CHAPTER 2

Are Learning Disabilities Real?

Constructs like LDs are often questioned because there is no "gold standard" indicating what is or is not an LD. Indeed, a recent book (Elliot & Grigorenko, 2014) was entitled *The Dyslexia Debate* and was widely interpreted as suggesting that dyslexia does not exist. In a similar vein, LDs are often characterized as "mild" disabilities, and some question whether LDs are in fact conditions that meet criteria for a disability. The description of "mild" is difficult to reconcile with the adaptive consequences of being a poor reader or of having inadequate mathematics skills in our society. In this chapter, we provide an affirming "yes" to the question of whether LDs represent a "real" construct. We also provide a conceptual framework for understanding disorders like LDs, where the defining attributes exist along a continuum and are noncategorical (i.e., *dimensional*), unlike medical conditions like mumps and measles or life and death (Ellis, 1984).

We believe the evidence supports the validity of the construct of LDs, and that it has evolved as a scientific construct with an evidence base that should guide practice. We acknowledge that this evidence base is often not used as a basis for decision making in education, but argue that it should be used, especially in translating science into practice (see Chapter 11). Presently many approaches to identifying and treating LDs are not strongly evidence-based but have their roots in historical conceptions, anecdotes, unsystematic observation, and approaches for which the evidence base has been studied and found inadequate. The lack of attention to empirical evidence has hampered the field, much to the detriment of the children and adults with these types of academically based disabilities.

Most questions about whether LDs exist actually address uncertainty about how to define them. The ensuing controversy about definition is misconstrued as an argument about whether LDs represent true disabilities. To reiterate, there is no gold standard for any definition of LD, which is also the case for many other "disorders," such as ADHD, obesity, or hypertension (Ellis, 1984; Hinshaw & Scheffler, 2014). Rather, we use different types of measures to "indicate" the construct of LD. As we discuss in Chapter 3, these measures have inherent unreliability when it comes to identifying the extent to which a person displays the indicators of the construct, which occur on a continuum of severity. This does not mean that the indicators are not real or that the construct is not real; obesity and hypertension, which like LD rely on indicators that occur on a continuum of severity, are also real (Ellis, 1984). It simply means that valid measurement is nonnegotiable and essential.

Elliott and Grigorenko (2014) attracted considerable media attention for putatively questioning whether dyslexia existed. In fact, even a cursory reading shows that the authors did not really question whether dyslexia existed. Rather, they questioned whether the *term* had any specific utility because "dyslexia" was used in so many different ways and proposed purposes that the label was questionably meaningful, a longtime issue in the field. In particular, Elliott and Grigorenko noted that there was little indication that providing the label of "dyslexia" was associated with specific approaches to intervention. In Chapter 6, we suggest that many children with word-level reading difficulties benefit from interventions targeted at their specific reading and spelling weaknesses, regardless of whether the dyslexia term is or should be applied to the child. Our recommendation is that the use of the term "dyslexia" be referenced (in part) to the nature of the academic difficulties, a conspicuous problem in reading and spelling isolated words. This approach can reduce confusion of what to do when children have word-level difficulties (see Chapter 6), which is more important than the label.

The issue of whether LDs exist can be empirically addressed. In this chapter, we do so by providing a brief historical context to help explain why there is confusion—individuals with LDs are phenotypically heterogeneous, meaning that what people see is a blend of academic and behavioral difficulties that are variable. We discuss critical issues related to the construct of LDs, including the idea of LDs as an unobservable construct that are only identified by how they are measured; the measured attributes are dimensions that vary normally in the population (like weight and blood pressure) and become a problem with adaptation when they are on the extreme end of the distribution. They are heritable, have a basis in brain structure and function, and need intervention when the condition interferes with some form of adaptation. We then discuss evidence of the evolution of LDs as a scientific concept with a firm but changing evidence base that can guide research and practice.

