MD is differentiated from MDRD may help explain an important source of variance in treatment outcomes. For example, Fuchs (2010) conducted an analysis of intervention effect sizes in which treatment outcomes were differentiated by LD subtype. It was found that for word problem outcomes, ES for students with MD was .92 and only .66 for students with MDRD. Additional research is needed to clarify the degree to which this subtyping scheme may serve to promote better treatment outcomes for those with and without co-morbid symptom presentation.

To aide treatment conceptualization, Fuchs and colleagues (2008) outlined seven principles for effective instruction for individuals with MDs. Based on these principles it was suggested that applied interventions should contain (a) explicit instruction, (b) instructional design to minimize learning challenges, (c) strong conceptual bases, (d) drill and practice (i.e., direct teaching), (e) cumulative review, (f) motivators to help students regulate their attention, and (g) formative progress monitoring to evaluate intervention effects. A recent synthesis by McKenna, Shin, and Ciullo (2015) found that effective instructional practices (e.g., explicit instruction, strategy instruction) were infrequently reported across the published observational research of mathematics instruction for students with LDs suggesting a continued research to practice gap.

Impairment in Written Language

According to Lerner and Johns (2012), approximately one-third of individuals with LDs have difficulties with written communication. As a subtype of LD, writing disability (WD) is characterized by difficulties in the acquisition of spelling, handwriting, and composition skills. Research has long indicated that RD and WD share many commonalities and follow a similar developmental course. As an example, neurobiological evidence indicates that impairment in written language or writing disability (WD) can be sourced to the same cortical networks that have been implicated for RD (Berninger, Richards, & Abbott, 2015). Nevertheless, Berninger and colleagues (2015) have provided a conceptual framework to help distinguish between RD and WD which they refer to as the *cascading levels of language framework*. According to this framework, the defining impairments of each LD subtype are based on the highest level of language that is impaired (i.e., subword, syntax, composition/generation). Similar to other bottom-up approaches, skills at higher-levels cannot be taught until lower-order skills are remediated.

Spelling/Orthographic Processing. Although spelling is a developmental process that is closely related to reading, early literacy skill development (i.e., PA) may not automatically transfer to spelling. As a result, spelling instruction is complex, involving a number of language processes such as PA, orthographic processing, and fine-motor skills. Despite this complexity, research has continually shown that the most effective spelling approaches involve the familiar concepts of explicit/direct instruction, multiple practice opportunities, and corrective feedback (Sayeski, 2011; Williams, Walker, Vaughn, & Wanzek, 2016).

One popular intervention strategy that incorporates many of the above elements is cover, copy, and compare (CCC). CCC requires students to look at a written spelling word, cover the word, copy the word, and compare their response to the original stimulus. Error correction procedures are then deployed if their response does not match the original stimulus (Erion et al., 2009). CCC is a highly flexible, low-cost technology and can be adapted to target a multitude of academic skill areas. As an example, one variation of the CCC (model-copy-cover-compare [MCCC]; Grafman & Cates, 2010) technique involves adding an additional step by having students copy the stimulus prior to covering. In a meta-analytic review, Joseph and colleagues (2011) synthesized the effects of 31 intervention studies and found that CCC had a moderate to strong effect on spelling outcomes for individuals with LDs. As a result, they concluded that CCC was a scientifically supported intervention technique for the remediation of spelling difficulties (A link to the EBI intervention brief and modeling videos for CCC implementation is available at http://ebi.missouri.edu/?p=93).

Additionally, Berninger and colleagues have also developed a series of empirically supported lesson plans aimed at remediating the orthographic processing weaknesses that may underlie deficits in spelling and other related writing skills (e.g., Berninger & Abbott, 2003;

Berninger & Wolf, 2009). Many of these lesson plans involve direct and explicit teaching of orthographic skills (e.g., orthographic coding, morphology), opportunities to practice using game or narrative-based vignettes, and direct feedback on performance. Berninger, Lee, Abbott, and Breznitz (2013) examined the effects of multiple orthographic spelling strategy treatments on the spelling skills of 24 students with LDs who were randomly assigned. Each treatment involved 30 lessons, completed in one-hour sessions twice a week over a five-month period. Results indicated that the application of orthographic strategies had a statistically significant effect on the spelling of dictated words by participants. These findings are buttressed by meta-analytic support which found that orthographic processing-based interventions had a moderate to large effects on spelling and other writing related outcomes (Datchuk & Kubina, 2013). Again, these findings have not been univocal. In a recent RCT (*N* = 205), Hooper et al. (2013) found that small-group multi-component orthographic processing instruction delivered twice a week for 12 weeks did not have a significant effect on writing outcomes. Although it was noted that individuals who received the interventions, showed an accelerated growth rate on academic measures post-treatment.

Squires and Wolter (2016) have conducted a best evidence synthesis of the effects of orthographic pattern intervention on spelling performance for students with LDs. They were able to locate five studies that met inclusion criteria (i.e., experimental design, peer-reviewed, etc.). Results revealed that several intervention approaches (e.g., Spelling Mastery, RAVE-O) with varying methods to improve orthographic pattern knowledge may be effective. In sum, all effective approaches relied heavily on direct/explicit instruction of spelling suggest that instruction should focus on “spelling-is-*taught’*” approaches as opposed to “spelling-is-*caught*.”

Larger effect sizes were associated with approaches that utilized multiple methods of teaching orthographic competence.

Written Composition/Cognitive Strategy Instruction. Written expression is a cognitively complex form of communication that refers to the ability for an individual to ideate in written form. As with spelling, deficits in reading can often lead to later impairment in writing abilities. Over the last 20 years a number of cognitive-behavioral intervention techniques have proven effective at ameliorating writing difficulties from the sentence-level to more complex forms of composition, editing, and grammar. Graham and colleagues have developed self-regulated strategy development (SRSD), one of the most well-researched strategy-based interventions for improving writing skills for individuals with WD (Santangelo, Harris, & Graham, 2008). With SRSD, students are explicitly taught specific writing strategies for planning and revising their compositions. From a cognitive-behavioral perspective, there are also taught procedures for regulating their behaviors relative to the writing process. Instruction is collaborative, with feedback and support delivered to help students internalize and master these techniques. While a more detailed description of SRSD is beyond the scope of the present chapter, interested readers are directed to a recent chapter by Graham, Harris, and McKeown (2013) with a step-by-step outline of SRSD instruction (additional SRSD implementation resources and training modules are available online at http://www.thinksrsd.com/). Meta-analytic support for positive SRSD and other related strategy intervention outcomes has been well documented.

Graham and Perrin (2007) surveyed the writing intervention literature for grades 4-12 with an explicit focus on experimental and quasi-experimental studies. They located 123 studies that yielded 154 effect sizes. In their synthesis, they obtained large weighted effect sizes for

SRSD (1.14) and related summarization (.82) interventions. Interestingly, it was noted that explicit teaching of grammar was not found to be an effective treatment (-.32). Effective writing intervention should involve (a) teaching strategies for planning, revising, and editing their compositions, (b) teaching strategies for summarizing reading material, (c) having students work together to plan, draft, and edit compositions, and (c) setting clear and specific goals for what is to be accomplished with each writing product. These outcomes were replicated in a subsequent meta-analyses that included 88 single-case outcomes (Rogers & Graham, 2008) and RCTs (Graham, McKeown, Kiuhara, & Harris, 2012). Additionally, an investigation of the strength of the SRSD research base (Baker et al., 2009) found that the corpus of both group-based and single-case SRSD studies met proposed methodological quality indicators. As a result, it was concluded that SRSD should be considered an evidence-based practice.

More recently, Gillespie and Graham (2014) examined the effect of writing interventions directed more specifically at individuals with LDs in grades 1-12. In their analyses they were able to locate 43 studies and calculate weighted effect sizes for six writing treatments that contained at least four or more studies each. Overall, writing interventions had a statistically significant positive impact on writing for students with LD (.74). However, only strategy instruction (1.09) had a consistently large effect overall. Not surprisingly, the effect size for treatments that used SRSD (1.33) was significantly higher than those that did not (.76). Of particular importance for treatment planning, Graham and Gillespie noted “Treatments designed to enhance a specific writing process were only effective when time was devoted to teaching the writing skill or process. Thus, simply providing students with a graphic organizer…without providing explicit instruction…is likely insufficient for students with LD” (p. 469).

Written Language Summary. Much less is known about effective writing interventions in comparison to other academic domains. Although positive effects for several treatments (e.g., direct/explicit instruction for spelling, strategy instruction) have been well replicated, the evidence-base for many potentially positive treatments continues to be limited to case studies and/or weak methodological designs that do not permit firm conclusions about their relative effect on writing outcomes. In fact, in a recent review of integrated reading and writing interventions, Kang, McKenna, Arden, and Ciullo (2016) were only able to locate 10 investigations that met WWC criteria for evaluation.

Although many of the above treatments have been posited as targeted Tier 2 interventions within the context of a multi-tier prevention framework, research on fully integrated RTI/MTSS writing models is relatively new. As an example, Jung, McMaster, and delMas (2016) examined the effect of writing interventions delivered within a data-based instruction framework for students with disabilities in an RCT with 46 students. Treatment students received supplemental instruction 30 minutes, three times per weeks. Results indicated that treatment effects on CBM outcomes were moderate to large (.74 to 1.36). However, given the complexity of writing, a more targeted approach to remediation may be most beneficial for students with LDs.

Results of Large-Scale Research Syntheses Across Domains

Whereas a plethora of meta-analytic studies have examined the effectiveness of interventions and teaching strategies for individuals with LDs in specific academic domains (e.g., Galuschka, Ise, Krick, & Schulte-Korne, 2014; Scammacca, Roberts, Vaughn & Stuebing, 2015) or within the broader context of special education as whole (e.g., Burns & Ysseldyke, 2009; Lloyd, Forness, & Kavale, 1998), comprehensive research syntheses of treatment outcomes for students with learning disabilities across all academic domains and intervention modalities have been relatively scarce. Swanson, Carson, and Saches-Lee (1996) conducted the first quantitative summary of treatment outcomes for individuals with learning disabilities. In their analyses, Swanson et al. (1996) evaluated 78 studies from 1967 to 1993 that employed a pretest-posttest control group design. In general, they found that cognitive strategy instruction (ES = 1.07), direct instruction (ES = .91), and remedial instruction (ES = .68) produced the highest effect sizes. However, specific procedures were more effective than others in certain academic domains. For instance, strategy instruction and direct instruction were most effective for reading comprehension, whereas word recognition and spelling were most influenced by remedial interventions that focused on phonics instruction. They also noted that the evidence did not support the matching of treatments to particular aptitudes (i.e., aptitude by treatment interaction [ATI]), though no academic domains appeared to be resistant to change.

Later, Swanson, Hoskyn, and Lee (1999) published *Interventions for Students with Learning Disabilities: A Meta-Analysis of Treatment Outcomes*, the most comprehensive quantitative meta-analysis of intervention research for students with learning disabilities that has been conducted in the field. As a result, their findings have been disaggregated and widely disseminated across the school psychology, educational psychology, and special education literatures over the last two decades. In their analyses, they synthesized the results of 272 group and single-subject studies in an effort to identify what works best for children and adolescents with learning disabilities.

In terms of salient findings, Swanson et al. (1999) found the mean effect sizes associated with cognitive strategy instruction (.84) and direct instruction (.82) were large albeit somewhat attenuated from the estimates produced by Swanson et al. (1996), a finding they attributed to the methodology they chose to employ. For specific academic domains they found that an integrated intervention approach that combined both strategy and direct instructional methods was most effective for reading but less effective for math in group studies. However, a bottom-up approach to instruction focusing more specifically on the remediation of component academic skills (i.e., phonics) was more effective for basic reading tasks such as word recognition but, that inclusion of additional strategy instruction was more beneficial for higher-order aspects of reading such as comprehension. Interestingly, single-subject studies tended to support the use of either direct instruction or strategy instruction in isolation across various academic domains. The reason for this discrepancy was not immediately clear. Consistent with previous research (e.g., Cronbach & Snow, 1977; Swanson et al. 1996), results did not support using individual cognitive processing strengths and weaknesses to guide treatment selection. However, with respect to the domain of reading, Swanson and colleagues clarified this finding stating, “Although it is important to identify elementary processes that underlie LD reader’s performance, such an approach may not be sufficient for explaining how cognitive processes are organized and work in unison to remediate academic deficits” (1999, p. 238).

