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CHAPTER 11

A Developmental Approach to Learning Disabilities

VIRGINIA W. BERNINGER

This chapter provides an overview of the various disciplines that have contributed to the conceptualization, diagnosis, and treatment of learning disabilities, with a focus on the field of developmental psychology and representative contributions of this discipline, including a life-span approach. Developmental changes in expression of learning disabilities are illustrated with cases. The contributions of linguistics and psycholinguistics are also emphasized. The unresolved issues related to defining learning disabilities for purposes of practice

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...d of research are highlighted. Recent approaches to ...ifferential diagnosis of specific learning disabilities ...e discussed, and research on effective prevention and ...eatment of learning disabilities is reviewed. The chap... ends with current challenges for the field of learning ...isabilities with respect to research and practice. The ...nresolved controversies are related to definition and ef...ective service delivery in schools.

...I am not being facetious when I characterize my line ...research as studying a phenomenon—dyslexia—that ...chools do not believe exists and that the experts cannot ...efine. Despite these challenges, progress is being made ...on the research front across the world, but many obsta...les remain in translating this scientific knowledge into ...ducational practice, for which cases in this chapter ...erve as reminders.

...IFE-SPAN APPROACH

...Biologically based learning problems may respond to ...reatment but persist over development in changing ...orms of behavioral expression. What is initially a prob...lem in *phonological awareness, phonological working ...emory,* and/or *accurate phonological decoding* (e.g., ...berman, Shankweiler, & Liberman, 1989; Snowling, ...980; Stanovich, 1986; Vellutino & Scanlon, 1987; Wag...er, Torgesen, & Rashotte, 1994) may resolve or persist ...but is likely to become a problem in *automatic word ...ecognition* and/or *reading fluency for text* (Biemiller, ...977–1978; Blachman, 1997; Breznitz, 1987; Kuhn & ...tahl, 2003; Levy, Abello, & Lysynchuk, 1997; Perfetti, ...985; Wolf, 2001; Young, Bowers, & Mackinnon, 1996) ...and *spelling and written expression* (Berninger, Abbott, ...homson, & Raskind, 2001). Despite early intervention, ...some reading and writing problems persist (Bruck, ...992, 1993; McCray, Vaughn, & Neal, 2001; Penning...on, Van Orden, Smith, Green, & Haith, 1990; Shaywitz, ...haywitz, Fletcher, & Escobar, 1990; Singleton, 1999) ...across development.

...Case Illustrating Behavioral Expression in ...arly Childhood

...Susan's dyslexia was first evident to her teachers at the ...end of second grade. A bright girl with superior oral vo...abulary and background knowledge, she once told her ...second-grade teacher that she thought the other children ...were missing the nuances in the stories they read and talked about. It was only when the research team asked her to pronounce real words on a list outside story context or pseudowords that can only be decoded based on letter-sound knowledge that the nature of her reading problem was apparent: Her reading was overly dependent on guessing at words in context and on memorizing a few words without understanding how to decode unfamiliar words. These are the hallmark signs of dyslexia early in schooling. Because her school did not recognize these hallmark signs in first grade and provide appropriate instruction, Susan's written language learning came to a standstill in third grade.

Case Illustrating Behavioral Expression in Middle Childhood

Sean had the same problems as Susan in the primary grades but received special education that emphasized phonics and oral reading. He learned to read, but his oral reading was not fluent and his silent reading was slow. In addition, his written work was peppered with misspellings that reflected omissions of sounds, additions of sounds, transposition of sounds, and plausible spellings (but not for the specific word used). He often did not complete written assignments satisfactorily. However, because he could read silently with reasonable comprehension, the school dismissed him from special education services. The school did not understand that the hallmark features of dyslexia during middle childhood are persisting reading rate, spelling, and written expression problems in students who have learned to decode sufficiently well to read silently with adequate comprehension. Without additional explicit instruction in these skills, Sean floundered in the regular program.

Case Illustrating Behavioral Expression in Early Adolescence

Sam, who is in eighth grade, has the hallmark signs of dyslexia in adolescence: impaired executive functions for self-regulation of reading, writing, learning from lectures, and completion of long-term assignments. Many schools provide explicit instruction for dyslexics when they are in the early grades, but not in middle school and high school, when they would benefit from systematic, explicit language arts instruction that prepares them for the reading and writing requirements across the curriculum, study skills, note taking, and

test taking. Sam, like many other adolescents with dyslexia, does not receive any explicit instruction related to his learning disability but does receive pull-out services to help him with his assignments in the regular program. However, the school wants to dismiss him from all pull-out services for special help because he passed the state's high-stakes writing test. Both Sam and his parents wanted him to continue to receive special education because he is barely passing most of his written assignments in the regular program. However, according to his school, his learning disability does not have an adverse impact on his performance in the regular program because he receives Ds and that is satisfactory progress. Moreover, because he asks too many questions and does not always raise his hand when answering questions, the school recommended that he be placed in a program for students with behavioral disabilities. They do not think that Sam's verbal IQ in the very superior range, his history of Attention-Deficit/Hyperactivity Disorder (ADHD), or test results using research-supported measures and diagnostic procedures showing that he has dyslexia and dysgraphia are reasons to reconsider dismissing him from special education. His parents are advised by special education officials that if they do not agree, they should hire a lawyer and go to a court hearing.

Sam's own story about his learning problems at different stages of his schooling is reproduced in Figure 11.1. Readers are encouraged to read this story before reading the rest of this chapter in order to understand what it is like to have dyslexia from the perspective of an affected individual during the school years.

Case Illustrating Behavioral Expression in Young Adult Years

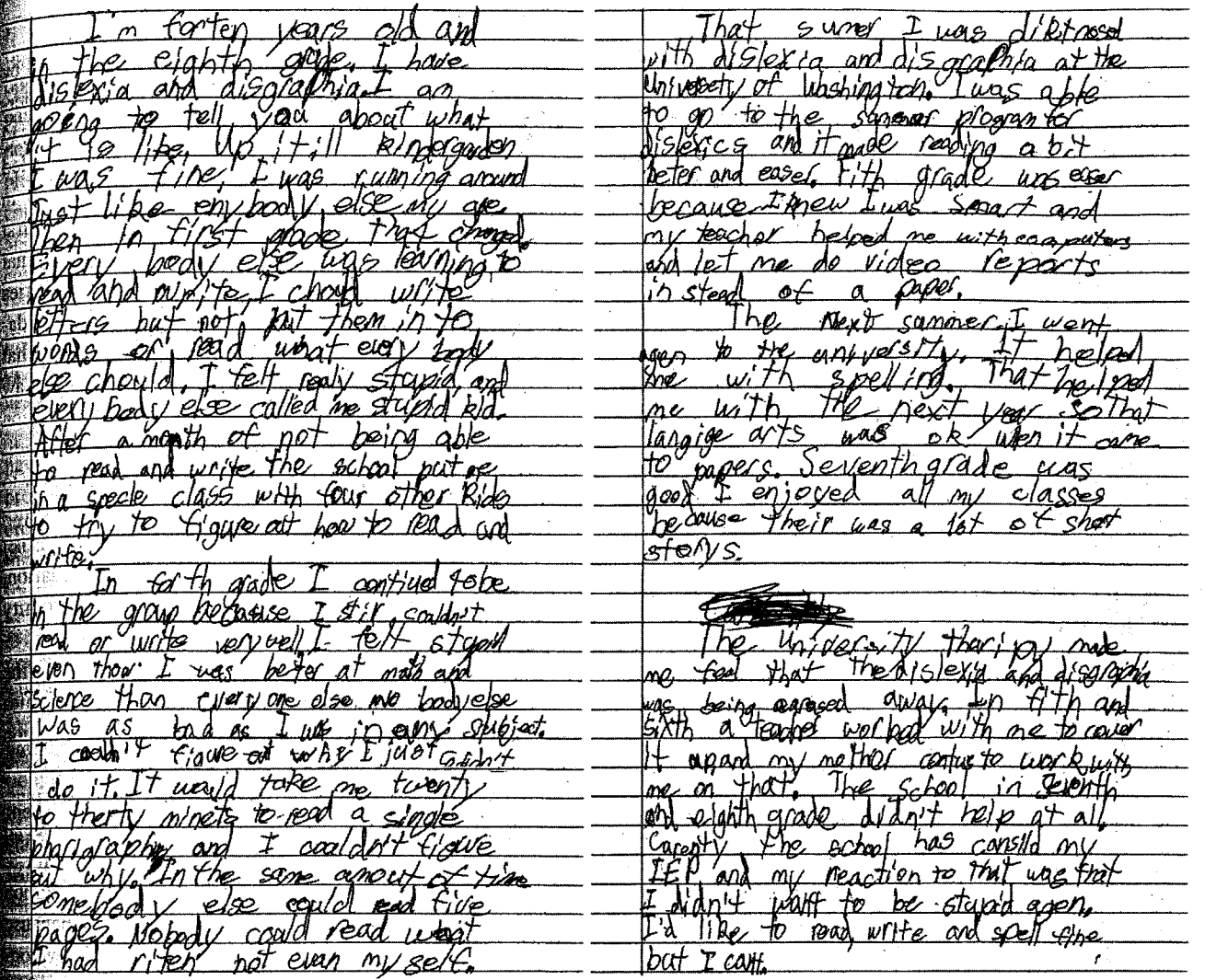
Sharon was the first in her family to complete a college education, which she paid for by working many jobs. She did reasonably well but had an enormous struggle learning foreign languages, which has been well documented by researchers (e.g., Ganschow & Sparks, 2000) as the hallmark feature of dyslexia during the college years. Her university graduation was held up because she could not meet the foreign language requirement. She tried three times, twice with one language and once with another language (and even spent a year living in that country to learn the language). She was told by her department that there was no point in being evaluated by the disabled student services on campus because disabilities affect physical skills like walking and using one's hands. She had had a history of reading rate and spelling problems, but the public school she attended refused to evaluate her because she was so bright. Our research team evaluated her in her early adult years (3 years after she should have graduated) and documented that she met research-supported criteria for severe dyslexia. Based on the test results, we obtained permission for her to substitute an alternative course for the foreign language requirement. By the time this volume is published, she should have her undergraduate degree.

At the end of this chapter, these cases are discussed again from the perspective of how their literacy development might have been different had appropriate educational programs been in place. Appropriate educational programs include both diagnostic assessment and differentiated instruction.

SIGNIFICANCE OF LEARNING DISABILITIES FOR CHILD PSYCHOLOGY

Five domains of development have proved reliable and valid in understanding and assessing child development: cognitive and memory, aural receptive and oral expressive, gross and fine motor, attention and executive function for self-regulation, and social-emotional (Berninger, 2001). Children with mental retardation (global developmental disability) fall outside the normal range in each of these domains of development. Children with Pervasive Developmental Disorders (including Autism Spectrum Disorder) fall outside the normal range in two or more of these developmental domains. Some children have primary impairment in one developmental domain (e.g., primary language disorder). Children with mental retardation, Pervasive Developmental Disorder, or primary language disorder will have some difficulty with learning academic subjects and are unlikely to achieve at the population mean. However, there are other children who are generally within the normal range in most areas of development, but who have a specific kind of learning problem, a learning disability. If unidentified and untreated, learning disabilities can significantly impair a child's overall cognitive and social developmental functioning.

One in five children has some kind of learning disability. The most frequently occurring developmental



I'm forten years old and in the eighth grade. I have dislexia and disgraphia. I am going to tell you about what it is like. Up it till kindergaden I was fine, I was running around just like everybody else my age. Then in first grade that chanqed. Every body else was learning to read and write, I chodn write letters but not put them in to words or read what every body else chould. I felt realy stupid and every body else called me stupid kid. After a month of not being able to read and write the school put me in a specle class with four other Kids to try to figure out how to read and write.