Historical Perspectives and U.S. Public Policy

There are many reviews of the history of the concept of LDs (e.g., Doris, 1993), including Chapter 2 in the previous edition of this book (Fletcher et al., 2007; see the box at the end of the table of contents).

LDs originated in the concept of intrinsic behavior problems that originated in the brain, not the environment. These notions gave rise to the concept of minimal brain injury (Strauss & Lehtinen, 1947) and minimal brain dysfunction (MBD) in the 1960s (Clements, 1966). With the advent of DSM-III (American Psychiatric Association, 1980), the concept of MBD largely disappeared because the group identified with MBD was extremely heterogeneous. Instead, academic skills disorders and ADHD were separately defined, thus separating LDs and behavior disorders. Kirk (1963) and his colleagues formally introduced LDs as an educational entity. The essential tenets were that children with LDs (1) demonstrated learning difficulties that were "unexpected" given the children's strengths in other areas; (2) had different learning characteristics than children diagnosed with intellectual disabilities or emotional disturbance; (3) manifested learning characteristics that resulted from intrinsic (i.e., neurobiological) rather than environmental factors; and (4) required specialized educational interventions. No mention was made of intelligence, just of the absence of intellectual disability.

As with MBD, definitions of LD and dyslexia were difficult to operationalize and typically led to groups that were extremely heterogeneous (Benton, 1975). The definitions specified no inclusionary criteria and were largely definitions by exclusion (Rutter, 1982). Genetic, cognitive neuroscience, and intervention research made little progress, partly because of the heterogeneity of the groups and the variation in selection criteria across labs (Doehring, 1978).

Why Are LDs Difficult to Define?

Three major issues make LDs difficult to define. As we noted in the first edition (Fletcher et al., 2007), LD represents an *unobservable latent construct* that does not exist apart from attempts to measure it. As such, LD has the same status as other unobservable constructs, such as IQ, achievement, or ADHD. The second involves the *dimensional* nature of LDs (i.e., the attributes representing LDs exist on a continuum and do not represent discrete categories; Ellis, 1984). The third issue is the problem of *comorbidity* with other developmental disorders (Pennington, 2009).

LDs Are an Unobservable Construct

LDs are a latent construct and not directly observable. Identification of a group of children whose academic underachievement is unexpected historically required ensuring the absence of other circumstances known to produce low achievement (sensory disorder, mental retardation, emotional disturbances, economic disadvantage, linguistic diversity, inadequate instruction), which leaves a very heterogeneous group. To remedy this problem, many efforts at definition and identification have been attempts to measure the attributes of *unexpected underachievement,* which epitomizes the LD construct. The primary approach to identification has been through cognitive discrepancy models in which the measurement of unevenness in academic or cognitive development is a marker for the "unexpectedness" of LDs, along with the exclusion of other causes of underachievement that would be "expected" to produce underachievement. Thus, children must be tested to identify discrepancies that would indicate unexpectedness and the latent construct of LDs.

A general problem that emerges with any form of testing is that the measures are imperfect indicators of the underlying construct. This is a problem with any approach to identification of LDs that involves psychometric tests. If different tests are used, different people will be identified with LDs because of differences in how the constructs are operationalized in the tests. This problem is magnified by slight amounts of unreliability in the measurements of the key academic, cognitive, and instructional attributes (see Chapter 3). We can observe what is measured, such as reading, math, cognitive processes, or instructional response. Each of these observable measures is intended to indicate, albeit imperfectly, the latent construct of LDs. The measurement is imperfect because no single measure captures all the components of the construct and each measurement contains a certain amount of error. The critical issue is the effect of these imperfect measurements on the reliability and validity of the overarching classification that is the basis for identifying LDs.