Remediation of Cognitive Weaknesses/ATI

Practitioners and researchers have long suggested that assessment of cognitive processes is necessary for developing effective treatments for individuals with LDs. For many years, these ambitious claims have outstripped available scientific evidence, a limitation that has even been acknowledged by some proponents of these approaches: “After rereading dozens of papers defending such assertions, including our own, we can say that this position is mostly backed by rhetoric in which assertions are backed by citations of other scholars making assertions backed by citations of still other scholars making assertions” (Schneider & Kaufman, 2016). However, these beliefs are not completely devoid of evidence.

Swanson (2015) provided evidence for a potential ATI for math problem solving and working memory that has been replicated (Swanson, Orosco, & Lussier, 2014) and there is additional evidence to suggest that other cognitively informed interventions may be useful for remediating math problem solving deficits (Iseman & Naglieri, 2011). However, the strength of the evidence-base for psychoeducational approaches to cognitive remediation as a whole remains questionable (Elliott & Resing, 2015; Kearns & Fuchs, 2013; McGill & Busse, 2017a, 2017b; McGill et al., 2016). It has long been known that individuals with LDs often present with deficits in one or more core cognitive processes such as short-term memory, working memory, processing speed, and PA (see Swanson, Hoskyn, & Lee, 1999). Empirical support for the direct remediation of cognitive abilities has long been found wanting (McCabe, Redick, & Engle, 2016; Pashler, McDaniel, Rohrer, & Bjork; 2008; Redick et al., 2015). As an example, Galuschka et al. (2014) found that the weighted effect sizes for auditory training, medical approaches to cognitive remediation, and ocular training on reading performance for individuals with RDs were not significant. More concerning, a recent meta-analysis by Burns and colleagues (2016) found that the effects of cognitively informed academic interventions were consistently small (.17), in contrast to the moderate to large effects that were associated with interventions that were informed by direct assessment of academic skills. Whereas moderate effects were observed when measures of PA were considered to be cognitive/neuropsychological measures, Burns et al. suggested that this classification makes little sense due to the fact that PA is a subskill of reading that can be taught directly using multiple empirically supported direct or small-group instructional techniques. Rather than using an ATI approach, practitioners could instead conceptualize treatments from a “skill by treatment” perspective. In sum, consistent with previous reviews, we were unable to locate compelling evidence to suggest that psychoeducational or related medical model approaches to treatment are consistently beneficial for students with LDs, though we do not discount the advances that are currently being made in these areas. As noted by Fuchs, Hale, and Kearns (2011), "research does not support 'shutting the door' on the possibility that cognitively focused interventions may eventually prove useful to chronically nonresponsive students in rigorous efficacy trials" (p. 102).

Psychosocial Interventions

LDs can significantly affect a number of nonacademic outcomes such as emotional adjustment, family functioning, and the prevalence of juvenile delinquency and substance abuse. In fact, surveys reveal that individuals with LDs may be at greater risk for a host of negative social outcomes such as depression, anxiety, peer stigmatization, bullying, and cyberbullying (e.g., Mishna, 2003). Sahoo and colleagues (2015) note that maladaptive behaviors (e.g., negative academic self-concept, school refusal, and depression) are especially prevalent in secondary students with LDs given their history of negative experiences in schools. Although these behaviors can have a recursive effect on academic functioning, we were unable to locate studies where mental health interventions were combined with academic interventions as part of a broader treatment package for individuals with LDs. According to Willner (2005), research on interventions to address the psychosocial and mental health needs of individuals with LDs has long been insufficient. Nevertheless, gold-standard treatments such as Cognitive Behavior Therapy (CBT) have been found to be effective for addressing a number of behavioral concerns as well as improving overall academic self-concept in students without LDs (e.g., Maynard, et al., 2015; Honicke, & Broadbent, 2016). Thus, we encourage clinicians to consider the need to supplement conventional academic interventions with additional forms of mental health support (see Creed, Reisweber, & Beck, 2011 for a useful handbook for applications of and resources for modifying CBT in school-based settings).

Treatment Moderators

Our review indicates that effective treatments share many commonalities (see Table 2 for a review of the evidence-base for LD treatments reviewed in the current chapter). These include (a) early identification/intervention, (b) direct/explicit instruction of target skills, (c) use of objective outcome data to inform treatment decisions, (d) ensuring that there is a match between intervention intensity and level of impairment (i.e., ≥ 30 minutes, multiple times per week), (e) remediation of lower-level skills prior to teaching higher-level skills (f) teaching multiple skills simultaneously, and (g) ensuring that treatments are delivered long enough to have a relevant impact on target outcomes (i.e., 15 weeks or more). As a result, we argue that clinicians should evaluate the degree to which prospective interventions adhere to these characteristics in addition to their evidentiary support in the professional literature.

Table 2

However, several variables appear to mediate treatment outcomes. Most important among these moderators is dosage. That is, ensuring that the intensity of an intervention is appropriately matched to the severity of a client's symptoms. All things being equal, better outcomes were associated with studies that delivered interventions with greater intensity. As an example, Morris et al. (2010) implemented a multi-component reading intervention to individuals with LDs that was highly effective. The intervention was delivered for an hour daily for a period of 70 days with an instructor to student ratio of no greater than 1:4 for all intervention groups. To put this in perspective, an hour of intervention represents approximately 20% of the time that is spent in instruction during the course of a typical school day. According to Vaughn, Denton, and Fletcher (2010), treatment intensity can be augmented by increasing the length or frequency of treatment sessions, extending the course of treatment, or decreasing the instructor to student ratio (which results in more opportunities for a student to respond during a session). Specifically, the authors recommend providing instruction in small groups (1:3-5 instructor to student ratio), 4-5 times per week, for an extended period of time (20-30 weeks).

Another important treatment moderator is symptom severity. For many of the interventions and treatment approaches highlighted in the present review, the effects on academic outcomes for students with LDs have been more modest when compared to the effects observed when these same treatments have been used for students with less severe academic impairments. These findings suggest that even for academic interventions that are regarded generally as evidence-based, there may be a dilution effect for students with LDs. The reason for this effect continues to be debated in the literature. Whereas some suggest that it may be due to the prevalence of low-intensity treatments in conventional educational settings, it is possible that the unique phenotype of individuals with LDs make them more resistant to certain type of interventions (see Toste et al., 2014).

Treatment integrity was also found to be an important moderator in LD treatment outcomes. Whereas a recent review suggests that the reporting of fidelity outcomes in academic intervention studies has increased over the last decade, this information was absent in over half the studies that were assessed (Bruhn, Hirsch, & Lloyd, 2015). This finding has important clinical implications. If a treatment does not result in the desired changes in client functioning, and fidelity is not assessed or monitored, it may be difficult for a practitioner to determine whether the lack of progress was due to the provision of an ineffective intervention or the fact that an intervention was not implemented correctly. This can result in the discontinuation of an intervention that would have otherwise been effective if implemented properly. The following strategies have been found to be helpful for enhancing treatment integrity: (a) selecting interventions that are likely to have adequate "buy-in" from stakeholders (don't force a preferred intervention that stakeholders may find difficult to implement or are incompatible with institutional goal), (b) making sure that those implementing the intervention (c) have necessary training and/or experience prior to implementation, (d) creating a detailed list or task analysis of the steps required for the intervention, defining each step in observational terms so that an observer can easily rate the occurrence or nonoccurrence of each step, (e) conducting fidelity checks throughout the course of treatment. In sum, if integrity is not an emphasis *a priori*, drift may occur. Combination of consultation and performance feedback have been found to be effective solutions when drift is observed (see Noell, et al., 1997). Exemplar treatment protocols for dozens of academic interventions are available at http://www.rtinetwork.org/getstarted/evaluate/treatment-integrity-protocols).

Finally, given the ubiquity of multi-tier intervention systems (e.g., MTSS/RTI) in the treatment literature, it is also important to make the distinction between *prevention* and *targeted remediation* for individuals with LDs. As previously discussed, the primary goal of MTSS/RTI systems is to provide a continuous surveillance network for detecting students who may be academically and/or behaviorally at-risk and intervening before these learning problems become more intractable. While tertiary interventions are embedded within a broader systems-level process such as RTI, it has been suggested that the intensity of many Tier 2 and Tier 3 interventions are not sufficient for remediating the severe academic deficits common in individuals with LDs (Vaughn, Denton, & Fletcher, 2010). In our experience, it is common for clinicians to suggest that a case *benefitted from RTI* when in reality it was the provision of a specific treatment within the broader RTI process that produced the positive treatment outcomes. While some may argue that these are semantic distinctions, they can have consequences for the selection of interventions and the integrity with which they are implemented. That is, risk screening, formative progress monitoring, and the delivery of targeted interventions will be of little benefit if the treatments that are available to practitioners within these models (a) lack empirical support, (b) are not matched to underlying skill deficits, (c) lack sufficient intensity, and (d) are delivered with poor fidelity. Clinical science would benefit greatly from additional "dismantling" studies that help to shed insight on the key ingredients that work with children with LDs who are serviced by MTSS models. Nevertheless, these models are important for early identification which has been found to be beneficial in overall treatment outcomes. For reading interventions in particular, diminished marginal returns have been found for interventions delivered after Grade 3 (Wanzek et al., 2013).

Course of Treatment

As previously mentioned, we encourage practitioners to adopt a low inference, functional skills-based approach when developing treatment protocols for individuals with LDs. The problem solving model illustrated in Figure 2 is a particularly useful heuristic for guiding the treatment process that can be modified and adapted across a host of clinical settings (see Deno, 2013 for a review).

Figure 2

In this section, we will illustrate an application of this model to help develop and implement a treatment plan using a fictional case study on an elementary school-aged child.

Intervention Case Study

Sam is an 8-year-old male student in 3rd grade (Fall) at a local elementary school with a history of reading difficulties. In 1st grade, his teacher began to notice that he had more difficulty decoding grade-level site words compared to his peers, although his math performance was much better. Supplemental instruction was provided to help address these difficulties; however, he scored below the 10th percentile the end of the year benchmark assessments in reading, prompting concern that he may have a learning disability. That summer, Sam was referred to the school psychologist for a learning disability evaluation. Results of the evaluation indicated that Sam had average to high average intellectual abilities but his reading fluency and phonemic awareness skills were significantly impaired. As a result, he was diagnosed with a Specific Learning Disorder, with Impairment in Reading (315.00) with primary deficits in word reading accuracy and reading rate. Throughout the course of second grade, he was provided with supplemental phonics instruction from an educational therapist and his decoding began to improve. However, his reading fluency scores remained at or below the 10th percentile at the end of the year, indicating that he was still *at-risk* compared to grade level peers.

Step 1: Problem Identification. The first step in the problem solving process is to define the specific academic skill that will serve as the intervention target. In many cases, this may require conducting additional assessment (e.g., administration of norm-referenced achievement tests, curriculum-based measures, behavioral rating scales, direct observations, review of available records, etc.) to help guide treatment selection. However, in Sam's case, there is likely sufficient information available to begin to develop treatment hypotheses without additional testing. As previously noted, the phonics interventions resulted in improvement's in Sam's reading (phonemic awareness skills are now close to grade level); yet, his overall reading rate remains a concern.

Step 2: Problem Definition. Once the target skill (fluency) has been identified, it is important to provide an objective definition of the problem to be solved (i.e., treatment goal). First baseline (pre-intervention) levels of performance should be established using a formative outcome measure (e.g., CBM). For reading, the number of words read correct (WRC) from a timed grade-level passage is often a useful measure as research has established, that regardless of the skill that is targeted, these types of probes are highly sensitive to change (i.e., if an intervention is effective, WRC should noticeably increase). CBM probes can also be administered during the treatment phase each week, providing an efficient means for evaluating treatment progress.

There are a number of well validated CBM tools available to practitioners (see the Appendix at the end of the chapter for additional resources for administering, scoring, and developing CBM measures). For the purpose of this case study, we have selected *easyCBM*[3]. Grade level norms and growth rates for a variety of CBM tasks are well established and can be consulted as a point of reference. For instance, Fuchs and colleagues (1993) provide *realistic* and *ambitious* growth rates for WRC that are often used as a reference in the treatment literature. According to those guidelines, the ambitious rate of growth for a 3rd grade student is 1.5 words per week. On baseline (pre-intervention) CBM probes, Sam read 39-45 (*Mdn* = 41) words correct per minute which puts him right around the 10th percentile based on Grade 3 norms for the beginning of the school year in the Fall. A treatment goal (41 + 30 [1.5 x 15] = 71) can easily be

[3] The *easyCBM* system (https://www.easycbm.com/) is free to practitioners and was developed at the University of Oregon.

established by calculating the anticipated growth rate over the course of the treatment and plotting a goaline (see Figure 3 for an example).