In forth grade I contiued to be in the group because I stir couldnt read or write very well. I felt stupid even thow I was beter at math and sclence than every one else one body else was as bad as I was in every subject. I couldn't figure out why I just couldn't do it. It would take me twenty to therty minets to read a single phargraphy and I couldn't figure out why. In the same amout of time somebody else could read five pages. Nobody could read what I had riten not even my self.

That suner I was diagnosed with dislexia and disgraphia at the Universety of Washington. I was able to go to the summer program for dislexics and it made reading a bit beter and easer. Fith grade was easer because I new I was smart and my teacher helped me with computers and let me do video reports instead of a paper.

The next summer I went agen to the university. It helped me with spelling. That helped me with the next year so that langige arts was ok when it came to papers. Seventh grade was good I enjoyed all my classes because their was a lot of short storys.

[redacted]

The univercity that you made me feel that the dislexia and disgraphia was being erased away. In fith and sixth a teacher worked with me to cover it up and my mother contue to work with me on that. The school in seventh and eighth grade didn't help at all. Curently the school has consild my IEP and my reaction to that was that I didn't want to be stupid agen. I'd like to read, write and spell the but I can't.

Figure 11.1 "My Story," told by eighth-grader with dysleXia, dysgraphia, and ADHD (Inattentive subtype).

disorder of childhood is specific learning disability in children whose development is otherwise in the normal range. Sometimes a child's problem may be specific to one academic domain (reading, writing, or math). Sometimes a child's learning problem is in aural/oral language, nonverbal reasoning, or social cognition, which affects school functioning even though none of these is a subject in the school curriculum. Sometimes a child has disabilities in more than one domain. The focus of this chapter is on learning disabilities that affect written language. Learning disabilities that are specific to reading and/or writing are among the most frequently occurring learning disabilities in school-age children and youth and have received the most research attention. Dyslexia, which was used to illustrate the changing developmental expression of a learning disability across schooling, is only one kind of learning disability.

MULTIDISCIPLINARY STREAMS OF KNOWLEDGE ABOUT LEARNING DISABILITIES

Federal special education law in the United States specifies that multiple disciplines should be involved in the assessment and educational planning of students with learning disabilities. Some other countries (e.g., Canada and England) have comparable laws for identifying and educating children with learning disabilities. Multiple

disciplines have also contributed to both research and clinical practice in the field of learning disabilities. These include neurology, experimental cognitive psychology, special education, linguistics, psycholinguistics, speech and child language, clinical and school psychology, and developmental psychology.

Neurology

Neurologists were the first to identify the extreme difficulty some otherwise normal children have in learning to read. One of the most informative introductions to the pioneering contributions of neurologists at the end of the nineteenth and beginning of the twentieth century is "The Historical Roots of Dyslexia" (Shaywitz, 2003, chap. 2). Neurology continued throughout the twentieth century to contribute, primarily through clinical studies (e.g., Orton, 1937). Now in the twenty-first century, this field continues to contribute through the use of in vivo brain imaging (scanning the brains of living children and adults as they perform cognitive and language tasks; for review, see Berninger & Richards, 2002).

Experimental Cognitive Psychology

Beginning early in the twentieth century, psychology contributed to the available literature by developing scientifically defendable paradigms for investigating mental processes involved in reading (e.g., Huey, 1908/1968). By the middle of the twentieth century, the psychology of reading had generated a wealth of knowledge about teaching children to read (e.g., Bond & Tinker, 1967; Gates, 1947; Gray, 1956; Harris, 1961), and this knowledge was transmitted in many (but not all) teacher training programs. Many schools had reading specialists who were well trained in reading (often with 60 to 90 graduate credits) and who were available for assessment, consultation, and small group instruction in local buildings. Decisions about who to test and teach and about how to work with teachers was left to specially trained professionals who were allowed to function in a flexible manner without burdensome regulations and paperwork. Unfortunately, not all schools had access to such professionals. Parents often had to turn to services outside the public school if their child had a specific learning disability in reading or writing.

Special Education

By the early 1960s, a national political movement led by parents was gaining momentum. Parents wanted to understand why schools could not teach children who had normal intelligence to read and write. This movement led to a parent-organized, landmark conference in 1963 in Chicago where Samuel Kirk (Kirk & Kirk, 1971) first proposed the label "learning disabilities." Following that conference, parents of children with learning disabilities partnered with parents of children with mental retardation to mount a national effort in the United States that culminated in the 1975 federal legislation, Public Law 94-142, that guarantees a free and appropriate education for all students with educationally handicapping conditions. Because professionals could not agree about how to define what a learning disability is (inclusionary criteria), the federal law defined it on the basis of what it is not (exclusionary criteria: It is not due to mental retardation, sensory acuity or motor impairment, lack of opportunity to learn, or cultural difference).

To support this new field of special education, the U.S. Department of Education provided funding for training programs for special educators, model demonstration projects, and research on teaching special populations of students with educationally handicapping conditions. (See Torgesen, 2004, for the history of the field of special education; see Johnson & Myklebust, 1967, and Kirk & Kirk, 1971, for a description of early conceptualization and practices in special education.) However, because "appropriate" was not defined on the basis of developmental and educational science, this legislation has often resulted in costly legal proceedings and adversarial relationships between parents and schools, without resulting in better academic achievement of students with learning disabilities. In fact, meta-analyses indicate that special education for students with learning disabilities has not been effective (e.g., Bradley, Danielson, & Hallahan, 2002; Steubing et al., 2002), especially in reading (Vaughn, Moody, & Schumm, 1998).

One reason for the relative ineffectiveness of special education is that special education teachers are not given much preservice training in the psychology of teaching reading; they also are not taught instructional practices that cover all reading and writing skills in the general education curriculum in a grade-appropriate manner from K to 12. Currently, many preservice teacher training programs advocate philosophical approaches (e.g.,

constructivism, which advises against explicit instruction) that are not consistent with what research in developmental science and educational science during the past 3 decades has shown is effective in teaching students with specific learning disabilities—namely, explicit instruction to bring language processes into conscious awareness. (See Berninger & Winn, in press; and Mayer, 2004, for shortcomings of constructivism in contemporary educational practices.) There is a myth that explicit instruction is skill and drill, but that is not the case (see Berninger, Nagy, et al., 2003, for examples of explicit instruction for developing linguistic awareness in reflective ways that are intellectually engaging).

Moreover, paraprofessionals, most of whom do not have specialized training in teaching reading or as much professional preparation as general educators, are increasingly providing instruction for students with learning disabilities. Many schools hire reading specialists trained outside professional preparation programs and in primarily a single method. There is unlikely to be a single program that meets the needs of all students. Children with specific reading and writing disabilities are more likely to learn to read and write if taught by professionals who are skilled in differentiated instruction; that is, they can construct programs that address all the necessary reading and writing skills at a specific stage of reading or writing development and individualize, if necessary, for specific students in group learning settings (Berninger, 1998).

In short, there are a number of unresolved problems in identification and service delivery for students with specific learning disabilities. It may not be possible to achieve the desired goals by simply legislating them; these goals probably require educating the educators as well as teaching the affected individuals (Berninger, Dunn, Lin, & Shimada, 2004; Berninger & Richards, 2002).

Developmental Psychology

In contrast to special education, which is an applied discipline, developmental psychology is a scientific discipline that contributes relevant basic knowledge to understanding learning disabilities. These contributions, which are discussed later in the chapter, include understanding rule-learning deficits; multiple levels of language; automaticity, fluency, efficiency, and timing deficits; comorbidities, normal variation, gender differences; nature-nurture interactions; life-span approaches; prevention and treatment validity; and randomized, controlled longitudinal experiments. Many of these contributions draw on earlier and concurrent contributions from linguistics and psycholinguistics.

Linguistics and Psycholinguistics

Linguistics specifies how speech is represented in English orthography in a rule-governed (not purely arbitrary) way and documents the morphophonemic nature of English (e.g., Venezky, 1970, 1999). Although spelling units (typically one or two letters in length) generally represent speech sounds, called phonemes, in a predictable manner (alternations or a set of rule-governed options such as the /k/ and /s/ sound associated with the letter *c*), not all spellings are perfectly predictable. Much of the predictability of American spelling relies on the morphology as well as the phonology of the language; for example, signal preserves the spelling of the stem *sign*. It has also been well established that knowledge of alphabetic principle (one- and two-letter spellings that represent the phonemes) can explain the acquisition of one- and two-syllable words of Anglo-Saxon origin that occur with high frequency in reading materials in the lower elementary grades (for reviews, see Balmuth, 1992; Ehri, Nunes, Stahl, & Willows, 2001; Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001).

However, knowledge of morphology is critical to the acquisition of the *longer, more complex written words* that occur with high frequency in reading materials from mid-elementary school through high school and college (Carlisle, 2004; Carlisle & Stone, 2004; Carlisle, Stone, & Katz, 2001; Nagy, Anderson, Schommer, Scott, & Stallman, 1989; Nagy, Osborn, Winsor, & O'Flahavan, 1994). From fourth grade on, students encounter in their school texts an increasing number of complex words in terms of sound-letter relations and internal structure (i.e., syllabic or morphemic structure; Carlisle, 2000; Carlisle & Fleming, 2003; Nagy & Anderson, 1984). Students who earlier struggled with mastering alphabetic principle because of difficulties in phonological processing (Liberman et al., 1989) face additional challenges in learning to recognize specific words automatically: (a) creating and linking precise phonological and orthographic representations (Ehri, 1992; Perfetti, 1992), and (b) encountering low-frequency written words frequently enough (White,

Power, & White, 1989). Students who were earlier taught phonics and may have learned letter-sound correspondences in alphabetic principle, word family patterns (e.g., -at in pat, bat), and syllable types (e.g., open and closed, vowel teams, silent e, r-controlled, and -le) may need additional strategies to deal with the complexity of English orthography (Schagal, 1992), especially in content area texts, which may have spellings unique to word origin (Anglo-Saxon, Latinate, or Greek), complex word structures, and unfamiliar, low-frequency words.

Another contribution of linguistics was demonstrating that most language knowledge is implicit (unconscious), but learning to read requires explicit instruction that brings this implicit knowledge to conscious awareness (Mattingly, 1972). Programs of explicit instruction in word decoding that draw on alphabetic principle and morphological structure have been developed by Henry (1988, 1989, 1990, 1993, 2003) and Lovett and colleagues (e.g., Lovett et al., 1994, 2000). Both programs require children to manipulate units of phonology, orthography, and morphology (see Figure 11.2). Both programs combine explicit instruction and strategy instruction and practice, which a meta-analysis showed

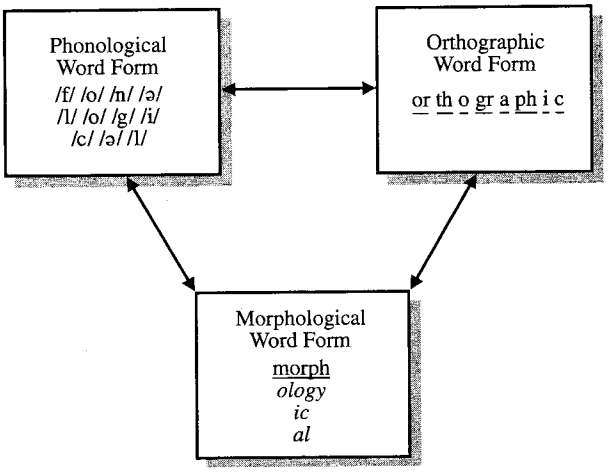


Figure 11.2 Schema of three word forms and their parts that are interrelated in decoding in working memory and creating precise orthographic word forms in long-term memory. *Sources:* From "Processes Underlying Timing and Fluency of Reading: Efficiency, Automaticity, Coordination, and Morphological Awareness" (Extraordinary Brain Series, pp. 383–414) by V. Berninger, R. Abbott, F. Billingsley, and W. Nagy, 2001, in *Dyslexia, Fluency, and the Brain,* M. Wolf (Ed.), Baltimore: York Press; and *Brain Literacy for Educators and Psychologists,* by V. Berninger and T. Richards, 2002, San Diego: Academic Press.

was the most effective approach for improving reading skill (Swanson, 1999).