The Attributes of LDs Are Dimensional

The second issue is the dimensional nature of the attributes of LDs. As we observed above, most of the research on LDs, particularly that affecting reading, shows that the defining attributes occur along a continuum of severity rather than presenting as an explicit dichotomous category delineated by clear cut points on the achievement distribution. Indeed, the psychometric markers of LDs, such as achievement test scores, appear normally distributed in most population-based studies (Lewis, Hitch, & Walker, 1994; Rodgers, 1983; Shalev, Auerbach, Manor, & Gross-Tsur, 2000; S. E. Shaywitz, Escobar, B. A. Shaywitz, Fletcher, & Makuch, 1992; Silva, McGee, & Williams, 1985).

This conclusion is not without controversy. Some studies of children with LDs in reading have suggested that the distribution of achievement test scores is not normal and have identified a natural cut point where a separate distribution of nondyslexic poor readers can be identified (Miles & Haslum, 1986; Rutter & Yule, 1975; Wood & Grigorenko, 2001). In the studies summarized by Rutter and Yule (1975), the separate distribution, or "hump," has been attributed to an inadequate ceiling on the reading test (van der Wissell & Zegers, 1985) and to the inclusion of a large number of children with brain injuries who had IQ scores in the intellectually deficient range (Fletcher et al., 1994). However, most of the research generated surrounding the distribution of achievement scores in samples with LDs supports Stanovich's (1988) contention that people with LDs fall along a spectrum of impairment, that is, students with severe LDs do not differ *qualitatively* from students who land at the milder end of the spectrum. Findings supporting the dimensional nature of LDs are consistent with studies applying methods from behavioral genetics, which have not identified qualitatively different genetic constellations associated with the heritability of reading and math disorders (Fisher & DeFries, 2002; Grigorenko, 2005; Plomin & Kovas, 2005). As these are dimensional traits that exist on a continuum, there would be no expectation of natural cut points that differentiate individuals with LDs from those who are underachievers, but not identified with LDs; the distribution is simply a continuum of severity (S. E. Shaywitz et al., 1992).

If we evaluated the average performances of groups with and without LDs, as is done in empirical research, the dimensional nature of LDs (and the imperfection of measurements of the construct) would not be a major problem because the errors of measurement would be reflected in the variability around the mean.

However, in public policy and educational applications it is necessary to identify individuals who have or do not have LDs. We rarely talk of degrees of LDs except in terms of severity, which is also a dimensional concept. The need to identify individuals for access to resources makes it necessary to categorize inherently normal distributions. Even with this need, the potential unreliability associated with these decisions must be recognized.

Comorbidity

Comorbidity refers to the co-occurrence of the attributes of two different disorders in the same person. It is well known that many children with dyslexia also have problems with math and/or ADHD. Sometimes they have accompanying speech and language disorders (Pennington & Bishop, 2009). In these instances, it is usually not the case that one problem causes another, although they may be linked. Rather, the individual actually meets diagnostic criteria for more than one disorder.

In retrospect, people who formulated early concepts of MBD were struggling with the fact that children with problems in reading or behavior often had overlapping difficulties. They also showed variable differences on cognitive, motor, and perceptual tasks that are still identified as special or pathognomic signs of LDs and targets for treatment, despite decades of evidence disputing whether LDs have any pathognomic signs and even clearer evidence that treating problems with perception, motor coordination, left–right reversals, and other "special signs" do not lead to improvement in academic skills (Mann, 1979) or ADHD behavior (Nigg, 2009; Hinshaw & Scheffler, 2014).

Exact determinations of comorbidity of LDs with other disorders vary considerably across studies and are ultimately arbitrary because any prevalence estimates depend on where the cut point is set for identification of the disorder. A major determinant is whether the individual is identified in the schools or in a clinic; the latter is associated with much higher rates of comorbidity diagnoses. However, estimates are that approximately 4–5% of the population experience comorbid word-level reading disability (RD) and ADHD (Carroll, Maughan, Goodman, & Meltzer, 2005; Pastor & Reuben, 2008), so that 25–50% of children identified as having word-level RD are also identified with LD (Pennington, 2009). About 20% of children with ADHD are identified with an RD and likely even more with math and writing problems, but these estimates are not reliably available (Carroll et al., 2005). Altogether, children with RDs are about four times more likely to present with ADHD behavior than children without an RD (Carroll et al., 2005). In many children, it is inattention rather than hyperactive-impulsive behavior that accounts for the common link with RD (Willcutt et al., 2010a; 2010b), although this is hardly an exclusive association. In terms of math and written expression, most people with reading problems also have writing problems; estimates of the co-occurrence of reading and math disability range from 30 to 70%, presumably because of shared cognitive liabilities (Willcutt et al., 2013).