Figure 3

Steps 3-4: Treatment Planning/Intervention Implementation. Now that the target skill has been identified and a treatment goal has been outlined, it is time for a clinician to select an intervention. Although there are a number of resources that can be used to inform treatment selection, we highlight the EBI network due to the fact that features interventions that are relatively easy to implement (with step-by-step instructions, treatment protocols, and modeling videos for those with limited direct intervention experience). On the EBI reading interventions page (http://ebi.missouri.edu/?page_id=981), treatments are separated by function (acquisition, accuracy, speed, generalization, and motivation). As the omnibus goal for the intervention is to increase Sam's reading rate, an intervention focused on increasing speed may be an ideal match. Given the limited resources involved and the robust literature base for using repeated readings (RR) for individuals with LDs, RR is an optimal starting point for treatment with Sam.

Initially, it was determined to provide Sam with 3x30 minute RR sessions per week as a supplement to his phonics and general education instruction at his school. For each session, Sam was provided with several grade level passages from a basal reader and asked to read each passage aloud 3-4 times. At the conclusion of each reading, Sam was given corrective feedback by the interventionist on words that he was unable to decode correctly. Finally, Sam was administered a CBM probe in order to objectively monitor treatment progress[4].

---

[4] RR can also be enhanced with additional behavioral modification techniques such as plotting CBM probe data with a student and providing reinforcement for improvements in WRC.

As previously mentioned, if a practitioner is serving as a consultant to an interventionist, it is important to establish a plan for monitoring fidelity during the course of treatment and to evaluate those outcomes systematically. It is important to have these data available in the event that an intervention outcome is negative and it also provides a means for troubleshooting unanticipated issues with implementation mid-course. Even if a clinician is implementing an intervention directly to a student, we recommend using a checklist to serve as a visual reminder of the protocol, see the EBI intervention brief for RR for a detailed protocol example (http://ebi.missouri.edu/wp-content/uploads/2011/03/ECU-EBI-Academic-Need-Practice-Repeated-Readings.pdf).

Step 5: Treatment Evaluation. Once an intervention has reached a critical point (approximately 8-15 weeks), outcome data should be evaluated to discern treatment effects. Intervention data for Sam is provided in Figure 3. Visual inspection of the graph reveals a consistent positive trend once RR instruction commenced. The trendline for the intervention data exceeded the goaline that was specified prior to treatment. Whereas the present treatment outcome was could be considered “effective,” additional considerations remain. A complicating factor in the course of LD treatment is the fact that the general education curriculum doesn’t remain static. That is, *all* children are expected to make progress on academic skills throughout the school year. Thus, for children with LDs, remediation can seem like a moving target.

Sam’s WRC on his last probe was 78. Although that score is a significant improvement from baseline, the WRC cut-score for the 50th percentile for the Spring of Grade 3 is 116. Accordingly, Sam has to improve his WRC by almost 40 words per minute in order to be out of the woods. Thus, treatment must continue since the problem has not been eliminated (i.e., the terminal goal is not satisfied). Fortunately, if Sam maintains his current rate of growth, he is likely to reach the 50th percentile for his grade by the end of the school year, so there is evidence to support maintaining the current treatment and dose. However, if the data were less positive, treatment decisions are less clear. Has the right treatment been identified? If so, has it been delivered at the right dose? If not, it may be necessary to return to Step 1 and obtain additional information to help inform the selection of a different treatment that may be more effective.

Conclusion

Tremendous advances have been made in the field of LDs over the course of the last decade. Empirically validated treatments and conceptual best practices for effective instruction are now well established for reading and the scientific knowledge base for math and writing continues to expand. Regardless of domain, the following list of "best practice" guidelines/recommendations are associated with more positive treatment outcomes:

- Select interventions that have been rigorously investigated in the literature and have a base of positive evidence for students with LDs.
- Use intervention approaches which incorporate explicit and systematic instruction of target academic skills.
- Make sure that there is an appropriate match between treatment intensity and symptom severity (e.g., group-size, number and length of sessions, course of treatment).
- For students with more pronounced deficits, it may be best to select an intervention package which targets multiple academic skills.
- Ensure that you (or those that you are consulting with to facilitate implementation) have the appropriate training to implement interventions effectively. Some interventions can be easily adapted to a multitude of clinical settings, whereas others may require additional resources.

- Make sure instruction is logically sequenced and developmentally appropriate for the child (i.e., don’t progress to higher-level skills before lower-level skills are mastered).
- When possible, implement interventions in a small group format with an instructor to student ratio of no more than 1:5.
- Provide sufficient opportunities for students to practice newly learned skills and give corrective feedback on their performance.
- Plan for generalization (i.e., if intervention occurs primarily in a clinical setting, make sure the student will be able to transfer newly learned skills to appropriate academic settings).
- Systematically monitor implementation fidelity throughout the course of treatment.
- Use objective data (i.e., progress monitoring) to guide treatment decisions.

Despite these advances, a significant research to practice gap remains. Interventions shown to be effective are not implemented consistently for individuals with LDs and practices associated with weak or negative effects continue to be utilized (Cook & Cook, 2013). However, the rise of the EBP movement and a renewed focus on implementation science in the treatment literature suggest optimism for the future. Implementing evidence-based treatments in practice is a challenging and rewarding endeavor. In many circumstances, it requires clinicians to persevere against the many forces that seek to maintain the status quo. While research plays an important part in this process, it is by no means a panacea. As noted by Fletcher et al. (2007), “research is only as good as its implementation” (p. 274).

References

Al Otaiba, S. & Foorman, B. (2008). Early literacy instruction and intervention. *Community Literacy Journal, 3,* 21-37.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington DC: American Psychiatric Publishing.

Anderson, P. L., & Meier-Hedde, R. (2001). Early case reports of dyslexia in the United States and Europe. *Journal of Learning Disabilities, 34,* 9-21.

Antoniou, F., & Souvignier, E. (2007). Strategy instruction in reading comprehension: An intervention study for students with learning disabilities. *Learning Disabilities: A Contemporary Journal, 5,* 41-57.

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.

Ardoin, S. P., Morena, L. S., Binder, K. S., & Foster, T. E. (2013). Examining the impact of feedback and repeated readings on oral reading fluency: Let's not forget prosody. *School Psychology Quarterly, 28,* 391-404.

Ardoin, S. P., Williams, J. C., Klubnik, C., & McCall, M. (2009). Three versus six rereadings of practice passages. *Journal of Applied Behavior Analysis, 42,* 375-380.

Askkenazi, S., Black, J. M., Abrams, D. A., Hoeft, F., & Menson, V. (2014). Neurobiological underpinnings of math and reading learning disabilities. *Journal of Learning Disabilities, 46,* 549-569.

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*, 91-97.

Baker, S. K., Chard, D. J., Ketterlin-Geller, L. R., Apichatabutra, C., & Doabler, C. (2009). Teaching writing to at-risk students: The quality of evidence for self-regulated strategy development. *Exceptional Children, 75, 303*-318.

Ball, C. R., & Christ, T. J. (2012). Supporting valid decision making: Uses and misuses of assessment data within the context of RTI. *Psychology in the Schools, 48,* 416-426.

Balu, R., Zhu, P., Doolittle, F., Schiller, E., Jenkins, J., & Gersten, R. (2015). *Evaluation of response to intervention practices for elementary school reading*. Washington DC: Institute of Education Sciences.

Barkley, R. A. (2014). *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment* (4th ed.). New York: Guilford.

Barnes, A. C., & Harlacher, J. E. (2008). Clearing the confusion: Response-to-intervention as a set of principles. *Education and Treatment of Children, 31,* 417-431.

Begeny, J. C., Krouse, H. E., Ross, S. G., & Mitchell, R. C. (2009). Increasing elementary-aged students' reading fluency with small-group interventions: A comparison of repeated reading, listening passage preview, and listening only strategies. *Journal of Behavioral Education, 18,* 211-228.

Bergin, J. R., & Kratochwill, T. R. (1990). *Behavioral consultation and therapy*. New York: Springer.

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*, 18-32.

Berninger, V. W., & Abbot, R. D. (2003). *PAL research-supported reading and writing lessons*.

San Antonio, TX: The Psychological Corporation.

Berninger, V. W., Lee, Y. L., Abbott, R. D., & Breznitz, Z. (2013). Teaching children with dyslexia to spell in a reading-writers' workshop. *Annals of Dyslexia, 63,* 1-24.

Berninger, V. W., Richards, T. L., & Abbott, R. D. (2015). Differential diagnosis of dysgraphia, dyslexia, and OWL LD: Behavioral and Neuroimaging evidence. *Reading and Writing, 28,* 1119-1153.

Berninger, V. W., & Wolf, B. J. (2009). *Teaching students with dyslexia and dysgraphia: Lessons from teaching and science*. Baltimore, MD: Brookes Publishing.

Bijou, S. W. (1970). What psychology has to offer education-now. *Journal of Applied Behavior Analysis, 3,* 65-71.

Boat, T. F., & Wu, J. T. (2015). *Mental disorders and disabilities among low-income children*. Washington, DC: National Academies Press.

Brueggeman-Taylor, A. E. (2014). *Diagnostic assessment of learning disabilities in childhood: Bridging the gap between research and practice*. New York: Springer.

Bruhn, A. L., Hirsch, S. E., & Lloyd, J. W. (2015). Treatment integrity in school-wide programs: A review of the literature (1993-2012). *Journal of Primary Prevention, 36,* 335-349.

Bryant D. P., Bryant B. R., Gersten R., Scammacca N., Chavez M. (2008). Mathematics Intervention for first- and second-grade students with mathematics difficulties: The effects of Tier 2 intervention delivered as booster lessons. *Remedial and Special Education*, *29*, 20-32.

Bryant, D. P., Bryant, B. R., Gersten, R. M., Scammacca, N. N., Funk, C., Winter, A., & Pool, C. (2008). The effects of Tier 2 intervention on the mathematics performance of first-grade students who are at risk for mathematics difficulties. *Learning Disability Quarterly, 31,* 47-63.

Bryant, D. P., Bryant, B. R., & Pfannenstiel, K. H. (2015). Mathematics interventions: Translating research into practice. *Intervention in School and Clinic, 50*, 255–256.

Bryant, B. R., Bryant, D. P., Porterfield, J., Dennis, M. S., Falcomata, T., Valentine, C., . . . Bell, K. (2016). The effects of a Tier 3 intervention on the mathematics performance of second grade students with severe mathematics difficulties. *Journal of Learning Disabilities, 49*, 176-188.

Burns, M. K. (2014). Reactions from journal editors: School Psychology Review. In T. R. Kratochwill & J. R. Levin (Eds.), *Single-case intervention research: Methodological and statistical advances* (pp. 339-346). Washington DC: American Psychological Association.

Burns, M. K., Kanive, R., & Degrande, M. (2012). Effect of a computer-delivered math fact intervention as a supplemental intervention for math in third and fourth grades. *Remedial and Special Education, 33*, 184-191.

Burns, M. K., Peterson-Brown, S., Haegele, K., Rodriguez, M., Schmitt, B., …& VanDerHeyden, A. M. (2016). Meta-analysis of academic interventions derived from neuropsychological data. *School Psychology Quarterly, 31*, 28-42.

Burns, M. K., Riley-Tillman, T. C., & VanDerHeyden, A. M. (2012). *RTI applications, volume 1: Academic and behavioral interventions*. New York: Guilford Press.

Burns, M. K., Riley-Tillman, T. C., & VanDerHeyden, A. M. (2013). *RTI applications, volume 2: Assessment, analysis, and decision making*. New York: Guilford Press.

Burns, M. K., & Ysselsyke, J. E. (2009). Reported prevalence of evidence-based instructional practices in special education. *Journal of Special Education, 43*, 3-11.

Burns, M. K., Zaslofsky, A. F., Kanive, R., & Parker, D. C. (2012). Meta-analysis if incremental rehearsal using phi coefficients to compare single-case and group designs. *Journal of Behavioral Education, 21,* 185-202.