Henry's (1990, 2003) program focuses on reading and spelling words from different etymological backgrounds: words of Anglo-Saxon, Romance, and Greek origins. For each word origin, students are taught linguistic units in written words (i.e., letter-sound correspondences, syllable types, morphemes). Before receiving such instruction, third, fourth, and fifth graders had letter-sound knowledge but little knowledge of syllable or morpheme patterns; the third and fifth graders who received the morphophonemic training linked to word origin improved significantly more in reading and spelling than those who received only basic phonics (Henry, 1988, 1989, 1993). Lovett (e.g., Lovett et al., 1994, 2000) validated methods to improve the word-reading skills of students with reading disabilities: PHAB/DI (direct instruction in sound analysis, blending skills, and letter-sound correspondences), WIST (four word identification strategies: using analogy, seeking the part of the word you know, attempting variable vowel pronunciations, and peeling off affixes), and Combined PHAB/DI and WIST (Phonological and Strategy Training Program [PHAST]). Clinical studies showed positive gains in reading both trained and untrained (transfer) words (Lovett, 2000).

However, the concept of how knowledge of morphological structure in low-frequency words can help students read content area texts from the fourth grade on is less widely understood. Analysis of the number of distinct words in printed school English showed that students encountered more than 88,000 "distinct" words in texts through ninth grade (Nagy & Anderson, 1984). About half the words in printed texts through ninth grade occur once in a billion words of text or less (e.g., *inflate, extinguish, nettle*), so knowledge of word-formation processes becomes necessary (Nagy & Anderson, 1984). For every word a student learns, there are between one and three related words that should be understandable to the student because of semantic transparency of words—whether the meaning of the base word is apparent in a longer word that contains that base word (e.g., *red* and *redness* have relative semantic transparency, whereas *apply* and *appliance* do not)—that reduces the number of distinct words that need to be learned (Nagy & Anderson, 1984). About 60% of the unfamiliar words encountered by students in the middle school years and beyond are sufficiently semantically transparent that a reader might be able to infer the mean-

ing of the word from context (Nagy et al., 1989). Thus, students with reading and writing disability also need explicit instruction in the word formation processes and inferring word meaning from context.

Triple Word Form Theory

Studies that integrated treatment and brain imaging provided support for the theory depicted in Figure 11.2. Both unique neural signatures for the three word forms (Richards et al., 2005, 2006) and cross-over effects (Richards, Aylward, Raskind, et al., in press) were observed: Individuals who received *morphological treatment* showed significant changes in *phoneme mapping* during brain scans, whereas individuals who received *phonological treatment* showed significant changes in *morpheme mapping* during brain scans. Richards et al. (2002) showed that morphological awareness training improved efficiency (rate) of phonological decoding and led to greater metabolic efficiency in neural processing during phonological judgment while the brain was scanned than did training in only phonological awareness. In addition, structural equation modeling of subphenotypes in the family genetics study showed that a second-order factor modeled on indicators of each word form factor predicts reading and spelling outcomes better than the first-order factors for each word form (Berninger, Abbott, Thomson, Wijsman, & Raskind, in press). The benefits of Wolf et al.'s (2003) RAVO, an intervention that trains rapid automatic retrieval of spoken names (phonology), vocabulary, and orthography, for the reading disabled may be related to the way it integrates phonological, orthographic, and morphological word forms.

Speech and Language Pathology and Child Language

Linguistics is a basic discipline. A professional specialization for applying basic knowledge of child language is speech and language pathology. All public schools at the beginning of the twenty-first century, in large part because of the federal special education laws, now have access to practitioners with professional training in speech and language pathology. Although they primarily work with children who qualify for services under the category of Communication Disorders, many of whom have more severe problems in receptive aural language, speech, or expressive oral language than those with specific learning disabilities, they are typically the professionals in the schools with the most training in language. Thus, they are a valuable resource for other educational professionals because children with reading and writing disabilities often have associated aural/oral language processing deficits. Developmental studies by speech and language specialists have shown that speech and language problems during the preschool years are associated with a variety of developmental outcomes during the school-age years, including (a) mental retardation, (b) specific aural/oral language impairment, (c) specific reading disabilities, (d) specific writing disabilities, and (e) normal reading function (e.g., Aram, Ekelman, & Nation, 1984; Bishop & Adams, 1990; Catts, Fey, Zhang, & Tomblin, 1999, 2001).

Clinical Psychology and School Psychology

Clinical psychology and school psychology are applied disciplines that have contributed scientific research knowledge about learning disabilities and train the practitioners who serve individuals with specific learning disabilities in the private and public school sectors. They are typically trained in cognitive, academic, social, and emotional assessment that yields relevant information for diagnosing and treating specific learning disabilities. Historically, they have relied on education to translate the assessment results into instructional practice. However, recently, there is growing interest in the treatment validity of linking psychological assessment with research-supported instructional practices (see Berninger, Dunn, & Alper, 2004). Because the federal special education law stipulates that all students with educationally handicapping conditions have the right to evaluation, whether or not they attend public schools, psychologists who work in school settings assess students attending public schools, students referred from private schools, and students who are home-schooled. However, there is a large and growing market for clinical psychologists, especially those with neuropsychological training, because many parents seek independent evaluations outside the public school. This trend is likely to increase because student achievement standards continue to increase in this era of educational accountability and are linked to high school graduation in some states.

Developmental Pediatrics

The child's pediatrician or family physician is the professional who often has the best knowledge of an individual child across development. Levine, who has been a

leader in developmental pediatrics, has (a) increased awareness of the normal variation among learners (Levine, 1993, 1998, 2002), (b) demystified learning problems for affected individuals (Levine, 1990), (c) documented that many learning disabled have developmental output failure (writing problems; Levine, Oversklaid, & Meltzer, 1981), and (d) emphasized that students who do not complete written work satisfactorily are more likely to have undiagnosed processing problems than to be lazy (Levine, 2003). Most students want to succeed—if only a caring, competent teacher could teach them in a way they can learn (Berninger & Hidi, in press). Because of my earlier clinical and research experience in the Ambulatory Pediatrics Department at Boston's Children's Hospital, headed by Levine, I began a programmatic line of research on normal variation as a reference point for understanding learning disabilities and focused on writing as well as reading.

CONTRIBUTIONS OF DEVELOPMENTAL PSYCHOLOGY

In this section, we highlight a few of the representative contributions of the discipline of developmental psychology to the field of learning disabilities.

Rule-Learning Deficit and Computational Mechanisms

Manis and Morrison (1985) and Manis et al. (1987) questioned whether the problems of the reading disabled in learning alphabetic principle (correspondences between letters and phonemes) reflects a more general underlying difficulty in inducing and applying rules. To test this hypothesis, Manis et al. paired words with visual symbols (arrows, squares, triangles plus dots or asterisks) so that rules were consistent across some situations but not others (as is the case in language, which tends to have predictable but flexible regularities). Their findings supported their hypothesis and are also consistent with recent brain imaging research showing activation in the fusiform gyrus (a brain region associated with pattern recognition and abstracting rules or regularities and pattern) in normal readers (e.g., Booth et al., 2003; Booth, Perfetti, & MacWhinney, 1999) and dyslexics (e.g., Richards et al., 2005). If the reading disabled have difficulty inducing the rule-governed patterns of regularities and/or flexibly adapting these as necessary across contexts, then they are likely to benefit from explicit instruction that assists them in abstracting those regularities and applying them strategically.

Connectionist models, which simulate computational processes in the brain during written word learning (e.g., Seidenberg & McClelland, 1989), demonstrated that overt, verbally articulated rules are not necessary to learn to read written words, and that one computational mechanism may underlie regular and irregular word reading. Manis and Seidenberg (e.g., Manis, Seidenberg, Doi, McBride-Chang, & Petersen, 1996), who collaborated in longitudinal studies of how children learn rule-governed phonological decoding and irregular word reading, identified subtypes of children with deficits in decoding or irregular word reading, but the subtypes were not completely stable across reading development. Over time, regular and irregular reading may converge because phonological decoding (often assessed by regular word reading) contributes to automatic word recognition (Ehri, 1992; Uhry & Shephard, 1997), which may be assessed with real words that are regular and irregular because exception words are at least partially decodable (Berninger, 1998; Berninger, Vaughan, et al., 2002). The contribution of the connectionist models was showing that procedural knowledge (unconscious computations without overt verbalizations of declarative knowledge of phonics rules) may guide reading development. Our instructional studies apply this principle in teaching connections between letters and sounds explicitly (both out of word context and in word context) but without overtly articulating any rules (e.g., Berninger et al., 1999; Berninger, Abbott, et al., 2000).

The research on the rule-deficit and computational modeling suggests that there is a *continuum of rule-learning in reading,* ranging from (a) highly implicit to (b) moderately implicit to (c) moderately explicit to (d) highly explicit:

1. Computational procedures out of conscious awareness induce connections between spoken and written words that support reading of unknown and familiar words.
2. Through repeated practice in word reading (applying procedural knowledge based on those connections between spoken and written words), *an autonomous lexicon is created* that can be accessed automatically for specific words.
3. Explicit instruction engages children in active manipulations of spoken and written words and their parts and in the process creates conscious linguistic aware-

ness of phonemes, spellings, and morphemes (see Figure 11.2).

4. Explicit instruction in deductive application of the verbalized phonics, morphology, or spelling rules (patterns within and between written and spoken words) creates strategic readers who consciously apply this knowledge to unknown words.

For individuals without the genetic influences associated with learning disabilities (discussed later in the chapter), 1 and 2 alone may be sufficient. For many children, with or without learning disabilities, 3 and 4 may be necessary for learning to read. There are individual differences in how much explicit instruction and what kind of explicit instruction students of the same age and grade level need. One of the greatest challenges in teaching reading is to provide differentiated instruction in the general education program during early and middle childhood so that children receive the appropriate degree of explicit instruction they require for mapping spoken words they already know onto written words they are learning, and recognizing new written words that may not be in their spoken vocabulary. Preservice teachers should be prepared to assess how much explicit instruction individual children require and to provide appropriate instruction along the continuum of explicit rule learning.

Is Phonology the Only Language Deficit?

Phonological skills appear to be impaired across development in reading disability (e.g., Berninger, Abbott, Thomson, et al., 2001, in press; Bruck, 1992, 1993; Pennington & Lefly, 2001; Scarborough, 1984). At the same time, there is evidence that other aspects of language (e.g., vocabulary or syntax) may contribute to reading development and its disorders, and which is the most important may change across development (Scarborough, 1984, 1989, 1990, 1991, 2001; Scarborough, Ehri, Olson, & Fowler, 1998). However, phonological processing is complex and may refer to at least three separable skills: phonological awareness of sound segments in spoken words, phonological working memory (storing and manipulating sound units in temporary working memory), and phonological decoding (translating orthographic units in written words into spoken words; Wagner & Torgesen, 1987).

Each of these phonological processes may be related to multiple levels of aural/oral or written language. For example, aural nonword repetition (see Bishop & Snowling, 2004) may be related to vocabulary (Gathercole & Baddeley, 1989), sentence processing (Willis & Gathercole, 2001), comprehension (Montgomery, 2003; Nation, Clarke, Marshall, & Durand, 2004), and executive functions (Baddeley & Della Sala, 1996). Thus, in the complex brain systems supporting reading (Berninger, 2004a) and writing (Berninger & Winn, in press), there are *systems within systems,* and it can be misleading to attribute any complex skill to a single underlying process. Nevertheless, there are identifiable language skills that can be assessed and taught explicitly for specific reading or writing skills at specific phases in reading and writing development. If professionals are not aware that language is a multilayered, complex system (Berninger & Richards, 2002) and use this knowledge in their assessment and treatment practices, some children will be *assessment casualties,* their problems going undetected, or *curriculum casualties,* children who can learn to read but have not been taught in a developmentally appropriate way. Teaching preservice teachers about the complexities of language may prevent learning disabilities.