Some researchers trying to understand comorbid relations of reading LDs and ADHD created an early framework suggesting that poor attention caused poor reading (Stanovich, 1986). Another early alternative hypothesized that poor reading leads to poor attention due to inability to fully engage in the classroom (Hinshaw, 1992). However, most of the current research is consistent with a *correlated liabilities* hypothesis, which predicts that some attributes are associated with ADHD and LDs in isolation, but that the different disorders share common weaknesses (Willcutt et al., 2010b). Interestingly, two recent reading intervention studies found that treatment for reading problems directly leads to improved reading, which in turn leads to improved teacher ratings of attention (Roberts et al., 2015; Miller et al., 2014). The hypothesis that inattention causes poor reading would predict that the reading intervention would have little effect on attention or that an intervention that improved reading would need to directly target attention skills, which in turn would affect reading. The intervention results described above do not support these predictions, finding instead that attention and reading improved in tandem.

More direct support for the correlated liabilities hypothesis comes from studies comparing cognitive performance in RD, math disability, and ADHD. Figure 2.1 compares cognitive processes in children impaired in word recognition with and without ADHD, showing that the two types of disorders are distinct and separable (Pennington et al., 2009; Willcutt et al., 2013; Wood, Felton, Flowers,

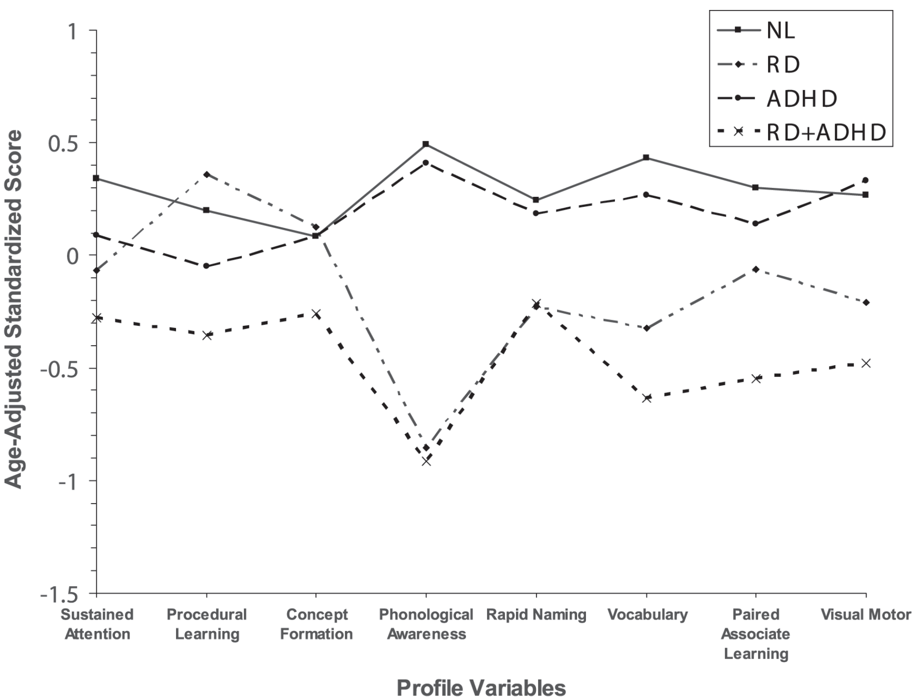

FIGURE 2.1. Profiles of cognitive performance by children with only reading disability (RD), only attention-deficit/hyperactivity disorder (ADHD), both RD and ADHD (RD + ADHD), and typically achieving children (NL). ADHD results in more severe RD, but the shape differences are not significant between the two reading-impaired groups. From Fletcher (2005, p. 310). Copyright © 2005 PRO-ED. Reprinted by permission.