Cattell, R. B. (1971). *Abilities: Their structure, growth, and action*. Boston, MA: Houghton Mifflin.

Cavendish, W. (2013). Identification of learning disabilities: Implications of proposed DSM-5 criteria for school-based assessment. *Journal of Learning Disabilities, 46,* 52-57.

Chard, D. J., Ketterlin-Geller, L. R., Baker, S. K., Doabler, C., & Apichatabutra, C. (2009). Repeated reading interventions with students with learning disabilities: Status of the evidence. *Exceptional Children, 75,* 263-281.

Clements, D. H., & Sarama, J. (2009). *Learning and teaching early math: The learning trajectories approach*. New York: Routledge

Codding, R. S., Archer, J., & Connell, J. (2010). A systematic replication and extension of using incremental rehearsal to improve multiplication skills: An investigation of generalization. *Journal of Behavioral Education, 19,* 93-105.

Codding, R. S., VanDerHeyden, A. M., Martin, R. J., Desai, S., Allard, N., & Perrault, L. (2016). Manipulating treatment dose: Evaluating the frequency of a small group intervention targeting whole number operations. *Learning Disabilities Research & Practice, 31,* 208-220.

Compton, D. L., Miller, A. C., Elleman, A. M., & Steacy, L. M. (2014). Have we forsaken reading theory in the name of "quick fix" interventions for children with reading disability. *Scientific Studies of Reading, 18,* 55-73.

Cook, B. G., & Cook, S. C. (2013). Unraveling evidence-based practices in special education.

Journal of Special Education, 47, 71-81.

Cook, B. G., & Odom, S. L. (2013). Evidence-based practices and implementation science in special education. *Exceptional Children, 79,* 135-144.

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.

Coyne, M. D., Kame'enui, E. J., & Carnine, D. W. (2011). *Effective teaching strategies that accommodate diverse learners* (4th ed.). Upper Saddle River, NJ: Pearson.

Creed, T. A., Reisweber, J., & Beck, A. T. (2011). *Cognitive therapy for adolescents in school settings*. New York: Guilford Press.

Cronbach, L. J. (1975). Beyond the two disciplines of scientific psychology. *American Psychologist, 30,* 116-127.

Cronbach, L. J., & Snow, R. E. (1977). Aptitudes and instructional methods: A handbook for research on interactions. New York: Irvington.

Cuthbert, B. N., & Insel, T. R. (2013). Toward the future of psychiatric diagnosis: The seven pillars of RDoC. *BMC Medicine, 11,* 126-133.

Daly III, E. J., Witt, J. C., Martens, B. K., & Dool, E. J. (1997). A model for conducting a functional analysis of academic performance problems. *School Psychology Review, 26,* 554-574.

Datchuk, S. M., Kubina, R. M. (2013). A review of teaching sentence-level writing skills to students with writing difficulties and learning disabilities. *Remedial and Special Education, 34,* 180-192.

Decker, S. L. (2008). Intervention psychometrics: Using norm-referenced methods for treatment planning and monitoring. *Assessment for Effective Intervention, 34,* 52-61.

Decker, S. L., Hale, J. B., & Flanagan, D. P. (2013). Professional practice issues in the assessment of cognitive functioning for educational applications. *Psychology in the Schools, 50,* 300-313.

Deno, S. L. (2013). Problem-solving assessment. In R. Brown-Chidsey & K. J. Andren (Eds.), *Assessment for intervention: A problem-solving approach* (2nd ed.; pp. 10-38). New York: Guilford.

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,* 331-370.

Dyson, N. I., Jordan, N. C., & Glutting, J. (2013). A number sense intervention for low-income kindergartners at risk for mathematics disabilities. *Journal of Learning Disabilities, 46,* 166-181.

Edmonds, M. S., Vaughn, S., Wexler, J., Reutebuch, C., Cable, A., Tacket, K. K., & Schnakenberg, J. W. (2009). A synthesis of reading interventions and effects on reading comprehension outcomes for older struggling readers. *Review of Educational Research, 79*, 262-300.

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.

Elliott, J. G., & Resing, W. C. M. (2015). Can intelligence testing inform educational intervention for children with reading disability? *Journal of Intelligence, 3,* 137-157.

Englemann, S. (2007). Teaching needs kids in our backward system: 42 years of trying. Eugene, OR: Association for Direct Instruction Press.

Englemann, S., Becker, W. C., Carnine, D., & Gersten, R. (1988). The direct instruction follow through model: Design and outcomes. *Education and Treatment of Children, 11*, 303-317.

Erchul, W. P., & Martens, B. K. (2010). *School Consultation: Conceptual and empirical bases of practice*. New York: Springer.

Erion, J., Davenport, C., Rodax., N., Scholl, B., & Hardy, J. (2009). Cover-copy-compare and spelling: One versus three repetitions. *Journal of Behavioral Education, 18*, 319-330.

Faggella-Luby, M., & Deshler, D. (2008). Reading comprehension in adolescents with LD: What we know; what we need to learn. *Learning Disabilities Research & Practice, 23*, 70-78.

Ferrer, E., Shaywitz, B. A., Holahan, J. M., Marchione, K., & Shaywitz, S. E. (2010). Uncoupling of reading and IQ over time: Empirical evidence for a definition of dyslexia. *Psychological Science, 21*, 93-101.

Finn, E. S., Shen, X., Holahan, J. M., Scheinost, D., Lacadie, C., Papademetris, X., Shaywitz, S. E., Shaywitz, B. A., & Constable, R. T. (2014). Disruption of functional networks in dyslexia: A whole brain, data-driven analysis of connectivity. *Biological Psychiatry, 76,* 397-404.

Fixsen, D. L., Blase, K. A., Duda, M. A., Naoom, S. F., & Van Dyke, M. (2010). Implementation of evidence-based treatments for children and adolescents: Research findings and implications for the future. In J. R. Weisz & A. E. Kazdin (Eds.), *Evidence-based psychotherapies for children and adolescents* (2nd ed.; pp. 435-450). New York: Guilford.

Fletcher, J. M., Foorman, B. R., Boudousquie, A., Barnes, M. A., Schatschneider, C., & Francis, D. J. (2002). Assessment of reading and learning disabilities: A research-based intervention-oriented approach. *Journal of School Psychology, 40*, 27-63.

Fletcher, J. M., Francis, D. J., Morris, R. D., & Lyon, G. R. (2005). Evidence-based assessment of learning disabilities in children and adolescents. *Journal of Clinical Child and Adolescent Psychology, 34,* 506-522.

Fletcher, J. M., Lyon, G. R., Fuchs, L. S., & Barnes, M. A. (2007). *Learning disabilities: From identification to intervention*. New York: Guilford.

Fletcher, J. M., & Vaughn, S. (2009). Response to intervention: Preventing and remediating academic difficulties. *Child Development Perspectives, 3,* 30-37.

Forman, B. R., Francis, D. J., Fletcher, J. M., Schatschneider, C. S., & Mehta, P. (1998). The role of instruction in learning to read: Preventing reading failure in at-risk children. *Journal of Educational Psychology, 90,* 37-55.

Forman, S. G., Olin, S. S., Hoagwood, K. E., Crowe, M., & Saks, S. (2009). Evidence-based interventions in schools: Developers' views of implementation barriers and facilitators. *School Mental Health, 1,* 26-36.

Forman, S. G., Shapiro, E. S., Codding, R. S., Gonzales, J. E., Reddy, L. A., Rosenfield, S. A., Sanetti, L. M. H., & Stoiber, K. C. (2013). Implementation science and school psychology. *School Psychology Quarterly, 28*, 77-100.

Frijters, J. C., Lovett, M. W., Sevcik, R. A., & Morris, R. D. (2013). Four methods of identifying change in the context of a multiple component reading intervention for struggling middle school readers. *Reading and Writing, 26,* 539-563.

Fuchs, D., Fuchs, L. S., Mathes, P. G., & Martinez, E. A. (2002). Preliminary evidence on the social standing of students with learning disabilities in PALS and no-PALS classrooms. *Learning Disabilities Research & Practice, 17,* 205-215.

Fuchs, D., Hale, J. B., & Kearns, D. M. (2011). On the importance of a cognitive processing perspective: An introduction. *Journal of Learning Disabilities, 44,* 99-104.

Fuchs, L. S. (2010). *Intervention: Defining the intersection of reading and mathematics learning disabilities*. Paper presented at the Defining the Intersection of Reading and Mathematics Learning Disabilities Workshop, National Institute of Child Health and Human Development, Rockville, MD.

Fuchs, D., & Deshler, D. D. (2007). What we need to know about responsiveness to intervention (and shouldn't be afraid to ask). *Learning Disabilities Research and Practice, 22,* 129-136.

Fuchs, L. S., Fuchs, D., Craddock, C., Hollenbeck, K. N., Hamlett, C. L., & Schatschneider, C. (2008). Effects of small-group tutoring with and without validated classroom instruction on at-risk students' math problem solving: Are two tiers of prevention better than one? *Journal of Educational Psychology, 100,* 491-509.

Fuchs, L. S., Fuchs, D., Hamlett, C. L., Walz, L., & Germann, G. (1993). Formative evaluation of academic progress: How much growth can we expect? *School Psychology Review, 22,* 27-48.

Fuchs, L. S., Fuchs, D., & Hollenbeck, K. N. (2007). Extending responsiveness to intervention to mathematics at first and third grades. *Learning Disabilities Research & Practice, 22,* 13-24.

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 Disabilities Quarterly, 31,* 79-92.

Fuchs, L. S., Fuchs, D., & Speece, D. L. (2002). Treatment validity as a unifying construct for identifying learning disabilities. *Learning Disability Quarterly, 25,* 33-45.

Fuchs, L. S., Fuchs, D., Stuebing, K., Fletcher, J. M., Hamlett, C. L., & Lambert, W. E. (2008). Problem solving and calculation skills: Shared or distinct aspects of mathematical cognition? *Journal of Educational Psychology, 100,* 30-47.

Fuchs, L. S., Powell, S. R., Cirino, P. T., Schumacher, R. F., Marrin, S., Hamlett, C. L., …& Changas, P. C. (2014). Does calculation or word-problem instruction provide a stronger router to pre-algebraic knowledge? *Journal of Educational Psychology, 106,* 990-1006.

Fuchs, L. S., Powell, S. R., Seethaler, P. M., Cirino, P. T., Fletcher, J. M., Fuchs, D., Hamlett, C. L., & Zumeta, R. O. (2009). Remediating number combination and word problem deficits among students with mathematics difficulties: A randomized control trial. *Journal of Educational Psychology, 101,* 561-576.

Gajria, M., Jitendra, A. K., Sood, S., & Sacks, G. (2007). Improving comprehension of expository text in students with LD: A research synthesis. *Journal of Learning Disabilities, 40,* 210-225.

Galuschka, K., Ise, E., Krick, K., & Schulte-Korne, (2014). Effectiveness of treatment approaches for children and adolescents with reading disabilities: A meta-analysis of randomized controlled trials. *PLoS One, 9 (2),* 1-12.

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

Geary, D. C. (2013). Early foundations for mathematics learning and their relations to learning disabilities. *Current Directions in Psychological Science, 22,* 23-27.

Gersten, R. (2016). Commentary: The tyranny of time and the reality principle. *New Directions for Child and Adolescent Development, 154,* 113-116.

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). Washington DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Science, U.S. Department of Education.

Gersten, R., Chard, D. J., Jayanthi, M., Baker, S. K., 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

Gersten, R., Clarke, B., & Mazzocco, M. (2007). Historical and contemporary perspectives on mathematical learning disabilities. In D.B. Berch & M.M.M. Mazzocco (Eds.). *Why is math so hard for some children? The nature and origins of mathematical learning difficulties and disabilities* (pp. 7-29). Baltimore, MD: Brooks Publishing.

Gersten, R., Compton, D., Connor, C. M., Dimino, J., Santoro, L., Linan-Thompson, S., & Tilly, W. D. (2008). *Assisting students struggling with reading: Response to intervention and multi-tier intervention for reading in the primary grades: A practice guide* (NCEE 2009-4045). Washington DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Science, U.S. Department of Education.

Gillespie, A. & Graham, S. (2014). A meta-analysis of writing interventions for students with learning disabilities. *Exceptional Children, 80,* 454-473.