Rapid Automatic Naming, Fluency, Efficiency, and Timing

One of the most reliable predictors that a prereading child will have a reading disability is inability to name objects or colors (assuming the child is not color blind; Manis, Seidenberg, & Doi, 1999; Wagner et al., 1994; Wolf, Morris, & Bally, 1986). By first grade and thereafter, the time required for naming multiple rows of continuous letters is one of the most frequent concurrent deficits in individuals with reading disabilities (e.g., Wolf & Bowers, 1999) and writing disabilities (e.g., Berninger, Abbott, Thomson, et al., 2001, in press). Students who have a double deficit in rapid naming of letters and phonological awareness are more impaired than those who are impaired in only one of those skills (Wolf & Bowers, 1999). Number of deficits in phonological, orthographic, and rapid naming skills predicts severity of reading disability (Berninger, Abbott, Thomson, et al., 2001).

Rapid automatic naming (RAN) is a deceptively simple task that reflects complex processing (see Wolf & Bowers, 1999): attention to visual stimuli (colors, pictures, or alphanumeric stimuli), rapid automatic access to familiar phonological codes in long-term memory,

and coordinating codes on different time scales (one visual/orthographic code and one oral linguistic code, for lexical or word-level representations) in real time (Breznitz, 2002).

Not all timing problems in reading disability involve rapid retrieval of single lexical items. Some appear to involve fluency (quick, smooth, coordinated processing of serial items), which is influenced by the efficiency of each of the language processes involved (e.g., Perfetti, 1985). A precise timing mechanism for coordinating reading processes may be impaired in reading disability (Wolf, 1999). Treatment that accelerates rate of processing appears to increase efficiency of the multiple processes involved and thus fluency (Breznitz, 1987, 1997a, 1997b).

Dyslexia (a specific kind of reading disability) may cause undue difficulty in *sustaining mental effort over time*. On the first row of the Wolf et al. (1986) RAN tasks (10 items), the child dyslexics do not differ significantly from grade norms, but on the remaining four rows of 10 items each they do (Berninger & Hidi, in press). Dyslexics appear to have an invisible difficulty in sustaining time-sensitive, goal-directed activity carried out in working memory. Many teachers have no empathy for students who cannot complete written assignments in a timely manner. They cannot directly observe this hidden disability in sustained effortful word retrieval, which is apparent on the clinically administered RAN task. In contrast, oral reading dysfluency is a publicly visible disability.

Comorbidities

Reading disability may occur with or without other learning or behavior problems. Some gifted children have disabilities in low-level writing skills that interfere with their high-level composing skills (Yates, Berninger, & Abbott, 1994) or low-level reading skills that interfere with high-level comprehension skills (e.g., untreated child dyslexics in our family genetics study). Many children with behavioral disabilities have undiagnosed and untreated learning disabilities in academic content domains and in aural/oral language (Berninger & Stage, 1996). Reading or writing disabilities may also occur along with developmental psychopathology, including ADHD (especially the Inattentive subtype) and/or Conduct Disorder (see Pennington, 2002, for further discussion of the issue of comorbidity that complicates both research and treatment and for a review of research on this topic).

Normal Variation in Reading and Writing

In contrast to comorbidities based on categorical variables, normal variation is based on quantitative traits modeled as continuous variables. *Normal variation (interindividual and intraindividual differences)* occurred in the processing skills related to reading and writing in a large, representative sample of typically developing primary grade students (Berninger & Hart, 1992). Intermediate grade students in another large, representative sample exhibited *intraindividual variation* in their profiles of word reading and text-level reading skills (Berninger, 1994) and their profiles of word choice, sentence construction, and discourse organization in composing (Whitaker, Berninger, Johnston, & Swanson, 1994). We observed *normal variation in response to the same instruction.* Berninger and Abbott (1992) documented normal variation among individual children in response to the same reading instruction across first grade. Traweek and Berninger (1997) and Abbott, Reed, Abbott, and Berninger (1997) documented normal variation in response to the same instruction during second grade. Among children who do not have ADHD, normal variation in their ability to self-regulate attentional focus and goal-directed attention uniquely predicts their ability to process the orthographic word form (see Figure 11. 2; Thomson et al., 2005).

Taken together, these various studies show that variation among learners is *normal;* the typical classroom will have students exhibiting many individual differences in processes and skills related to literacy learning. Thus, one of the pressing needs in an era of increasing expectations for high levels of academic performance is to prepare teachers to deal effectively with the normal diversity in cognitive processes among the students in their classrooms. This diversity requires a continuum of explicit instruction to create awareness of language processes. Another pressing need is to understand learning disabilities in reference to the normal variation in reading and writing acquisition (Berninger, 1994) and typical reading (e.g., Chall, 1983, 1996) and writing (e.g., Templeton & Baer, 1992; Treiman, 1993).

Gender Differences

Gender differences in reading disabilities appear to be related to referral biases (Shaywitz et al., 1990). However, gender differences do occur in writing. Typically developing boys are more impaired in handwriting auto-

maticity and its related orthographic (not motor) skills (Berninger & Fuller, 1992; Berninger, Fuller, & Whitaker, 1996). Boys with dyslexia are impaired on a wide variety of writing skills (handwriting, spelling, written composition, and related neuropsychological processes in our family genetics phenotyping battery; Berninger, Nielsen, Abbott, Wijsman, & Raskind, 2005; Nielsen, Berninger, & Raskind, 2005).

Nature and Nurture

Although some think of the biological and experiential influences on learning and its disorders as mutually exclusive, independent factors, it is more likely that they are interacting variables. In this section, we consider studies of environmental influences, genetic influences, and then of combined brain imaging and instructional interventions to study nature-nurture interactions in individuals with learning disabilities.

Role of Education and Experience

Although developmental research historically emphasized the biologically constrained maturational processes in development, during the past 15 years there has been a more balanced approach that acknowledges the role of experience. Morrison, Smith, and Dow-Ehrensberger (1995) conducted groundbreaking school cutoff studies showing that children who just made the cutoff and entered kindergarten outperformed, during the current and subsequent years, their age-equivalent peers who just missed the cutoff. Vellutino and Scanlon's (e.g., Vellutino et al., 1996) longitudinal instructional study showed that explicit instruction could eliminate many (but not all) reading problems; these findings, based on direct manipulation of experience, added to those based on indirect measures of experience (self-reported print exposure; Cunningham & Stanovich, 1998) to make the case that instruction and reading experience matter (Morrison et al., 1995). A number of longitudinal treatment studies pointed to the same conclusion: Reading problems could be prevented or the severity of their expression reduced to a large extent with appropriate early intervention, even if children came from low-literacy homes (Foorman, Francis, Fletcher, Schatschneider, & Mehta, 1998; Foorman et al., 1996; Torgesen, Wagner, & Rashotte, 1997; Torgesen et al., 1999). Yet, close scrutiny of data showed that not all children were treatment responders in early intervention (Torgesen, 2000) or over the course of schooling (Shaywitz et al., 2003). That is, even though most reading problems can be prevented with appropriate instruction, some will not be totally eliminated because there is a genetic (Olson, 2004) and neurological (Hynd, Semrud-Clikeman, Lorys, Novey, & Eliopulos, 1990; Shaywitz et al., 2003) basis for reading disability, which may persist throughout schooling in some form in some individuals.

Genetic Influences in Reading and Writing

Heritability studies with twins (e.g., Byrne et al., 2002; Olson, Datta, Gayan, & DeFries, 1999; Olson, Forsberg, Wise, & Rack, 1994) and family genetics studies (e.g., Chapman et al., 2003, 2004; Raskind, 2001, Raskind et al., 2005) have documented genetic influences on reading disability. Genetic influences on phonological processes and verbal working memory emerge in the preschool years (Byrne et al., 2002). These are the same two areas of functioning that we observed showed the greatest genetic influences during the school-age and adult years (Berninger, Abbott, Thomson et al., 2005; Berninger & O'Donnell, 2004). Considering these genetic influences on processes that affect ease of learning written language, students would probably benefit from learning environments that are optimally designed for their genetically influenced, reading-related processing characteristics (cf. Plomin, 1994) that include anomalies in phonological processing and working memory (Swanson & Siegel, 2001).

Brain Constraints in Infancy versus Plasticity of the Brain during Childhood and Adult Years

Electrophysiological recording in newborns identified event-related potential (ERP) components for speech discrimination of stop consonants in consonant-vowel patterns that predicted language development at age 3 and 5 and reading (including diagnosis of dyslexia) at age 8 (D. Molfese et al., 2002). Newborn ERP recordings were more isolated within brain regions, and adults showed more interactions between brain regions (D. Molfese et al., 2002). Not only brain variables but also social and other environmental variables influenced reading development at the brain and behavioral levels (V. Molfese & Molfese, 2002). Event-related potent- waveforms change as a result of training in infants and adults (D. Molfese et al., 2002).

Plasticity of Brain in Middle Childhood and Adult Years

At least nine studies, using a range of imaging methodologies, including functional magnetic resonance imaging (fMRI), functional magnetic spectroscopic imaging, magnetic source imaging, and electrophysiological recordings of ERPs, now show that the brains of beginning readers (Shaywitz et al., 2004; Simos et al., 2002), developing readers (Aylward et al., 2003; Richards et al., 2000, 2002; Temple et al., 2000, 2003), and adults (Eden et al., 2004; D. Molfese et al., 2002) change in processing related to reading in normal and disabled readers.

The University of Washington brain imaging studies have shown that the brain responds to reading and spelling instruction. The treatment that contained all the instructional components recommended by the National Reading Panel (Berninger, Nagy, et al., 2003) resulted in significant lactate reduction (increased efficiency during neural metabolism) in left frontal regions during phonological judgment (Richards et al., 2002) and increased fMRI Blood Oxygen-Dependent Level (BOLD) activation in frontal and parietal regions (Aylward et al., 2003). In both cases, pretreatment differences between dyslexics and controls disappeared after treatment. Evidence of *treatment-specific brain responding* (e.g., Richards et al., 2005) have also been observed, for example, robust changes during scanning on a spelling task following orthographic treatment but not morphological treatment in dyslexics in grades 4, 5, and 6. Richards et al. (2005) proposed a paradigm for analyzing the results of combined brain imaging and treatment studies that takes into account (a) reliability of responding in controls from time 1 to time 2, (b) significant pretreatment differences between dyslexics and controls in regions that are reliably activated in controls, and (c) significant change following treatment in those regions in the direction of normalization (activating regions that controls had activated or deactivating regions that controls had not activated).

Prevention and Treatment Validity

We conclude this section on contributions of developmental psychology to learning disabilities with an example of a programmatic line of research at the University of Washington that is grounded in theory of reading and writing development and instructional interventions for preventing and treating reading and writing disabilities. Berninger, Stage, Smith, and Hildebrand (2001) proposed a three-tier model to redirect psychologists' attention from diagnosis of chronic failure in reading and writing to early intervention and prevention. The first tier focuses on screening for early intervention, similar to approaches taken to prevent developmental psychopathology and social-emotional problems (see Cicchetti & Toth, Chapter 13, and Selman & Dray, Chapter 10, this *Handbook,* this volume). The second tier focuses on ongoing progress monitoring and supplementary intervention throughout schooling. The third tier focuses on differential diagnosis and specialized treatment for those with persisting, biologically based specific learning disabilities. At each tier, randomized controlled instructional experiments have been conducted, and the assessment measures that were validated in the studies of intraindividual and interindividual differences are used as predictors of response to intervention and/or outcome measures. In contrast to many instructional studies that use convenience samples or school-identified samples, our samples are ascertained on the basis of well-defined subject inclusion criteria for individuals who are at risk or disabled in specific reading or writing skills.