& Naylor, 1991). LDs involving word recognition are consistently associated with deficits in phonological awareness regardless of the presence or absence of ADHD, whereas the effects of ADHD on cognitive functioning are variable, with primary deficits noted in processing speed, working memory, and other executive functions (Barkley, 2015; Pennington et al., 2009). Furthermore, ADHD appears relatively unrelated to phonological awareness tasks (Pennington, 2009). A child who meets the criteria for both an LD in reading and ADHD shows characteristics of both, but the impairments are more severe than those of a child with only one of the two disorders. This suggests that certain skills are impaired both by LD and by ADHD, so that when both disorders are present, these skills are doubly weakened. What these subgroups share most often are difficulties in processing speed for symbolic material (e.g., McGrath et al., 2011).

In studies examining the comorbidity of math disabilities and ADHD (see Figure 2.2), the groups overlap more than groups with RDs and ADHD. This likely reflects the role of executive functions (strategy use, procedural learning) and working memory in both math disabilities and ADHD. The behavioral phenotypes of the disorders share deficits in working memory, processing speed, and verbal comprehension, but each disorder also has unique correlates (Willcutt et al.,

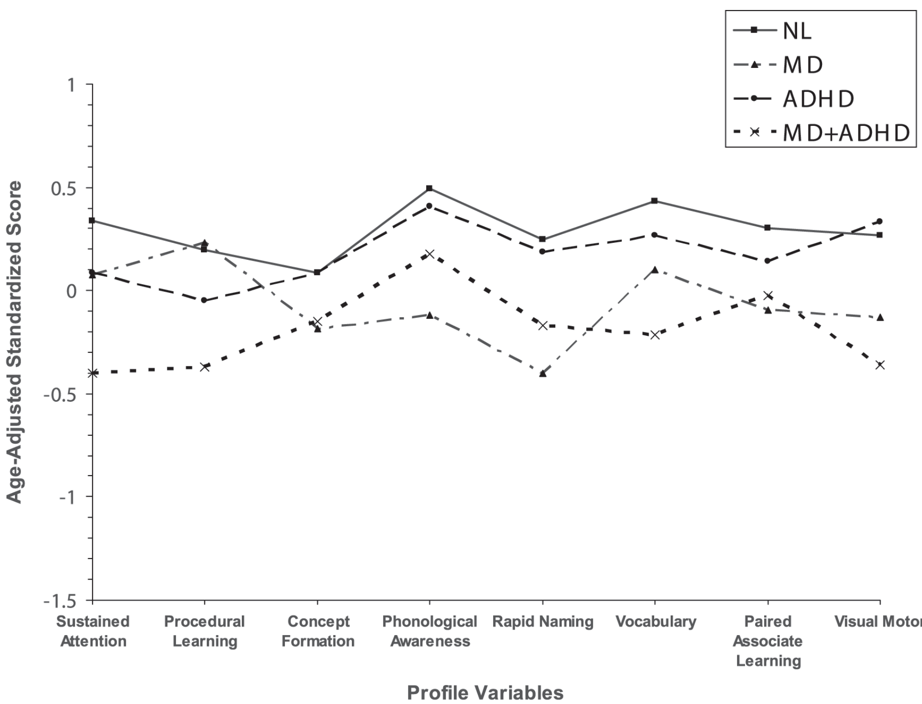

FIGURE 2.2. Profiles of cognitive performance by children with only math disability (MD), only attention-deficit/hyperactivity disorder (ADHD), both MD and ADHD (MD + ADHD), and typically achieving children (NL). ADHD results in more severe MD, but shape differences are not significant between the two math-impaired groups. From Fletcher (2005, p. 311). Copyright © 2005 PRO-ED. Reprinted by permission.