Grafman, J. M., & Cates, G. L. (2010). The differential effects of two self-managed math instruction procedures: Cover, copy, and compare versus copy, cover, and compare. *Psychology in the Schools, 47,* 165-165.

Graham, S., Harris, K. R., & McKeown, D. (2013). The writing of students with learning disabilities, meta-analysis of self-regulated strategy development 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.

Graham, S., McKeown, D., Kiuhara, S., Harris, K. R. (2012). Meta-analysis of writing instruction for students in elementary grades. *Journal of Educational Psychology, 104,* 879-896.

Graham, S., & Perrin, D. (2007). A meta-analysis of writing instruction for adolescent students. *Journal of Educational Psychology, 99,* 445-476.

Gresham, F. M., MacMillan, D. L., Beebe-Frankenberger, M., & Bocian, K. M. (2000). Treatment integrity in learning disabilities intervention research: Do we really know how treatments are implemented? *Learning Disabilities Research and Practice, 15*, 198-205.

Gresham, F. M., MacMillan, D. L., & Bocian, K. M. (1996). Learning disabilities, low achievement, and mild mental retardation: More alike than different? *Journal of Learning Disabilities, 29,* 570-581.

Gresham, F. M., & Witt, J. C. (1997). Utility of intelligence tests for treatment planning, classification, and placement decisions: Recent empirical findings and future directions. *School Psychology Quarterly, 12*, 249-267.

Griffiths, A-J., VanDerHeyden, A. M., & Parson, L. B., & Burns, M. K. (2006). Practical applications of response-to-intervention research. *Assessment for Effective Intervention, 32,* 50-57.

Hale, J. B., Chen, S. H. A., Tan, S. C., Poon, K., Fitzer, K. R., & Boyd, L. A. (2016). Reconciling individual differences with collective needs: The juxtaposition of sociopolitical and neuroscience perspective son remediation and compensation of student skill deficits. *Trends in Neuroscience Education, 5,* 41-51.

Hale, J. B., & Fiorello, C. A. (2004). *School neuropsychology: A practitioner's handbook*. New York: Guilford.

Hallahan, D. P., Pullen, P. C., & Ward, D. (2013). A brief history of the field of learning disabilities. In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of Learning Disabilities* (2nd ed.; pp. 15-32). New York: Guilford.

Henbest, V. S., & Apel, K. (2017). Effective word reading instruction: What does the evidence tell us? *Communication Disorders Quarterly.* Advance online publication.

Honicke, T., & Broadbent, J. (2016). The influence of academic self-efficacy on academic performance: A systematic review. *Educational Research Review, 17,* 63-84.

Hooper, S. R., Costa, L. J. C., McBee, M., Anderson, K. L., Yerby, D. C., Childress, A., & Knuth, S. B. (2013). A written language intervention for at-risk second grade students: A randomized controlled trial of the process assessment of the learner lesson plans in a Tier 2 response-to-intervention (RtI) model. *Annals of Dyslexia, 63,* 44-64.

Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wollery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children, 71,* 165-179.

Hosp, M. K., Hosp, J. L., & Howell, K. W. (2016). *The ABCs of CBM* (2nd ed.). New York: Guilford.

Hunsley, J., & Mash, E. J. (2010). The role of assessment in evidence-based practice. In M. M. Anthony & D. H. Barlow (Eds.), *Handbook of assessment and treatment planning for psychological disorders* (2nd ed.; pp. 3-22). New York: Guilford.

Iseman, J. S., & Naglieri, J. A. (2011). A cognitive strategy instruction to improve math calculation for children with ADHD and LD: A randomized controlled study. *Journal of Learning Disabilities,* *44,* 184-195.

Jitendra, A. K., Burgess, C., & Gajria, M. (2011). Cognitive strategy instruction for improving expository text comprehension of students with learning disabilities: The quality of evidence. *Exceptional Children, 77*, 135-159.

Jitendra, A. K., Dupuis, D. N., Star, J. R., & Rodriguez, M. C. (2016). The effects of schema-based instruction on the proportional thinking of students with mathematics difficulties with and without reading difficulties. *Journal of Learning Disabilities, 49,* 354-367.

Joseph, L. M., Konrad, M., Cates, G., Vajcner, T., Eveleigh, E., & Fishley, K. M. (2011). A meta-analytic review of the cover-copy-compare and variations of this self-management procedure. *Psychology in the Schools, 49,* 122-136.

Johnson, V. E., Payne, R. D., Wang, T., Asher, A., & Mandal, S. (2016). On the reproducibility of psychological science. *Journal of the American Statistical Association*. Advance online publication.

Jung, P-G., McMaster, K. L., & delMas, R. C. (2016). Effects of early writing intervention delivered within a data-based instruction framework. *Exceptional Children*. Advance online publication.

Kame'enui, E. J., Fein, H., & Korgesaar, J. (2013). Direct instruction as Eo nomine and contronym: Why the right words and details matter. In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of Learning Disabilities* (2nd ed.; pp. 489-507). New York: Guilford.

Kang, E. Y., McKenna, J. W., Arden, S., & Ciullo, S. (2016). Integrated reading a writing interventions for students with learning disabilities: A review of the literature. *Learning Disabilities Research and Practice, 31*, 22-33.

Kazdin, A. E. (2008). Evidence-based treatment and practice: New opportunities to bridge clinical research, and practice, enhance the knowledge base, and improve patient care. *American Psychologist, 63,* 146-159.

Kearns, D. M., & Fuchs, D. (2013). Does cognitively focused instruction improve the academic performance of low-achieving students? *Exceptional Children, 79,* 263-290.

Kennedy, M. J., Deshler, D. D., & Lloyd, J. W. (2015). Effects of multimedia vocabulary instruction on adolescents with learning disabilities. *Journal of Learning Disabilities, 48,* 22-38.

Kilgus, S. P., Riley-Tillman, T. C., & Kratochwill, T. R. (2016). Establishing interventions via a theory-driven single case design research cycle. *School Psychology Review, 45,* 477-498.

Kirk, S. A., McCarthy, J. J., & Kirk, W. D. (1961). *Illinois Test of Psycholinguistic Abilities*. Urbana, IL: University of Illinois Press.

Klingner, J. K., Vaughn, S., Dimino, J., & Bryant, D. (2001). *From clunk to click: Collaborative strategic reading*. Longmont, CO: Sopris West.

Kratochwill, T. R. (2007). Preparing psychologists for evidence-based school practice: Lessons learned and challenges ahead. *American Psychologist, 62,* 829-843.

Kratochwill, T. R., Hitchcock, J., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., & Shadish, W. R. (2010). *Single-case designs technical documentation*. Retrieved from http://ies.ed.gov/ncee/wwc/pdf/wwc_scd.pdf

Kratochwill, T. R., Hitchcock, J. H., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., & Shadish, W. R. (2013). Single-case intervention research design standards. *Remedial and Special Education, 34,* 26-38.

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.

Langberg, J. M., Epstein, J. N., Becker, S. P., Grio-Herrera, E., & Vaughn, A. J. (2012). Evaluation of the Homework, Organization, and Planning Skills (HOPS) intervention for middle school students with ADHD as implemented by school mental health providers. *School Psychology Review, 41*, 342-364.

Lee, J., & Yoon, S. Y. (2017). The effects of repeated reading on reading fluency for students with reading disabilities: A meta-analysis. *Journal of Learning Disabilities*, *50*, 213-224.

Lerner, J. W., & Johns, B. H. (2012). *Learning disabilities and related mild disabilities: Teaching strategies and new directions* (12th ed.). Belmont, CA: Cengage.

Lewandowski, L. J., & Lovett, B. J. (2014). Learning disabilities. In E. J. Mash & R. A. Barkley (Eds.), *Child Psychopathology* (3rd ed; pp. 625-669). New York: Guilford.

Lichtenstein, R., & Klotz, M. B. (2007). Deciphering the federal regulations on identifying children with specific learning disabilities. *Communiqué, 36(3),* 13-16.

Lovett, B. J., & Hood, S. B. (2011). Realism and operationalism in psychiatric diagnosis. *Philosophical Psychology*, *24,* 207-222.

Lovett, M. W., De Palma, M., Frijters, J., Steinbach, K., Temple, M., Benson, N., & Lacerenza, L. (2008). A comparison of response to intervention by ELL and EFL struggling readers. *Journal of Learning Disabilities, 41*, 333-352.

Lovett, M. W., Lacerenza, L., De Palma, M., & Frijters, J. C. (2012). Evaluating the efficacy of remediation for struggling readers in high school. *Journal of Learning Disabilities, 45,* 151-169.

Lovett, M. W., Lacerenza, L., Steinbach, K. A., & De Palma, M. (2014). Development and evaluation of a research-based intervention program for children and adolescents with reading disabilities. *Perspectives on Language and Literacy, 40 (3)*, 21-31.

Lilienfeld, S. O. (2011). Distinguishing scientific from pseudoscientific psychotherapies: Evaluating the role of theoretical plausibility, with a little help from Reverend Bayes. *Clinical Psychology: Science to Practice, 18,* 105-112.

Lilienfeld, S. O., Ritschel, L. A., Lynn, S. J., Cautin, R. L., & Latzman, R. D. (2013). Why many clinical psychologists are resistant to evidence-based practice: Root causes and constructive remedies. *Clinical Psychology Review, 33,* 883-900.

Lloyd, J. W., Forness, S. R., & Kavale, K. A. (1998). Some methods are more effective than others. *Intervention in school and Clinic, 33,* 195-200.

Lyon, G. R., & Cutting, L. E. (1998). Treatment of learning disabilities. In E. J. Mash & R. A. Barkley (Eds.), *Treatment of childhood disorders* (2nd ed.; pp. 468-500). New York: Guilford.

Lyon, G. R., Fletcher, J. M., Fuchs, L. S., & Chhabra, V. (2006). Learning disabilities. In E. J. Mash & R. A. Barkley (Eds.), *Treatment of Childhood Disorders* (3rd ed.). New York: Guilford.

Lyon, G. R., & Weiser, B. (2013). The state of science in learning disabilities: Research impact on the field from 2001 to 2011. In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of Learning Disabilities* (2nd ed.; pp. 118-154). New York: Guilford.

Maisog, J. M., Einbinder, E. R., Flowers, D. L., Turkeltaub, P. E., & Eden, G. F. (2008). A meta-analysis of functional neuroimaging studies of dyslexia. *Annals of the New York Academy of Sciences*, *1145*, 237-59.

Makel, M. C., Plucker, J. A., Freeman, J., Lombardi, A., Simonsen, B., & Coyne, M. (2016). Replication of special education research: Necessary but far too rare. *Remedial and*

Special Education, 37, 205-212.

Malouf, D. B., & Taymans, J. M. (2016). Anatomy of an evidence base. *Educational Researcher, 45*, 454-459.

Mann, L. (1971). Psychometric phrenology and the new faculty psychology. *Journal of Special Education, 5*, 3-14.

Mann, L. (1979). *On the trail of process*. New York: Grune & Stratton.

Margari, L., Buttiglione, M., Craig, F., Cristella, A., de Giambattista, C., Matera, E., Operto, F., & Simone, M. (2013). Neuropsychological comorbidities in learning disorders. *BMC Neurology*, *13*, 198-203.

Mascolo, J. T., Alfonso, V. C., & Flanagan, D. P. (2014). *Essentials of planning, selecting, and tailoring intervention for unique learners*. Hoboken, NJ: Wiley.

Maynard, B. R., Heyne, D., Brendel, K. E., Thompson, J. J. M., & Pigott, T. D. (2015). Treatment for school refusal among children and adolescents: A systematic review and meta-analysis. *Research on Social Work Practice*. Advance online publication.

Mazzocco, M. M. M., Feigenson, L., & Halberda, J. (2011). Impaired acuity of the approximate number system underlies mathematical learning disability (dyscalculia). *Child Development, 82,* 1224-1237.

McCabe, J. A., Redick, T. S., & Engle, R. W. (2016). Brain training pessimism, but applied memory optimism. *Psychological Science in the Public Interest, 17,* 187-191.

McDermott, P. A., Goldberg, M. M., Watkins, M. W., Stanley, J. L., & Glutting, J. J. (2006). A nationwide epidemiologic modeling study of learning disabilities: Risk, protection, and unintended impact. *Journal of Learning Disabilities, 39*, 230-251.

McFall, R. M. (1991). Manifesto for a science of clinical psychology. *The Clinical Psychologist,* *44*, 75-88.