Randomized, Controlled, Longitudinal Experimental Studies

A brief overview of findings is provided that is based on large-scale studies in the schools for tiers 1 and 2 and on smaller-scale studies at the University of Washington Multidisciplinary Center for Learning Disabilities (UWLDC) for tier 3. A summary of instructional design principles implemented in all three tiers follows the research review.

Effective Tier 1 and Tier 2 Reading Instruction

At-risk first graders improved more in word reading when their attention was drawn explicitly to letters in words corresponding to phonemes than to the whole word (all letters and the word name; Berninger et al., 1999). At-risk first graders learned taught words and transfer words better when taught the alphabetic principle in isolation, in word context, and in story context than when only phonological awareness of spoken words was taught (Berninger, Abbott, et al., 2000). Explicit instruction for 20 minutes twice a week for 24 lessons over a 4-month period resulted in half the at-risk readers reaching grade level by the end of the year and maintaining gains at the beginning and end of second grade; the other half reached average levels after a second dose

of 24 additional, explicit lessons at the beginning of second grade and maintained the gains at the end of second grade (Berninger, Abbott et al., 2002).

Combined explicit instruction in reading comprehension and decoding led to greater improvement in word decoding than decoding instruction alone for at-risk second-grade readers (Berninger, Vermeulen, et al., 2003). Integrated reading instruction aimed at linguistic awareness, word decoding, automatic word reading, oral reading fluency, and reading comprehension resulted in greater improvement in word decoding and fluency than did the regular, balanced reading program for at-risk second-grade readers (Berninger, Abbott, Vermeulen, & Fulton, in press).

Effective Tier 1 and Tier 2 Writing Instruction

First graders at risk in handwriting improved more in handwriting legibility and automaticity than did children in the contact control group or four alternative handwriting treatments when given a treatment combining (a) studying numbered arrow cues in model letters, and (b) holding the letter forms in memory for increasing duration. All children practiced composing from teacher prompts, but only the treatment combining numbered arrow cues and writing letter forms from memory generalized to both improved handwriting and better compositional fluency (Berninger et al., 1997). At-risk second-grade spellers given instruction in multiple correspondences between units of written words and spoken words did better in dictated spelling and spelling during composition than did the control group given phonological awareness training (Berninger, Vaughan, et al., 1998). Training phonological awareness of six syllable types in English had some added value to training alphabetic principle for spelling polysyllabic words (Berninger, Vaughan, et al., 2000). Explicit instruction in alphabetic principle facilitated learning to spell structure words that were not as phonologically predictable as content words, and explicit instruction in planning, translating, and revising/reviewing led to improved composing (Berninger, Vaughan, et al., 2002).

Effective Tier 3 Treatment in the Multidisciplinary Center for Learning Disabilities

Teaching struggling readers multiple correspondences between units of written and units of spoken words resulted in greater improvement in reading than teaching a single correspondence (Hart, Berninger, & Abbott, 1997). At-risk spellers learned to spell equally well with pencil or keyboard (Berninger, Abbott, et al., 1998). At-risk writers taught integrated handwriting, spelling, and composing skills improved more in each of these skills than the controls at posttest and 6-month follow-up (Berninger, Abbott, Whitaker, Sylvester, & Nolen, 1995). Children taught content reading skills improved more than those in the wait-list control group (Berninger, Abbott, Abbott, Graham, & Richards, 2001). Morphological awareness treatment improved rate of phonological decoding more than phonological awareness treatment did (Berninger, Nagy, et al., 2003), suggesting that dyslexics in upper elementary grades need to learn to coordinate phonological, morphological, and orthographic processes to develop efficient phonological decoding (see Figure 11.2). Morphological awareness training benefited the spelling of pseudowords, and orthographic awareness training benefited the spelling of real words (Berninger & Hidi, in press).

It is never too late to remediate: Upper elementary and middle school students responded positively to instructional interventions that emphasized linguistic awareness and executive functions (Abbott & Berninger, 1999). See Hooper, Swartz, Wakely, deKruif, & Montgomery, 2002, for the importance of executive functions in writing.

Effective Tier 3 Treatment in Schools

Second graders meeting research criteria for dyslexia who used rate criteria in phonological decoding training and progress monitoring improved more in real word reading than those who used accuracy criteria (Berninger, Abbott, Billingsley, Nagy, 2001). For dyslexics in grades 4, 5, and 6, prior attention training did not transfer directly to improved written composition but did lead to greater improvement in written composition, compared to the control group, once written composition instruction was introduced for both groups (Chenault, Thomson, Abbott, & Berninger, in press). Prior attention training also improved oral verbal fluency significantly more in the treatment group that had received reading fluency training.

Instructional Design Principles for Educational Treatment for Biological Problems

All UWLDC treatment research is grounded in a *nature-nurture perspective*. Dr. Raskind, the principal investigator of the Family Genetics Study, emphasizes that the value of genetics research lies in identifying the

subphenotypes that have a genetic basis so that instruction is uniquely designed to help dyslexics overcome these genetic influences. For example, based on the aggregation (Raskind, Hsu, Thomson, Berninger, & Wijsman, 2000), segregation (Wijsman et al., 2000), linkage and brain imaging results (Richards, Berninger, et al., submitted) for aural nonword repetition, all our *phonological training starts with spoken words before we introduce the same written words*. Students clap the number of syllables and count with color tokens the number of phonemes in each word to develop precise phonological word forms before they are ever shown the written form of the word.

Also, based on the finding of a unique genetic pathway for rate of phonological decoding (Chapman, Raskind, Thomson, Berninger, & Wijsman, 2003), we use *rate criteria for training alphabetic principle in "Jibberwacky" words* (our modification of Lewis Carroll's Jabberwocky) to teach children to apply alphabetic principle when meaning cues are not available; we use both accuracy and rate criteria in progress monitoring (Berninger, Nagy, et al., 2003). Children with persisting reading problems are typically assessed with pseudowords and often have aversive reactions to them. We use them in instruction in playful ways to reduce the negative affect associated with them. Another instructional design principle is *teaching to all levels of language close in time and to low-level and high-level skills close in time so that the working memory architecture works efficiently* (Berninger & Abbott, 2003).

A final instructional design principle is *externalizing cognition for purposes of overcoming limitations in working memory* and learning *strategies for self-regulation that do not require overt verbalization of rules*. Instructional approaches that externalize cognition render students' ideas visible to themselves and to others so that they can be objectively viewed and manipulated. Once cognition is externalized, students can experiment with their ideas in ways that are difficult to do internally (possibly because of overloading working memory). We *externalize cognition through cue cards that are designed to cue orthographic and phonological awareness of units in the alphabetic principle during teacher-directed instructional activities and for self-regulation during independent reading and writing activities*. (For further information, see the chapter on instructional design principles in Berninger & Abbott, 2003.)

Treatment Validity

A new approach to assessment examines the validity of assessment-intervention links. Results of the UWLDC programmatic research are relevant to treatment validity and have been presented in a way practitioners can use in practice with time-efficient branching diagnosis, validated instructional based assessment, and multilevel profile assessment (Berninger, Dunn, & Alper, 2004). Berninger and Abbott (2003) have developed lesson plans based on the tier 1, tier 2, and tier 3 interventions.

Social and Cognitive Development

Although learning disabilities involving written language are academic problems, they have important implications for both social and cognitive development. Using the gold-standard treatment research paradigm (evaluate whether a new treatment has added value over and beyond that usual treatment), Weiss, Catron, Harris, and Phung (1999) showed that traditional psychotherapy was no more effective than academic instruction in changing mental health status. This finding implies that fostering academic learning may have positive effects on social and emotional development. Moreover, chronic cognitive learning problems can cause social problems, even though social or emotional problems are not the initial cause of the learning problems. Effective treatment may require both cognitive and social/affective components. Many research-supported approaches for fostering social/affective development in the general education program are now available (e.g., Frey et al., in press; Frey, Nolen, Van Schoiack-Edstrom, & Hirschstein, 2005; Van Schoiack-Edstrom, Frey, & Beland, 2002). Emotional coaching implemented in whole classrooms consistently throughout the school year may enhance learning by improving social relationships in the classroom (Lovitt, 2005). Likewise, interventions designed to improve social relationships between teachers and students are proving fruitful in enhancing school learning (Pianta, 1999; see Vaughn, Sinaguh, & Kim, 2004, for a review of social competence and social skills of students with learning disabilities).

ALTERNATIVE APPROACHES TO DEFINING LEARNING DISABILITIES

In this section controversies regarding how to define learning disabilities for purposes of research and of service delivery in the schools are discussed, along with recent developments that take into account response to

early intervention in identifying students with learning disabilities.

Defining Reading Disabilities for Research Purposes

There is a continuing lack of consensus around the world about how to define dyslexia (one kind of specific reading disability; Chapman et al., 2003, 2004; Igo et al., 2005; Raskind et al., 2005), which may confound interpretation of results across research groups. We adopted the definition proposed by the International Dyslexia Association (Lyon, Shaywitz, & Shaywitz, 2003) in the UWLDC Family Genetics Study: unexpectedly low word reading, decoding, spelling, and oral reading fluency of neurobiological origin.

The Verbal Comprehension Factor (based on prorated Verbal IQ without arithmetic or digit span subtests) is used rather than Full-Scale IQ in determining relative criteria for two reasons. First, evidence from studies funded by the National Institutes of Health (NIH) and available at the time this family genetics study began showed that Verbal IQ (VIQ) is a better predictor than Performance IQ of reading disability in referred samples (Greenblatt, Mattis, Trad, 1990) and unreferred samples (Vellutino, Scanlon, & Tanzman, 1991). Second, since then, the publishers of the Wechsler scales recommend using factor scores rather than Full-Scale IQ in identifying students with learning disabilities (e.g., Prifitera, Weiss, & Saklofske, 1998). Also, site visit reviewers in 1995 recommended setting an IQ cutoff at the 25th percentile (standard score of 90 for a scale with a mean of 100 and standard deviation of 15) because it is well documented that prevalence of developmental disorders of genetic origin is significantly higher in children whose IQs fall in the bottom quartile of the population, and these genetic disorders may cause development to fall outside the normal range in specific developmental domains, including cognitive, language, motor, attention/executive, and/or social-emotional function, and could confound a study seeking the genetic mechanisms for a specific learning disorder that affects only written language in children whose development is otherwise normal. In addition, the NIH-funded research of Olson et al. (1999) showed that reading disabilities identified on the basis of relative criteria (low reading relative to IQ) are more likely to have a genetic basis than those identified only on the basis of low achievement.

The size of VIQ-achievement discrepancy that we required (at least 1 standard deviation) is much less than that required by the special education law in the state where this research was conducted and that is used by other research groups, particularly in England. So that the discrepancy could not be attributed to normal intraindividual variation, we required that the achievement be below the population mean as well as discrepant from IQ on the inclusion measures for reading and spelling. This approach, using simple differences relative to VIQ and low achievement relative to the population mean, has been fruitful in genetic linkage studies that replicated others' work (Chapman et al., 2004) and identified novel chromosome sites for fluency-related subphenotypes for dyslexia (Igo et al., in press; Raskind et al., 2005).

Definitions Related to Providing Services in Schools

Berninger, Hart, Abbott, and Karovsky (1992) adopted a systems approach (of multiple component processes in the reading and writing systems) and applied the Mahalanobis statistic to determine how many students might be at risk for specific kinds of learning disabilities. Mahalanobis D^2 measures the distance a set of scores is from the centroid formed by the means of the joint distribution of the scores, taking the correlations among the measures into account. For two scores, Mahalanobis measures the distance that the value of X is from the mean of X and the distance that the value of Y is from the mean of Y, taking the XY correlation into account. In regression, only the distance of the predicted Y from the actual Y is considered. Results showed that different children were identified depending on whether only low achievement was considered or whether that and discrepancy from VIQ were both considered. We therefore took the position that flexible definitions, based on both absolute (low achievement) and relative (IQ-achievement discrepancy) criteria, were needed to meet the needs of all students in educational settings. In our early intervention, we studied any child whose VIQ appeared to be at least in the low-average range (standard score of 6 on the Wechsler Intelligence Scale for Children, third edition [WISC-III] Vocabulary subtest) and whose word reading and/or decoding accuracy was at least 1 standard deviation below the mean. However, in our family genetics

research, we took a different approach based on existing research literature at the time and feedback from the site visitors, as previously explained.

We recognize that there is widespread dissatisfaction with the rigid approach to IQ-achievement discrepancy for qualifying students for special education services (e.g., Bradley et al., 2002; Lyon et al., 2001; Siegel, 1989; Steubing et al., 2002; Vellutino, Scanlon, & Lyon, 2000). Others (e.g., Fletcher et al., 1994) used other data analysis approaches to support the claim that the same children are identified for special education services whether IQ is or is not used. However, those analyses were conducted in a state that uses different criteria for identifying students with learning disabilities for special education and for dyslexia in general education. The results of the Mahalanobis analyses and procedures in place in our state lead to a different conclusion, and we are concerned that all students with learning differences are served appropriately: those with low IQs, those with high IQs, and all those in between (Berninger, 1998).

Thus, the flexibility in the recently revised federal special education law (IQ-achievement discrepancy shall not be the sole criterion for identifying learning disabilities) will allow school professionals in many states to serve students whose learning disabilities express themselves in ways that are difficult to capture in a single diagnostic algorithm and also to focus more on early intervention than in the past. The concept of response to intervention, discussed next, is relevant to the new approach to identifying children needing special help in reading and writing.

Response to Instruction

This emerging approach for defining learning disability—failure to respond to intervention—is relevant in early childhood. Rice (1913) conducted the first large-scale application of the scientific method to evaluate effective educational methods based on student response to instruction. She studied spelling instruction in classrooms throughout the United States and found that children who received 15 minutes of spelling instruction a week achieved significantly higher spelling test scores than those who were drilled for an hour or more a week. This result suggests that explicitness of instruction may be more important than intensity. Chall (1967/1996) showed that primary grade children responded better to explicit phonics instruction than to the basals in use at that time. Brown and Felton (1990) reported evidence that explicit phonics instruction was associated with better student learning outcomes. Despite this research knowledge regarding the importance of explicit phonics instruction, many teachers in the last 3 decades of the twentieth century favored whole-language methods over explicit reading instruction. Left untreated, early reading problems persist (Juel, 1988). Thus, it was not always clear whether reading disabilities resulted from a biological basis or lack of explicit instruction.

In 1993, NIH sponsored a working conference for researchers in the field of learning disabilities at which these issues were discussed; it resulted in *New Frames of Measurement* (Lyon, 1994). Analyzing change by modeling individual growth (Francis, Fletcher, Stuebing, Davidson, & Thompson, 1991) was a theme in the NIH conference on new frames of measurement. Berninger and Abbott (1994) proposed response to intervention as a research tool to control for effects due to lack of opportunity to learn. We subsequently carried out our proposed research on early intervention in reading and writing outlined in our chapter for the conference. Results were analyzed for individual growth curves, treatment effects, classes of responses (faster and slower responses to instruction), and process measures that predicted individual response to treatment (the earlier discussed tier 1 and tier 2 interventions).

Following that conference, Slavin, Madden, Dolan, and Wasik (1996) showed that the effects of poverty and low literacy could be overcome by changing educational practice at the system level. Vellutino and colleagues (1996) showed that longitudinal early intervention in reading could eliminate most (but not all) reading disabilities. Compton (2000a, 2000b, 2002, 2003a, 2003b) documented that (a) there are individual differences prior to the beginning of instruction, (b) dynamic change occurs in response to instruction for children in general, and (c) processes such as phonological awareness, knowledge of letter-sound correspondence, and rapid automatic naming predict the slopes of individual growth curves.

From its inception (Deno, Marston, & Mirkin, 1982; Fuchs, 1986; Fuchs, Deno, & Mirkin, 1984), curriculum-based measurement (CBM) has been a progress-monitoring, response to intervention model. Unfortunately, with the widespread use of literature-

based texts in the whole-language movement, it was often not possible to link the assessment to actual instruction, and CBM made increasing use of standard passages unrelated to those used during classroom instruction. Nevertheless, at a time when prevailing practices were to assess only accuracy and not rate, even though children may have either accuracy and rate reading disabilities or only rate disabilities (Lovett, 1987), CBM provided a useful fluency metric. Another contribution of CBM was that it encouraged teachers to assess student progress on a more regular basis than typically happens in the general education classroom or than is required by federal special education law (every 3 years). A new form of CBM, *instructionally based assessment,* which is more closely yoked to teacher's instructional goals and cognitive processes for adapting instruction, has been introduced (Peverley & Kitzen, 1998; Wong, 2000) and is used in the UWLDC reading and writing lessons (Berninger & Abbott, 2003). One view is that norm-referenced tests are not sensitive to change in response to instruction, but we have not found that to be the case for the explicit instructional treatments we evaluated in randomized, controlled designs. Thus, we use a mix of standardized tests and instructionally based assessments in evaluating response to instruction.

Processes That Mediate Written Language Learning

Some believe that all that needs to be done to prevent reading and writing disabilities is to teach children. Others value the importance of assessment of mediating processes and designing instruction that improves these processes in the context of comprehensive reading and writing instruction. A large body of research points to processes that are concurrent and longitudinal predictors of written language acquisition: *phonological* (e.g., Bishop & Snowling, 2004; Catts et al., 2001; Catts, Fey, Tomblin, & Zhang, 2002; Manis et al., 1999; Mattingly, 1972; Scarborough, 1998; Snowling, 1980; Stanovich, 1986; Torgesen et al., 1997; Vellutino & Scanlon, 1987; Wagner et al., 1994); *letter naming* (Catts et al., 2001), *rapid letter naming* (Compton, 2003a, 2003b; Manis et al., 1999; Meyer, Wood, Hart, & Felton, 1998; Wolf et al., 1986), *rapid switching between letter and number naming* (Wolf, 1986) or *rate* (Wolf, 1999); *orthographic* (e.g., Berninger, Abbott, Thomson, et al., 2001, in press; Olson, Forsberg, & Wise, 1994; Schlagal, 1992); *morphological* (Carlisle, 2000; Carlisle & Stone, 2004; Carlisle et al., 2001; Nagy & Anderson, 1984; Nagy, Anderson, Shommer, Scott, & Stallman, 1989; Nagy, Berninger, Abbott, Vaughan, & Vermeulen, 2003; Singson, Mahony, & Mann, 2000; White et al., 1989); *syntactic* (e.g., Scarborough, 1990); and *attention* (Berninger et al., 1999; Thomson et al., 2005; Torgesen et al., 1999). Individual differences in *both vocabulary and phonological skills* predict whether children require teacher-directed, explicit instruction to respond optimally to instruction (Connor, Morrison, & Katch, 2004). Just as medical professionals now screen newborns for markers of medical disorders that can be prevented (e.g., mental retardation or other handicaps due to phenylketonuria, thyroid deficiency, RH factor incompatibility), so should educational professionals now screen children during early or middle childhood for marker processes associated with specific reading or writing disabilities and, when necessary, provide supplementary or specialized instruction with frequent progress monitoring (assessment of student response to instruction) and instructional adaptation as needed.

Developmental Expression of Dyslexia Subphenotype(s)

Which of the processes that impair written language learning in early or middle childhood are impaired throughout development? In a dyslexia phenotyping study based on families who were enrolled after a major revision in the test battery, we sought the developmentally stable, impaired processes. Based on relative criteria (for VIQ) and absolute criteria (for population mean), on average, child probands ($n = 122$; affected children who qualified the family) had a mean of 6.0 ($SD = 2.8$) deficits on the nine reading measures used for inclusion and a mean of 4.1 deficits on the six writing measures used for inclusion. Their affected parents had on average a mean of 1.9 ($SD = 1.7$) deficits on the same reading measures and 1.8 ($SD = 1.6$) deficits on the same writing measures.

Table 11.1 summarizes which subphenotypes met both absolute (low achievement at or below 1 *SD*) and relative (at least 15 standard score points difference between VIQ and measure based on transformation to make scales comparable if necessary) criteria at each developmental level. Six met both criteria at both

Table 11.1 Impaired Phenotypes Based on Absolute and Relative Criteria in Children Only and Children and Adults with Dyslexia

Child and adult	CTOPP nonword repetition, TOWRE pseudoword reading efficiency, Wolf RAN letter naming, UW alphabet letter writing, Wolf RAS letter and number, and Wolf RAS color, letter, and number. *Note:* D-KEF color word inhibition and verbal fluency repetitions met only the relative criteria in both child and adult dyslexics.
Child only	WRMT-R Word Identification and Word Attack, TOWRE sight word efficiency, GORT3 accuracy and rate, UW morphological decoding and accuracy, WRAT 3 and WIAT II spelling, WIAT II written expression, PAL receptive and expressive orthographic coding, CTOPP phoneme reversal, Wolf RAN color, Wolf RAN number, D-KEF color word inhibition. *Note:* Only in child dyslexics did inhibition on the Stroop meet both absolute and relative criteria.
Adult only	None.

Notes: CTOPP = Comprehensive Test of Phonological Processing; D-KEF = Delis Kaplan Executive Functions; PAL = Process Assessment of the Learner; RAN = Rapid Automatic Naming; RAS = Rapid Automatic Switching; TOWRE = Test of Word Reading Efficiency; WIAT II = Wechsler Individual Achievement Test, second edition; WRAT3 = Wide Range Achievement Test, third edition; WRMT-R = Woodcock Reading Mastery Test Revised.

Source: From "Modeling Developmental Phonological Core Deficits within a Working-Memory Architecture in Children and Adults with Developmental Dyslexia," by V. Berninger, R. Abbott, J. Thomson, et al., in *Scientific Studies in Reading,* in press; and "Research-Supported Differential Diagnosis of Specific Learning Disabilities" (pp. 189–233), by V. Berninger and L. O'Donnell, in *WISC-IV Clinical Use and Interpretation: Scientist-Practitioner Perspectives,* A. Prifitera, D. Saklofske, L. Weiss, & E. Rolfhus (Eds.), 2004, San Diego: Academic Press.

developmental levels and are stable hallmark features across development. Many subphenotype measures met both criteria in children but not adults and thus are more likely to show compensation (normalization) over development. No impairments met both criteria only in the adults, but the adults met both the absolute and relative criteria for impaired real word reading efficiency but not for real word reading accuracy (Berninger & O'Donnell, 2004); and real word reading accuracy and rate appear to have different genetic mechanisms based on chromosome linkage (Igo et al., in press).

The stable impaired skills represent the three components of working memory: phonological storage (aural nonword repetition), phonological loop (rapid letter naming and writing), and executive functions (switching attention and inhibition; e.g., Baddeley, 2002; Baddeley & Della Sala, 1996). The stable phonological deficits (cf. Morris et al., 1998) may explain the word decoding problems, and the set of all three deficits may explain the persistent fluency problems of dyslexics due to inefficient working memory (Berninger, Abbott, Thomson, et al., in press; Berninger & O'Donnell, 2004).

The findings raised new questions we are still investigating. The phonological loop has a role in learning new written words by coordinating linguistic codes (e.g., Baddeley, Gathercole, & Papagano, 1998) and in accessing familiar words rapidly and efficiently in long-term memory. Does the RAN deficit reflect the impaired time-sensitive phonological loop? Did the Vicar of Nibbleswicke, whom Roald Dahl introduced us to, have a recurrence of childhood dyslexia moments with written text in his adult years when he faced his first adult job as a pastor delivering sermons where he transposed the sounds in spoken words (e.g., God and dog; Dahl, 1990)? If inefficiency in the executive functions for phonologically coded working memory is the underlying problem, it may make it more difficult to learn to read (coordinate spoken and written words) in childhood but also to express oneself later in life when working memory is being taxed as in learning a new job and may affect oral expression as well as reading or written expression. More than phonological decoding may be impaired in dyslexia.