McGill, R. J., & Busse, R. T. (2014). An evaluation of multiple single-case outcome indicators using convergent evidence scaling. *Contemporary School Psychology, 18*, 13-23.

McGill, R. J., & Busse, R. T. (2017a). A rejoinder on the PSW model for SLD identification: Still concerned. *Contemporary School Psychology, 21,* 23-27.

McGill, R. J., & Busse, R. T. (2017b). When theory trumps science: A critique of the PSW model for SLD identification. *Contemporary School Psychology, 21,* 10-18.

McGill, R. J., Styck, K. S., Palomares, R. S., & Hass, M. R. (2016). Critical issues in specific learning disability identification: What we need to know about the PSW model. *Learning Disability Quarterly, 39,* 159-170.

McKenna, J. W., Shin, M., & Ciullo, S. (2015). Evaluating reading and mathematics instruction for students with learning disabilities. *Learning Disability Quarterly, 38,* 195-207.

Methe, S. A., Kilgus, S.P., Neiman, C., & Riley-Tillman, T. C. (2012). Meta-analysis of interventions for basic mathematics computation in single-case research. *Journal of Behavioral Education, 21,* 230-250.

Miller, D. C. (2013). *Essentials of school neuropsychology* (2nd ed.). Hoboken, NJ: Wiley.

Mishna, F. (2003). Learning disabilities and bullying. *Journal of Learning Disabilities, 36,* 336-347.

Moll, K., Kunze, S., Neuhoff, N., Bruder, J., & Schulte-Korne, G. (2014). Specific learning disorder: Prevalence and gender differences. *PLOS One, 9 (7),* 1-8.

Montague, M. (2008). Self-regulation strategies to improve mathematical problem solving for students with learning disabilities. *Learning Disability Quarterly, 31,* 37-44.

Montague, M., & Dietz, S. (2009). Evaluating the evidence base for cognitive strategy instruction and mathematical problem solving. *Exceptional Children, 75,* 285-302.

Montague, M., Enders, G., & Dietz, S. (2011). Effects of cognitive strategy instruction on math problem solving of middle school students with learning disabilities. *Learning Disability Quarterly, 34,* 262-272.

Montague, M., Krawec, J., Enders, C., & Dietz, S. (2014). The effects of cognitive strategy instruction on math problem solving of middle-school students of varying ability. *Journal of Educational Psychology, 106,* 469-481.

Morgan, P. L., Farkas, G., Hillmeier, M. M., Mattison, R., Maczuga, S., Li, H., & Cook, M. (2015). Minorities are disproportionally underrepresented in special education: Longitudinal evidence across five disability conditions. *Educational Researcher, 44,* 278-292.

Morgan, P. L., Siderdis, G., & Hua, Y. (2012). Initial and over-time effects of fluency interventions for students with or at risk for disabilities. *Journal of Special Education, 46,* 94-116.

Morris, R., Lovett, M., Wolf, M., Sevcik, R., & Steinbach, K. (2012). Multiple component remediation of developmental reading disabilities: A controlled factorial evaluation of the influence of IQ, socioeconomic status, and race on outcome. *Journal of Learning Disabilities. 45,* 99-127.

No Child Left Behind (NCLB) Act of 2001, Pub. L. No. 107-110, § 115, Stat. 1425 (2002).

Noell, G. H., Witt, J. C., Gilbertson, D. N., Rainier, D. D., & Freeland, J. T. (1997). Increasing teacher intervention implementation in general education settings through consultation and performance feedback. *School Psychology Quarterly, 12,* 77-88.

Norton, E. S., Black, J. M., Stanley, L. M., Tanaka, H., Gabrieli, J. D. E., Sawyer, C., & Hoeft,

F. (2014). Functional neuroanatomical evidence for the double-deficit hypothesis of developmental dyslexia. *Neuropsychologia, 61,* 235-246.

Norton, E. S., & Wolf, M. (2012). Rapid automatized naming (RAN) and reading fluency: Implications for understanding and treatment of reading disabilities. *Annual Review of Psychology, 63,* 427-452.

Open Science Collaboration. (2012). An open, large-scale, collaborative effort to estimate the reproducibility of psychological science. *Perspectives on Psychological Science, 7,* 657-660.

Pashler, H., McDaniel, M., Rohrer, D., & Bkork, R. (2008). Learning styles: Concepts and evidence. *Psychological Science in the Public Interest, 9,* 105-119.

Pastor, P. N., & Reuben, C. A. (2008). *Diagnosed attention deficit hyperactivity disorder and learning disability: United States, 2004-2006*. Washington DC: U.S. Department of Health and Human Services.

Pendergast, L. L., & Kaplan, A. (2015). Instructional context and student motivation, learning, and development: Commentary and implications for school psychologists. *School Psychology International, 36,* 638-647.

Piazza, M., Faocoetti, A., Trussardi, A. N., Berteletti, I., Conte, S., Lucangeli, D., Dehaene, S., & Zorzi, M. (2010). Developmental trajectory of number acuity revels a severe impairment in developmental dyscalculia. *Cognition, 116,* 33-41.

Polloway, E. A., Patton, J. R., Smith, T. E. C., & Buck, G. H. (1997). Mental retardation and learning disabilities: Conceptual and applied issues. *Journal of Learning Disabilities, 30,* 297-308.

Powell, S. R., Fuchs, L. S., Cirino, P. T., Fuchs, D., Compton, D. L. & Changas, P. C. (2015).

Effects of a multi-tier support system on calculation, word-problem, and pre-algebraic learning among at-risk learners. *Exceptional Children, 81*, 443-470.

Powell, S. R., Fuchs, L. S., Fuchs, D., Cirino, P. T., & Fletcher, J. M. (2009). Effects of fact retrieval tutoring on third-grade students with math difficulties with and without reading difficulties. *Learning Disabilities Research & Practice, 24*, 1-11.

Pressley, M., & Woloshyn, V. (1995). *Cognitive strategy instruction that really improves children's academic performance* (2nd ed.). Cambridge, MA: Brookline.

Raddatz, J., Kuhn, J-T., Holling, H., Moll, K., & Dobel, C. (2016). Comorbidity of arithmetic and reading disorder: Basic number processing and calculation in children with learning impairments. *Journal of Learning Disabilities*. Advance online publication.

Rafdal, B. H., McMaster, K. L., McConnell, S. R., Fuchs, D., & Fuchs, L. S. (2011). The effectiveness of kindergarten peer-assisted learning strategies for students with disabilities. *Exceptional Children, 77*, 299-316.

Redick, T. S., Shipstead, Z., Wiemers, E. A., Melby-Lervag, M., & Hulme, C. (2015). What's working in working memory training? An educational perspective. *Educational Psychology Review*, *27*, 617-633.

Reid, R., Lienmann, T. O., & Hagaman, J. L. (2013). *Strategy instruction for students with learning disabilities* (2nd ed.). New York: Guilford Press.

Reschly, D. J. (2008). School psychology paradigm shift and beyond. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology* (5th ed., Vol 1; pp. 3-15). Bethesda, MD: National Association of School Psychologists.

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*, 130-145.

Richards, T. L., & Berninger, V. W. (2008). Abnormal fMRI connectivity in children with dyslexia during a phoneme task: Before but not after treatment. *Journal of Neurolinguistics, 21*, 294-304.

Riley-Tillman, C. T. (2014). *Evidence based intervention network manual*. Retrieved from http://ebi.missouri.edu/wp-content/uploads/2014/01/EBI-Network-Manual-S.pdf

Riley-Tillman, T. C., & Burns, M. K. (2009). *Evaluating educational interventions: Single-case design for measuring response to intervention*. New York: Guilford.

Roberts, G., Torgeson, J. K., Boardman, A., & Scammacca, N. (2008). Evidence-based strategies for reading instruction of older students with learning disabilities. *Learning Disabilities Research and Practice, 23,* 63-69.

Rogers, L. A., & Graham, S. (2008). A meta-analysis of single subject design writing intervention research. *Journal of Educational Psychology, 100,* 879-906.

Rupley, W. H., Blair, T. R., & Nichols, W. D. (2009). Effective reading instruction for struggling readers: The role of direct/explicit teaching. *Reading & Writing Quarterly, 2-3,* 125-138.

Sackett, D. L., Rosenberg, W. M. C., Gray, J. A. M., Haynes, R. B., & Richardson, W. S. (1996). Evidence based medicine: What it is and what it isn't. *BMJ, 312*, 71-72.

Sáenz, L., McMaster, K. L., Fuchs, D., & Fuchs, L. S. (2007). Peer-assisted learning strategies in reading for students with different learning needs. *Journal of Cognitive Education and Psychology, 6,* 395-410.

Sahoo, M. K., Biswas, H., & Padhy, S. K. (2015). Psychological co-morbidity in children with specific learning disorders. *Journal of Family Medicine and Primary Care, 4,* 21-25.

Santangelo, T., Harris, K. R., & Graham, S. (2008). Using self-regulated strategy development to support students who have "trubol giting thangs into werds". *Remedial and Special*

Education, 29, 78-89.

Sayeski, K. L. (2011). Effective spelling instruction for students with learning disabilities. *Intervention in School and Clinic, 47,* 75-81.

Scammacca, N. K., Roberts, G., Vaughn, S., & Stuebing, K. (2015). A meta-analysis of struggling readers in grades 4-12. *Journal of Learning Disabilities, 48,* 369-390.

Schneider, W. J., & Kaufman, A. S. (2016). Let's not do away with comprehensive cognitive assessments just yet. *Archives of Clinical Neuropsychology*. Advance online publication.

Schulte, A. C. (2015). Prevention and response to intervention: Past, present, and future. In S. R. Jimerson, M. K. Burns, & A. VanDerHeyden (Eds.), *Handbook of response to intervention: The science and practice of multi-tiered systems of support* (2nd ed.; pp. 59-72). New York: Springer.

Schutte, G. M., Duhon, G. J., Solomon, B. G., Poncy, B. C., & Story, B. (2015). A comparative analysis of masses vs. distributed practice on basic math fact fluency growth rates. *Journal of School Psychology, 53,* 149-159.

Shapiro, E. S. (2010). *Academic skills problems: Direct assessment and intervention* (4th ed.). New York: Guilford Press.

Shavelson, R. J., & Towne, L. (2002). *Scientific research in education*. Washington, DC: National Academy Press.

Shaywitz, B. A., Shaywitz, S. E., Blachman, B. A., Pugh, K. R., Fulbright, R. K., Skudlarski, P., … & Gore, J. C. (2004). Development of left occipitotemporal systems for skilled reading in children after a phonologically-based intervention. *Biological Psychiatry, 55,* 926-933.

Sheridan, S. M., & Gutkin, T. B. (2000). The ecology of school psychology: Examining and changing our paradigm for the 21st century. *School Psychology Review, 29,* 485-502.

Shin, M, & Bryant, D. P. (2015). A synthesis of mathematical and cognitive performances of students with mathematics learning disabilities. *Journal of Learning Disabilities, 48,* 96-112.

Shinn, M. R., & Brown, R. (2016). *Much ado about little: The dangers of disseminating the RTI outcome study without careful analysis*. Location: Author.

Skeide, M. A., Kraft, I., Muller, B., Schaadt, G., Neef, N., …& Friederici, A. D. (2016). NRSN1 associated grey matter volume of the visual word form area reveals dyslexia before school. *Brain, 139,* 2792-2803.

Sleeter, C. E. (1986). Learning disabilities: The social construction of a special education category. *Exceptional Children, 53,* 46-54.

Solis, M., Ciullo, S., Vaughn, S., Pyle, N., Hssaram, B., & Leroux, A. (2012). Reading comprehension interventions for middle school students with learning disabilities: A synthesis of 30 years of research. *Journal of Learning Disabilities, 45,* 327-340.

Sporer, N., Brunstein, J. C., & Kieschke, U. (2009). Improving students' reading comprehension skills: Effects of strategy instruction and reciprocal teaching. *Learning and Instruction, 19,* 272-286.

Squires, K. E., & Wolter, J. A. (2016). The effects of orthographic pattern intervention on spelling performance of students with reading disabilities: A best evidence synthesis. *Remedial and Special Education, 37,* 357-369.

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly, 21,* 360-407.

Steacy, L. M., Elleman, A. M., Lovett, M. W., & Compton, D. L. (2016). Exploring differential effects across two decoding treatments on item-level transfer in children with significant word reading difficulties: A new approach for testing intervention elements. *Scientific Studies of Reading,* Advance online publication.

Stoiber, K. C., & DeSmet, J. L. (2010). Guidelines for evidence-based practice in selecting interventions. In G. Gimple Peacock, R. A. Ervin, E. J. Dally III, & K. W. Merrell (Eds.), *Practical handbook of school psychology: Effective practices for the 21st century* (pp. 213-234). New York: Guilford.

Straus, S. E., Glasziou, P., Richardson, W. S., & Haynes, R. B. (2011). *Evidence-based medicine: How to teach and practice EBM* (4th ed.). New York: Churchill Livingstone.

Strickland, W. D., Boon, R. T., & Spencer, V. G. (2013). The effects of repeated reading on the fluency and comprehension skills of elementary-age students with learning disabilities (LD), 2001-2011: A review of research and practice. *Learning Disabilities: A Contemporary Journal, 11,* 1-33.

Suggate, S. P. (2016). A meta-analysis of the long-term effects of phonemic awareness, phonics, fluency, and reading comprehension interventions. *Journal of Learning Disabilities, 49,* 77-96.

Swanson, E. A. (2008). Observing reading instruction for students with learning disabilities: a synthesis. *Learning Disability Quarterly, 31,* 115-133.

Swanson, H. L. (1999). Instructional components that predict treatment outcomes for students with learning disabilities: Support for a combined strategy and direct instructional model. *Learning Disabilities Research & Practice, 14,* 129-140.

Swanson, H. L. (2015). Cognitive strategy interventions improve word problem solving and working memory in children with math disabilities. *Frontiers in Psychology, 6,* 1-13.

Swanson, H. L., Carson, C., & Sachse-Lee, C. M. (1996). A selective synthesis of intervention research for students with learning disabilities. *School Psychology Review*, *25*, 370-391.

Swanson, H. L., Harris, K. R., & Graham, S. (2013). Overview of foundations, causes, instruction, and methodology in the field of learning disabilities. In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of Learning Disabilities* (2nd ed.; pp. 3-14). New York: Guilford.

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.

Swanson, H. L., Hoskyn, M., & Lee, C. (1999). *Interventions for students with learning disabilities: A meta-analysis of treatment outcomes*. New York: Guilford.

Swanson, H. L., Orosco, M. J., & Lusssier, C. M. (2014). The effects of mathematics strategy instruction for children with serious problem-solving difficulties. *Exceptional Children, 80*, 149-168.

Toste, J. R., Compton, D. L., Fuchs, D., Fuchs, L. S., Gilbert, J. K., Cho, E., Barquero, L. A., & Bouton, B. D. (2014). Understanding unresponsiveness to Tier 2 reading intervention: Exploring the classification of profiles of adequate and inadequate responders in first grade. *Learning Disability Quarterly, 37,* 192-203.

U.S. Office of Education. (1968). *First annual report of the National Advisory Committee on Handicapped Children*. Washington DC: U.S. Department of Health, Education, and Welfare.

VanDerHeyden, A. M. (2013). Universal screening may not be for everyone: Using a threshold model as a smarter way to determine risk. *School Psychology Review, 42,* 402-414.

VanDerHeyden, A. M., Codding, R. S., & Martin, R (2017) Relative value of common screening measures in mathematics. *School Psychology Review, 46,* 65-87.

VanDerHeyden, A. M., Witt, J. C., & Gilbertson, D. (2007). A multi-year evaluation of the effects of a response to intervention (RTI) model on identification of children for special education. *Journal of School Psychology, 45,* 225-256.

Vannest, K. J., Davis, J. L., & Parker, R. I. (2013). *Single-case research in schools: Practical guidelines for school-based professionals*. New York: Routledge.

Vaughn, S., Denton, C. A., & Fletcher, J. M. (2010). Why intensive interventions are necessary for students with severe reading difficulties. *Psychology in the Schools*, *47*, 432-444.

Vaughn, S., & Fletcher, J. M. (2012). Response to intervention with secondary school students with reading difficulties. *Journal of Learning Disabilities, 45,* 244-256.

Vaughn, S., & Linan-Thompson, S. (2003). What is so special about special education for students with learning disabilities? *Journal of Special Education, 37,* 140-147.

Vaughn, S., & Wanzek, J. (2014). Intensive interventions in reading for students with reading disabilities: Meaningful impacts. *Learning Disabilities: Research and Practice, 29,* 46-53.

Vazquez-Nuttall, E., Li, C., Dynda, A. M., Ortiz, S. O., Armengol, C. G., Walton, J. W., & Phoenix, K. (2007). Cognitive assessment of culturally and linguistically diverse students. In G. B. Esquivel, E. C. Lopez, & S. Nahari (Eds.), *Handbook of multicultural school psychology: An interdisciplinary perspective* (pp. 265-288). Mahwah, NJ: Erlbaum.

Vellutino, F. R., Scanlon, D. M., Sipay, E., Small, S., Pratt, A., Chen, R., & Denckla, M. (1996). Cognitive profiles of difficult-to-remediate and readily remediated poor readers:

Early intervention as a vehicle for distinguishing between cognitive and experiential deficits as basic causes of special reading disability. *Journal of Educational Psychology, 88,* 601-638.

Vernon-Feagans, L., Kainz, K., Amendum, S., Ginsberg, M., Wood, T., & Bock, A. (2012). Targeted reading intervention: A coaching model to help classroom teachers with struggling readers. *Learning Disability Quarterly, 35,* 102-114.

Wamphold, B. E., & Bhati, K. S. (2004). Attending to the omissions: A historical examination of evidence-based practice movements. *Professional Psychology: Research and Practice, 35,* 563-570.

Wanzek, J., Vaughn, S., Scammacca, N., K., Metz, K., Murray, C. S., Roberts, G., & Danielson, L. (2013). Extensive reading interventions for students with reading difficulties after Grade 3. *Review of Educational Research, 83,* 163-195.

Wanzek, J., Vaughn, S., Scammacca, N., Gatlin, B., Walker, M. A., & Capin, P. (2016). Meta-analysis of the effects of Tier 2 type reading interventions in grades K-3. *Educational Psychology Review*. Advance online publication.

Wanzek, J., Wexler, J., Vaughn, S., & Ciullo, S. (2010). Reading interventions for struggling readers in the upper elementary grades: A synthesis of 20 years of research. *Reading and Writing, 23,* 889-912.

Watson, S. M. R., & Gable, R. A. (2013). Unraveling the complex nature of mathematics learning disability: Implications for Research and Practice. *Learning Disability Quarterly, 36,* 178-187.

Weddle, S. A., Spencer, T. D., Kajian, M., & Petersen, D. B. (2016) An examination of a multitiered system of language support for culturally and linguistically diverse preschoolers: Implications for early and accurate identification. *School Psychology Review, 45,* 109-132.

Wernicke, C. (1874). *The symptoms of aphasia*. Breslau, Poland: Cohn & Weigert.

Wexler, J., Vaughn, S., Roberts, G., & Denton, C. A. (2010). The efficacy of repeated reading and wide reading practice for high school students with severe reading disabilities. *Learning Disabilities: Research and Practice, 25,* 2-10.

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,* 500-516.

Williams, J. L., Miciak, J., McFarland, L., & Wexler, J. (2016). Learning disability identification criteria and reporting in empirical research: A review of 2001-2013. *Learning Disabilities Research and Practice, 31,* 221-229

Williams, K. J., Walker, M. A., Vaughn, S., & Wanzek, J. (2016). A synthesis of reading and spelling interventions and their effects on spelling outcomes for students with learning disabilities. *Journal of Learning Disabilities*. Advance online publication.

Willner, P. (2005). The effectiveness of psychotherapeutic interventions for people with learning disabilities: A critical review. *Journal of Intellectual Disability Research, 49*, 73-85.

Wolf, M., & Bowers, P. G. (1999). The double-deficit hypothesis for the developmental dyslexias. *Journal of Educational Psychology, 91,* 415-438.

Wolf, M., Miller, L., & Donnelly, K. (2000). Retrieval, automaticity, vocabulary elaboration, orthography, (RAVE-O): A comprehensive, fluency-based reading intervention program. *Journal of Learning Disabilities, 33,* 375-386.

World Health Organization. (1992). *The ICD-10 classification of mental and behavioural disorders: Clinical descriptions and diagnostic guidelines*. Geneva: Author.

Youngstrom, E. A., & Prinstein, M. J. (in press). Evidence-based practice perspective or use of common tools. In M. J. Prinstein, E. A. Youngstrom, E. J. Mash, & R. A. Barkley (Eds.), *Treatment of childhood disorders* (4^{th} ed., pp. XX-XX). New York: Guilford Press.

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology, 81*, 329-339.

Appendix

Clinical Resources for Practitioners

Academic Intervention Resources

- Evidence-Based Intervention Network (http://ebi.missouri.edu/)
- What Work's Clearinghouse (https://ies.ed.gov/ncee/wwc/)
- Intervention Central (http://www.interventioncentral.org/)
- IRIS Center, Vanderbilt University (https://iris.peabody.vanderbilt.edu/)
- *Strategy Instruction for Students with Learning Disabilities-Second Edition* (Reid, Ortiz, & Hagaman, 2013)
- *Academic Skills Problems: Direct Assessment and Intervention-Fourth Edition* (Shapiro, 2010)

RTI/MTSS

- National Center on Response to Intervention (http://www.rti4success.org/)
- *RTI Applications (Volumes 1-2)* (Burns, Riley-Tillman, & VanDerHeyden, 2012, 2013)

Intervention Assessment

- Dynamic Indicators of Basic Early Literacy Skills (https://dibels.uoregon.edu/)
- easyCBM (https://www.easycbm.com/)
- *The ABCs of CBM: A Practical Guide to Curriculum-Based Measurement* (Hosp, Hosp, & Howell, 2016)

Intervention Analysis

- *Evaluating Educational Interventions: Single-Case Design for Measuring RTI* (Riley-Tillman & Burns, 2009)
- *Single-Case Research in Schools: Practical Guidelines for School-Based Professionals* (Vannest, Parker, & Davis, 2013)

Table 1

General guidelines for implementing cognitive strategy instruction (CSI) across academic domains

Systematically teach only one strategy at a time.
Make sure that strategies are efficient and facilitate good information processing.
Model and teach student when and where to use strategies.
Provide plenty of opportunities for students to practice strategies with constructive feedback.
Plan for generalization (i.e., make sure student can implement strategy in appropriate settings).
When possible, teach in context.
Encourage students to monitor their strategy use and reflect on successful/unsuccessful attempts.

Note. Practitioners who are interested in implementing CSI are advised to consult Pressley and Woloshyn (1995) for more information.