Research-Supported Inclusionary Criteria

Resolving issues of definition for research purposes is also important for educational practice if both assessment and instruction are ever to be grounded in scientific research. It is no wonder that educators are confused about what dyslexia is and whether it exists if neither federal legislation nor professionals can define it on the basis of *inclusionary criteria.* Toward the goal of developing inclusionary criteria, we carefully examined cases of children who did and did not have discrepancies between VIQ and reading and spelling achievement. Based on Snow (1994) and Snow, Cancino, Gonzales, and Shriberg (1989), Nagy, who is on the UWLDC research team, proposed that defining words is really a metalinguistic awareness index of a child's ability to use words in a decontextualized manner, distinct from contextual-

ized use of language in conversation (see Berninger, Abbott, Vermeulen, et al., in press). It follows that VIQ, which is highly correlated with expressive vocabulary, may be a general metalinguistic awareness index.

Further group analyses showed that dyslexics appeared to be primarily impaired in phonological and orthographic processing, rapid automatic naming, and executive functions (such as supervisory switching attention and inhibition) but to have intact oral language skills for morphology and syntax, that is, good metalinguistic awareness at those levels of language. However, the language learning disabled (Butler & Silliman, 2002; Wallach & Butler, 1994) children appeared to be impaired in those oral language skills as well as in phonological skills and also to be more impaired in reading comprehension than the dyslexics. Their impaired metalinguistic awareness of morphology and syntax may account for their lower VIQs.

Differential diagnosis for dyslexia versus language learning disability has implications for research and treatment. Dyslexics and language learning disabled individuals are probably included in many studies of reading disability, and results may or may not generalize across studies depending on the relative proportion of these individuals in a particular study. For dyslexics, all that may be needed is explicit instruction in orthographic and phonological awareness and decoding, but for those with language learning disability affecting all aspects of metalinguistic awareness, effective treatment may require explicit instruction in phonological, morphological, and syntactic awareness.

Drawing on Chall's (1983) observation that students first learn to read and then use reading to learn, we have observed that the language learning disabled have *significant problems in using language to learn.* School learning requires using language to understand teachers' instructional language, using language to self-regulate the internal mental processes in learning across the academic curriculum, and using language to self-regulate emotions and behavior. Thus, the language learning disabled need special instruction in using language to learn. The Appendix describes assessment procedures for the differential diagnoses among dyslexia, language learning disability, and dysgraphia (also see Berninger & O'Donnell, 2004). In addition, some individuals have specific comprehension disability without any language disability (e.g., Oakhill & Yull, 1996) or combinations of dyslexia, dysgraphia, and/or language learning disability.

Differential Diagnosis for Teaching versus Labels

Many parents and teachers reject terms such as learning disabilities as labels that stigmatize and do not make a difference in instruction. In contrast, we use the terms *dyslexia, dysgraphia,* and *language learning disability* because they identify both the nature of the problem and the need for specialized instruction in the affected academic skills:

Dyslexia: Impaired word reading and spelling (see Berninger, 2001)

Dysgraphia: Impaired handwriting and/or spelling (forming the letters of the language by hand; see Berninger, 2004b)

Language learning disability: Impairments in both aural/oral and written language (see Berninger & O'Donnell, 2004)

These terms can be used in the general education program, without the legal and paperwork constraints of special education, as well as in special education.

Effective Instruction for Dyslexia and Dysgraphia

Although there is a long-standing clinical research literature on treating dyslexia and specific reading disabilities, studies employing randomized, controlled designs have increased in recent years. Three programmatic lines of research on effective treatment of children with dyslexia include the groundbreaking studies of Wise and Olson at the University of Colorado Learning Disabilities Center with Talking Computers (e.g., Wise, Ring, & Olson, 1999), Lovett and colleagues at Toronto Children's Hospital (e.g., Lovett et al., 1994, 2000), and Torgesen and colleagues (e.g., Torgesen et al., 1999, 2001). More recently, a large randomized controlled study across three sites was conducted by Morris, Wolf, and Lovett (Wolf et al., 2003).

There has been a recent explosion of knowledge in evidence-based, effective reading instruction (e.g., McCardle & Chhabra, 2004; National Reading Panel, 2000; Snow, Burns, & Griffin, 1998); although there is not as much knowledge available for writing instruction, there is some (e.g., Berninger & Richards, 2002, chap. 9; Hooper et al., 1993; Swanson, Harris, & Graham, 2003, chaps. 16, 20, 21). High-stakes tests in

many states require writing skills for assessing all domains, not just reading (Jenkins, Johnson, & Hileman, 2004). Also, many of the reviews of research-supported instruction are focused on early reading—and in the general education classroom. There is need for continuing research on instructional interventions that are effective across development and that are validated for specific kinds of learning and development problems, including but not restricted to dyslexia and dysgraphia.

Effective Instruction for Language Learning Disability

Little is known about effective reading or writing treatment for students with reading disabilities and additional oral language disabilities, which increasingly are referred to as language learning disabilities (e.g., Butler & Silliman, 2002; Wallach & Butler, 1994). In our experience, these children show mild to moderate indicators of difficulty in learning aural/oral language during the preschool years; although these oral language problems resolve in terms of production during the school-age years, lingering problems in metalinguistic awareness remain that may affect oral as well as written language. They may also have written expression problems (Fey, Catts, Proctor-Williams, Tomblin, & Zhang, 2004). Effective treatment is needed to help them improve in using decontextualized language to learn (to self-regulate internal learning processes for reading and writing and across the content subjects in the curriculum). They may learn more easily nonverbally (the twenty-first-century curriculum is very verbally oriented), but more research is needed on this issue.

Summary Position on Definitional Issues

We believe the trends toward more flexible criteria for qualifying children for services in the schools and the addition of a response to intervention component are steps in the right direction to prevent severe learning disabilities. Response to intervention will establish dynamic assessment as standard psychological practice (see Grigorenko & Sternberg, 1998; Lidz & Elliott, 2000). At the same time, it is important to retain comprehensive assessment and introduce scientifically supported differential diagnosis that has treatment validity for those who fail to respond to early intervention and have biologically based learning disabilities. Differential diagnosis relies on cognitive tests and associated phenotypic markers of specific learning disabilities.

CONTINUING CHALLENGES

Validity of Special Education Categorical versus Research-Supported Practices

The special education categories for qualifying children for services are not the same as research-supported diagnoses (Berninger, 1998). The shortcomings of the categories for qualifying children for special education services go beyond problems in IQ-achievement discrepancy the way it has been implemented. Often, cluster scores that are composites of more than one subtest are used to qualify students for special education services. This practice is problematic because when subtests are combined; a relative strength on one subtest may mask impairment on another subtest that contributes to the cluster. For example, beginning at-risk readers show *intraindividual differences in the growth curves for real word reading and pseudoword reading* (Berninger, Abbott, et al., 2002). Children who show significant growth in both of these single-word reading skills have the best outcomes; those who show significant growth in only one of these have significantly lower outcomes in reading. Combining these two subtests may miss a significant deficit in either pseudoword reading or real word reading that has important implications for diagnosis and treatment (see Berninger & O'Donnell, 2004).

Likewise, in computing IQ-writing achievement discrepancy, only accuracy measures of writing achievement—cluster scores on the Woodcock-Johnson, third edition (WJ-III) or Wechsler Individual Achievement Test, second edition (WIAT-II) that confound quality of writing samples and writing fluency—are often used. In addition, impaired spelling, handwriting, or compositional fluency are often not recognized as learning disabilities, but 15 years of our National Institute of Child Health and Human Development (NICHD) supported research indicates they are. For example, higher scores on WJ-III Writing Samples (an untimed test that does not require sustained writing and that is scored for content and ideas but not the mechanics of written expression with which students with learning disabilities have difficulty) may mask problems in writing fluency (speed of composing). However, when WJ-III Writing Samples is compared to writing fluency or writing fluency is compared to VIQ, the disparity is evident (significantly lower writing fluency) and typically is confirmed through examination of daily written work.

Thus, children with persisting reading or spelling problems may not qualify for any specialized instruction if they are significantly impaired in (a) accuracy of word decoding (reading pseudowords) but not word reading (real words) or of real word but not pseudoword reading; (b) rate of single word or pseudoword reading or rate of oral reading of passages; (c) spelling; and/or (d) handwriting. It does not matter if it is obvious that the child cannot read classroom materials with accuracy and fluency, spell at a grade-appropriate level in daily written work, and/or has illegible or painfully slow handwriting. There also is no procedure in place to identify or serve students with language learning disability, which may account for more cases of specific learning disability than classic dyslexia or dysgraphia.

The Problem Is Lack of Knowledge, Not Lack of Money

Given the sociopolitical context in which we conduct our research (11 local schools have sued the state superintendent of education, director of special education, and governor because they do not think they have enough money to teach students who qualify for special education), we frequently remind educators that *there is nothing in the special education law that says it is illegal or unethical or unprofessional to help students with learning disabilities in the general education program by implementing research-supported assessment and teaching practices.* Although qualifying students for special education is sometimes an appropriate goal, some parents want appropriate diagnosis and services in general education. Unfortunately, schools are reluctant to accept the research-based definitions of learning disability (many of which have been shown to have a genetic or neurological basis) because they fear the state auditors will penalize them by decreasing their funding if they do not use the current legally mandated procedures even if they are not supported by research and children who have obvious reading or writing problems do not qualify under one of the existing legal definitions. Even though the federal regulations now require that science-based reading instruction be used in schools accepting No Child Left Behind funding, there are no regulations that support use of scientifically supported diagnostic categories for diagnosing or treating reading, writing, or math disabilities. Although students with tier 3 problems benefit from specialized instruction, it is not cost-effective to provide all of their reading, writing, and math instruction in pull-out programs. Therefore, students with these specific learning disabilities in reading, writing, math, or language learning should be given the option of a special section within general education taught by a qualified teacher who provides *explicit, language-based, intellectually engaging instruction.* Although affected individuals can learn to decode and read real words if given appropriate, explicit instruction, the underlying genetic basis for the disorder appears to exert its effects in different ways as affected individuals advance in schooling and the curriculum requirements change. Persisting spelling and written expression problems and silent reading fluency problems are typically observed in older students unless new kinds of instructional interventions are put in place. Unfortunately, many schools offer older students only accommodations rather than continuing explicit instruction aimed at fluent reading, spelling, and written expression and executive functions. Schools might benefit from a return to the flexible model of building-based, well-trained academic learning specialists who provide direct services and also collaborate with teachers to plan and implement differentiated instruction. Such an approach would necessitate more comprehensive teacher training in explicit instruction strategies (e.g., Cunningham, 1990) and domain knowledge relevant to literacy (e.g., Cunningham, Perry, Stanovich, & Stanovich, 2004; McCutchen & Berninger, 1999).

High-Stakes Tests

Based on the experiences of students in our research studies, we wonder whether the high-stakes tests, which are aimed at high-level thinking skills, are adequately assessing low-level decoding, word reading, fluency, handwriting, and spelling skills that can compromise performance on daily school assignments, whether or not students pass the high-stakes tests. (See Figure 11.1, which is a recent writing sample from an eighth grader who passed the high-stakes test in writing.)