Table 2

Levels of treatment evidence for Children and Adolescents with LDs

Treatment	Level of Evidence	Treatment Implications of Common Comorbidities	Other Moderating Factors	Treatment Adjustment
Impairment in Reading				
Phonemic Awareness/Phonics Instruction	Well-established	ADHD: consider combination of pharmacological and behavioral intervention (Barkley, 2014) LD-Writing: supplement with additional instructional support and strategy instruction to address writing deficits Borderline ID: consider combination of direct instruction and adaptive behavior supports	May be less effective when implemented after Grade 3 (Wanzek et al., 2010) Enhanced effects when combined with fluency training (Galuschka et al., 2014) Treatment integrity: poor fidelity may result in less consistent gains	Fluency and comprehension training can be included to address co-lateral deficits in other areas of reading Provide therapy in small-groups Extend number of sessions needed based on progress monitoring data Pair with behavioral modification procedures to

				enhance learning outcomes
Repeated Reading (RR)	Well-established		Enhanced effects when combined with phonics training (Lee & Yoon, 2017) Less effective when implemented with secondary students (Wexler, Vaughn, & Denton, 2010)	Extend re-readings from three to six to enhance generalization Provide corrective feedback after each reading Pair with behavioral modification procedures to enhance learning outcomes
Cognitive Strategy Instruction[b]	Well-established		Token strategies and supports (e.g., graphic organizers) not associated with long term gains (Gajria et al., 2007)	Vary delivery method: teacher-led versus peer-mediation (i.e., collaborative strategic reading) Utilize sequenced lessons with explicit instruction and

				modeling for correct usage For older students, encourage self-monitoring of strategy usage
Multi-Component Reading Programs (e.g., RAVE-O, *PHAST*, Reading Recovery)	Probably efficacious		Enhanced effects when combined with direct instruction (Morris et al., 2012) Treatment integrity: poor fidelity may result in less consistent gains	Extend duration and length of sessions (i.e., 5 days per week, at least one hour per day) Provide therapy in small-groups
Peer Assisted Learning Strategies (PALS)	Possibly efficacious		Higher-levels of support have not been associated with better treatment outcomes (Rafdal et al., 2011) May be less effective with older students with LDs	For older students, consider extending course of treatment (3 days per week for 15-20 weeks)

			(Faggela-Luby & Deshler, 2008)	
Multi-Tiered Systems of Support (MTSS/RTI)	Possibly efficacious		May be less effective when implemented at secondary level (Wanzek et al., 2013) Lack of treatment integrity may create resource strain in clinical settings (Fletcher & Vaughn, 2009)	Utilize systematic progress monitoring to inform treatment decisions and movement between Tiers Instruction at Tier 3 should be more intensive than Tier 2 (i.e., duration and course of treatment)
Cognitive Remediation (e.g., working memory training)	Questionable treatment			Combine with direct academic instruction Select tasks that are likely to lead to far transfer
Whole Class Instruction	Questionable treatment			Provide explicit instruction with sufficient opportunities to respond and practice

				Augment with direct instruction and small-group practice
Impairment in Mathematics				
Direct Instruction (DI): Calculation, Basic Math Facts, and Math Fluency (e.g., Math Flash, Renaissance Learning)	Well-established	ADHD: consider combination of pharmacological and behavioral intervention (Barkley, 2014) LD-Reading: supplement with additional instructional support and strategy instruction to address reading deficits (Shin & Bryant, 2015) Borderline ID: consider combination of direct instruction and adaptive behavior supports	Better outcomes associated with treatments in which DI is supplemented with other adjunct therapies (e.g., peer-mediated instruction, computer-based instruction; Gersten et al., 2009) Interventions implemented beyond Grade 5 may be less effective (Methe, Kilgus, Neiman, & Riley-Tillman, 2012).	Use flash cards to increase fluency and automaticity of skills Consider supplementing DI with short (i.e., 5-15 minutes) computer-based learning sessions
Cognitive Strategy Instruction[b]	Possibly efficacious		May be less effective when implemented below Grade 4 (Jitendra et al., 2016) Outcomes with secondary students have been	Supplement with grade-level instruction in math facts and calculation skills

			inconsistent (Montague & Dietz, 2009) Treatment integrity: Some clinical applications lack systematic instruction and modeling	Provide teacher consultation to ensure that strategies are implanted across settings Encourage self-monitoring of strategy usage with older students
Incremental Rehearsal (IR)	Possibly efficacious		Better outcomes associated when combined with other therapies (e.g., DI, strategy instruction)	Increase number of known items to increase success rate of responding (Burns, Zaslofsky, Kanive, & Parker, 2010)
Multi-Tiered Systems of Support (MTSS/RTI)	Possibly efficacious		Treatment intensity: small-group interventions delivered less than 3 days per week have been less effective (Codding et al., 2016)	Targeted treatment may be needed at Tier 2 (Powell et al., 2015) Models must incorporate treatments designed to target multiple skill areas
Number Sense + DI	Experimental treatment[a]		May be less effective when implemented after Kindergarten or Grade 1(Dyson et al., 2015)	Supplement with whole class instruction in basic

				math facts and word problem skills
Cognitive Remediation (e.g., working memory training)	Questionable treatment			Combine with direct academic instruction Select tasks that are likely to lead to far transfer
Impairment in Writing/Spelling				
Cover, Copy, Compare (CCC)	Well-established	ADHD: consider combination of pharmacological and behavioral intervention (Barkley, 2014) LD-Writing: supplement with additional instructional support and strategy instruction to address writing deficits Borderline ID: consider combination of direct instruction and adaptive behavior supports	Deficits in fine-motor skills: Consider modifying with alternate response formats (Far transfer to higher-order skills such as text construction and comprehension may be limited (Williams et al., 2016)	Flexible selection of model sequence (CCC versus MCCC) Supplement with additional strategy instruction and/or direct instruction in text construction skills Consider pairing with behavioral modification procedures to enhance learning

Self-Regulated Strategy Development (SRSD)	Well-established		Token strategies and supports (e.g., graphic organizers) not associated with long term gains (Graham & Gillespie, 2014)	Flexible selection of intervention components Additional targeted support may needed to address deficits in grammar
Cognitive Remediation: Orthographic Processing	Possibly efficacious		Treatment approaches utilizing DI and systematic instruction have been more effective (Squires & Wolter, 2016)	Flexible selection of intervention components
Multisensory Instruction	Questionable treatment			Pair with DI and/or systematic instruction of writing/spelling skills
Multi-Tiered Systems of Support (MTSS/RTI)	Questionable treatment			Outcome studies continue to be limited (Fuchs & Deshler, 2007)
Adjunct Therapies (Organized by Target Area)				
Homework, Organization and Planning Skills (HOPS; organizational and homework skills)	Possibly efficacious		Far transfer to more focal academic skills may be limited	May be useful supplement for older students and those with co-morbid ADHD (Langberg, 2012)

Psychosocial interventions (e.g., psychotherapy, CBT; academic self-concept, school refusal)	Possibly efficacious		Far transfer to more focal academic skills may be limited	Flexibility in selecting intervention components

Note. LDs = learning disabilities. ADHD: attention-deficit/hyperactivity disorder, ID = intellectual disability, CBT = cognitive behavioral therapy.

[a] Clinical applications of treatment have been limited or effectiveness with individuals with LDs has not been established.

[b] Multiple forms of strategy instruction have been shown to be effective for the target academic domain.

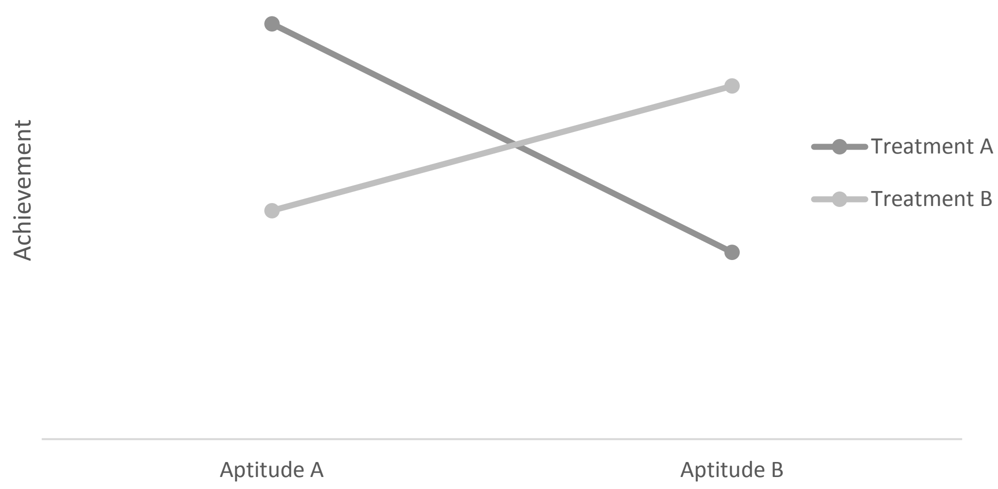

Figure 1. Evidence of an Aptitude by Treatment Interaction (ATI).

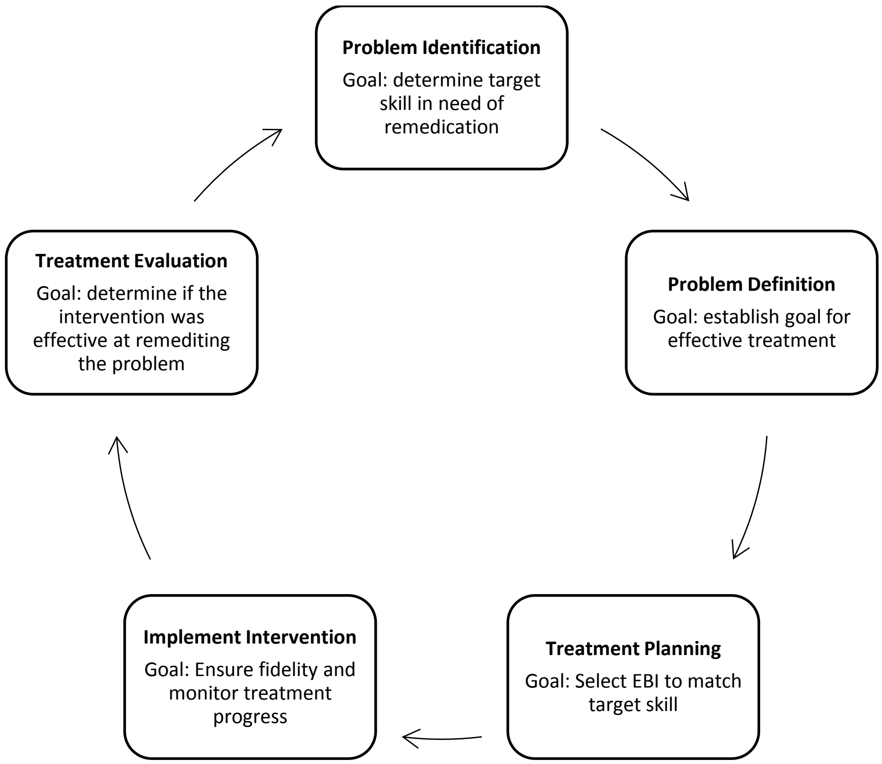

Figure 2. Problem-Solving Intervention Model (Deno, 2013).

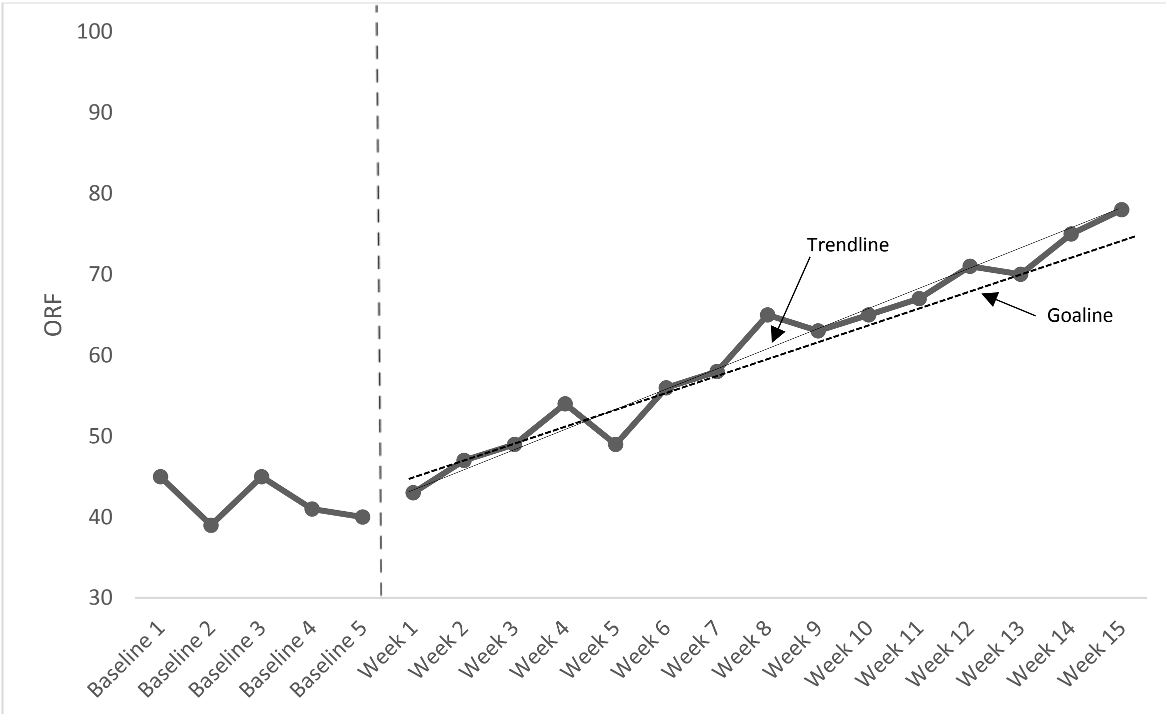

Figure 3. Graphic array of Sam's progress monitoring data for a repeated reading intervention. ORF = oral reading fluency probe.