Another issue is that high-stakes tests often require writing across all academic domains (reading, math, and writing; Jenkins et al., 2004). Many students who have writing rather than reading problems may perform poorly on these tests because, although they have the domain-specific knowledge, they lack adequate writing skills to express what they know. As one adolescent suicide survivor told me, "I am good at math [and individually administered psychometric tests support this

self-perception] and I can explain my math thinking by talking, but I cannot explain my math thinking in writing. I thought my life was over because I can do math but not write about it." Although federal initiatives emphasize the importance of research-supported reading instruction and now annual reading and math assessment, they have not yet included writing in that mandate for scientifically supported instruction and annual assessment. Many students who are failing in course work or achieving far below grade-appropriate levels are mistakenly thought to be not motivated; yet, when they are given tests of writing-related processes validated in research, they are typically shown to have undiagnosed and untreated writing disabilities (Berninger & Hidi, in press). Introducing research-supported writing interventions so that they can become successful in writing often transforms a reluctant writer into an able and willing writer.

Increasingly, students with learning disabilities are brought to our attention because they have not passed the high-stakes test or teachers fear they will not pass it. One of the worst cases we have encountered was the school who refused to listen to parents' concerns that their child was not learning to read during the early grades. Later, a teacher asked the parents to agree to a special education placement for learning disabilities so that the child's scores on the high-stakes test would not bring down her class average. According to the UWLDC assessment results, the child was a nonreader. Had tier 1 research-supported screening and early intervention been in place in this school, this child would probably not have had years of chronic failure and likely would have been a reader and writer. There are many more such stories that constantly remind us that there is still an enormous job yet to be done in educating educators about learning disabilities and effectively teaching students with learning disabilities.

PROFESSIONALS WHO PRACTICE THE THREE Cs: CARE, CONNECT, AND COMMUNICATE

Instructional Research Is Necessary but Not Sufficient

Basic laboratory research may not generalize to real-world settings. Therefore, when applying research results, the effectiveness of the implementation should also be evaluated on the basis of evidence. Achieving desired results in practice may well require both art as well as science. The art involves clinical skills for direct services and consulting with other professionals (Rosenfield, 1987; Rosenfield & Gravois, 1996). Over the years, we have encountered many dedicated, competent professionals who work hard and effectively to help students with learning disabilities. At the same time, we have encountered many cases in which the students were not being served well and the schools were resistant to outside professional assistance in helping the students with learning disabilities.

Professional Approach

In our professional preparation program for psychologists, I emphasize the three Cs for effective clinical practice: *caring* about the individuals affected with learning disabilities, *connecting* with them and their families, and *communicating* effectively with parents and teachers regarding ways to help children with learning disabilities. This kind of professional practice, reflecting the spirit of federal legislation that guarantees the civil rights of children with educationally handicapping conditions, cannot be legislated. It involves opening one's heart to others (see "Open Hearts," the March 2 reflection in *Native Wisdom for White Minds,* Schaef, 1995). Well-trained professionals, knowledgeable about scientifically supported assessment and instruction, able to open their hearts to care about the plight of children who learn differently because of biological influences (which make it harder but not impossible to learn) are as necessary as laws to optimize academic success during childhood and workplace success during adulthood of individuals with specific learning disabilities. Professionals who practice the three Cs develop collaborative rather than adversarial relationships with parents. Because the parents know that the educators care, there is no need to turn to lawyers who are not professional educators to resolve disputes. This emphasis on caring about others is consistent with progressive pedagogy that underscores the need to meet student strengths and needs (Barth, 2002; Bruner, 1966; Dewey, 1963) through caring (Noddings, 1992).

VISION OF APPROPRIATE EDUCATION FOR STUDENTS WITH LEARNING DISABILITIES

This chapter ends with a vision of what could be so that students like Susan, Sean, Sam, and Sharon do not come to a standstill, flounder, or agonize over why no one can teach them, or waste precious years of their lives be-

cause they learn in a different way. This vision does not require more money, but rather more creative and intelligent use of the limited resources available to schools so that they are not needlessly drained by expensive legal proceedings. What follows is implemented fully within general education, with building-level flexibility, and without special education auditors, paperwork, and legal procedures. Special education still exists to provide an appropriate education for students with more severe handicapping conditions, but those with dyslexia, dysgraphia, and language learning disability are appropriately diagnosed and served within the general education program in a manner that provides the specialized instruction they require.

To begin with, schools make greater use of the *language arts block,* during which all teachers at the same grade level or across grade levels teach language arts at the same time. In keeping with the continuum of explicit instruction discussed earlier in the chapter, each school designates at least one class or section at the elementary and middle school level for offering explicit, intellectually engaging reading and writing instruction for those who require, depending on grade level, highly explicit instruction for phonological, orthographic, and morphological awareness (see Figure 11.2, p. 426), alphabetic principle, word families, structure words, decoding, automatic word recognition, oral and silent reading fluency, reading comprehension, handwriting automaticity, spelling, compositional fluency, or genre-specific composing, including report writing, note taking, study skills, and test taking. Not all children require highly explicit instruction, but those with dyslexia, dysgraphia, and language learning disability and others need this option in the general education curriculum. (See Berninger, 1998, and Berninger & Richards, 2002, for the inspiring story of a special education teacher who organized such a language arts block in the general education program and showed that the children with learning disabilities who start out behind can reach the same literacy outcomes as their peers without learning disabilities if provided explicit, intellectually engaging instruction.)

The *role of the school psychologist* changes from giving a battery of tests for the sole purpose of deciding whether children qualify for costly pull-out, special education services, to that of assessment specialist (funded by general education) who serves two important roles in meeting the needs of students with learning disabilities. First, the school psychologist organizes a schoolwide screening and progress monitoring program. The purpose of the tier 1 screening is to identify those students who are at risk for dyslexia, dysgraphia, language learning disability, or other developmental or learning problems. When children show indications of being at risk, the school psychologist shares this information with the general educator (and parents, to create collaborative rather than adversarial relationships) and uses problem-solving consultation skills (Rosenfield, 1987; Rosenfield & Gravois, 1996) to help the general educator provide differentiated instruction to meet individual students' instructional needs within a group setting. The school psychologist also assists with progress monitoring so that teachers, parents, and the children themselves know if they are making reasonable progress in specific reading and writing skills. Second, when a child is not making adequate progress in response to the initial intervention and possibly tier 2 additional intervention, the school psychologist then conducts tier 3 assessment and administers standardized tests, obtains a developmental history from parents, collects work samples, and observes the child in the classroom to determine if any of the differential diagnoses in the Appendix or others apply. The goal of diagnosis is to (a) understand why a child has struggled, (b) identify an educationally handicapping condition that qualifies the child for both explicit instruction *and* accommodation in the regular program, and (c) plan differentiated instruction for this student within the language arts section that is explicit, intellectually engaging, and appropriate for the diagnosis.

Had this kind of approach been in place, Susan would have been identified in the kindergarten and first-grade screening and given tier 1 supplementary reading and writing instruction in the general education program. By third grade, she would not have been at a standstill, but would probably have been flagged again in fourth grade for reading and writing rate and spelling problems and then again given supplementary instruction for those skills. Likewise, the teachers and psychologists would have realized that just because Sean has learned to decode and read with accuracy does not mean that his dyslexia no longer has implications for his instructional needs. Sean would have continued to receive explicit instruction in silent reading fluency, spelling, and written composition during the upper elementary grades until those skills were well developed. Sam (see Figure 11.1, p. 423) would not be begging for someone to teach him to read and write better. What is unfortunate in his case is that with appropriate intervention at school (supplemented with university assistance), Sam was reading and writing on grade level up through the end of elementary school. He lost relative ground when all explicit instruction in reading and

writing was eliminated in middle school, highlighting the *necessity for sustained explicit instruction across schooling for students with dyslexia and dysgraphia (and also language learning disability).* Finally, Sharon's mother's pleas to have her assessed during the school years would not have been dismissed with the misguided assumption that she cannot possibly have a learning disability because she is bright. Her dyslexia would have been diagnosed and treated and she may even have fared better in learning a second language with specialized instruction; she would have graduated from college at the same time as her peers and found employment commensurate with a college education.

Translating this vision of research into practice requires keeping abreast of the rapidly expanding body of research on learning disabilities. It also requires common sense, caring, and commitment to educating all students, even those who pose more challenges because they do not learn as easily despite being intelligent. There is no teacher-proof curriculum that will bring about this vision. Achieving this vision will require developing more informed and collaborative relationships between educators and state legislators to pass legislation that affirms the professionalism of educators entrusted with bringing about this vision and delegates to them the responsibility of doing so.

APPENDIX WITH HALLMARK FEATURES FOR DIFFERENTIAL DIAGNOSIS

Inclusionary Hallmark Criteria for Dyslexia Constellation

- Verbal IQ (or Verbal Comprehension Factor) at least 90.
- Meets at least one of the following criteria (most will probably meet several):
  - —Decoding or real word reading accuracy or rate is below the population mean and at least 1 *SD* (15 standard score points) below VIQ.
  - —Oral reading accuracy or rate is below the population mean and at least 1 *SD* (15 standard score points) below VIQ.
  - —Spelling is below the population mean and at least 1 *SD* (15 standard score points) below VIQ.
- Does not meet any exclusionary criteria related to other neurodevelopmental disorder, brain injury or disease, or psychiatric disorder, and is not an English-language learner.

Comorbidity Issues

Oral language milestones are normal during the preschool years except in phonology. Rarely do the children who meet this criterion meet the criteria for ADHD specified in the *Diagnostic and Statistical Manual for Mental Disorders (DSM-IV),* but they do show individual variation along a continuum of inattention (based on parental ratings).

Inclusionary Hallmark Criteria for Language Learning Disability Constellation

- Preschool history of some indicator of slower language milestones (first words, first sentences, early intervention in speech or expressive language).
- Performance IQ or Perceptual Organization Factor at least 90 (to reduce probability of confounding developmental neurogenetic disorders); WISC-III or WISC-IV VIQ may be below 90 (or Vocabulary subtest below 8).
- Meets at least one of the following criteria (most will probably meet several):
  - —Decoding or real word reading accuracy or rate at least 1 *SD* below the mean.
  - —Oral reading accuracy or rate at least 1 *SD* below the mean.
  - —Spelling at least 1 *SD* below the mean.
  - —Oral or reading vocabulary at least 1 *SD* below the mean.
  - —Reading comprehension at least 1 *SD* below the mean.
- Does not meet any exclusionary criteria related to other neurodevelopmental disorder, brain injury or disease, or psychiatric disorder, and is not an English-language learner.

Comorbidity Issues

The following indicators are typical: (a) slower preschool language milestones, (b) preschool motor milestones are possibly slower, (c) some oral language skills (morphological and syntactic awareness and sentence formulation) during the school-age years are outside the normal range, and (d) comorbid diagnosis of ADHD (especially Inattention), although the attention problems may be the result of language-processing problems.

Inclusionary Hallmark Criteria for Dysgraphia Constellation

- No preschool history of slower language milestones (first words, first sentences, early intervention in speech or expressive language) but may have preschool indicators of motor delays or dyspraxias or attentional difficulties.
- VIQ at least 90.
- Meets at least one of the following criteria (most will probably meet several):
  - —Does not meet the criteria for dyslexia for word decoding, real word reading, or oral reading of passages.
  - —Does meet one or more of the following criteria:
    - Handwriting is below the population mean and either at least 15 standard score points below VIQ or at least 1 *SD* below population mean.
    - Spelling is below the population mean and at least 15 standard score points below VIQ.
    - Does not meet any exclusionary criteria related to other neurodevelopmental disorder, brain injury or disease, or psychiatric disorder, and is not an English-language learner.

Comorbidity Issues

Does not tend to have slower language milestones during the preschool years or oral language skills during the school-age years that are outside the normal range. Some of these children meet *DSM-IV* criteria for ADHD and are more likely to have Hyperactivity symptoms (particularly impulsivity) than the other subtypes but also show signs of Inattention.

Note well: Some children meet the inclusionary criteria for more than one specific learning disability and may have combinations of dyslexia, disgraphia, and/or language learning disability.

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