2013). The disorders are separable on dimensions involving attention and behavior, with individuals who meet criteria for both disorders showing characteristics of both disorders. When children are identified with written language difficulties, ADHD is common (Barkley, 2015), as are word-level reading problems. In most instances, these appear to be comorbid associations; a child with disabilities involving ADHD and a domain-specific LD appears like a child with ADHD through the behavioral lens, and like a child with LDs through the cognitive lens. However, when both lenses are considered simultaneously, the cognitive and academic deficits invariably appear more severe than the behavioral ones (Figures 2.1 and 2.2).

In a large study, Willcutt et al. (2013) compared cognitive performance in groups defined with only RD, only math disability, both an RD and a math disability, and a non-LD comparison group. All groups defined with LDs performed lower than the comparison group on most measures, with greater impairment in the group with both a reading and a math disability. Weaknesses in processing speed, working memory, and language comprehension were shared across all groups with LDs. However, the group with only a reading LD had weaknesses in phonological awareness and rapid naming. In contrast, only problems with set shifting were uniquely associated with math LDs. In another study making the same comparisons, Cirino, Fuchs, Elias, Powell, and Schumacher (2015) found that the group with both reading LD and math LD had the same weaknesses as the group with only reading or math LD, but they were more severe. Moll, Gobel, and Snowling (2015) compared verbal, visual–verbal, and visual number processing in children with only reading LD, only math LD, both reading and math LD, and typically developing children. Children with only RD were impaired only on verbal number tasks; children with only math LD were impaired across number tasks; and children with comorbid reading and math LD had deficits characteristic of both the other groups. They suggested that number processing in reading LD represented a phonological deficit, while math LD was associated with a more basic numerosity problem. These results support the correlated liabilities model of comorbidity because reading and math LDs have unique correlates, but share cognitive difficulties with processing speed, working memory, and language comprehension.

A final source of understanding of comorbidity comes from behavioral genetics research. These studies, which cut across potential domains of comorbidity, show that there are shared and unique genetic influences on the heritability of reading, math, and attention disorders. The shared influences have been articulated in the *continuity hypothesis* (Plomin & Kovas, 2005), which indicates that different characteristics of LDs and ADHD are associated with some of the same "generalist" genes: (1) the same genes influence high and low levels of academic abilities; (2) many of the genes associated with one aspect of LDs (e.g., phonological processing) also influence other aspects of this LD (e.g., vocabulary); and (3) some of the genes that influence one LD (e.g., RD) overlap with those that influence other LDs (e.g., mathematics disability) and ADHD.

We discuss these genetic issues in more detail in Chapter 6. It is important to remember that these correlates represent dimensional attributes of these domains and are correlated. The key to dealing with comorbidity in research and practice is to ensure that individuals are broadly assessed across domains so that the shared and unique components of academic and behavioral domains can be specified, especially if the goal is to develop an effective intervention program.

U.S. Public Policy

The difficulties with classification and definition have made policy formulations more difficult. Whereas researchers struggle with these fundamental issues, policymakers want approaches that are not complex and serve as vehicles for supporting services and allocating resources. It is interesting to examine U.S. public policy as it has evolved over the past 40 years to reflect the complexity of LDs.

Statutory Definition

Despite problems with definitions, through advocacy the concepts underlying emerging frameworks for LDs were eventually represented in U.S. public policy in 1968, forming what is still *the current statutory* definition of LDs in special education legislation with the adoption of Public Law 94–142 (Education of All Handicapped Children Act) in 1975:

> The term “specific learning disability” means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in an imperfect ability to listen, speak, read, write, spell, or to do mathematical calculations. The term includes such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. The term does not include children who have learning disabilities, which are primarily the result of visual, hearing, or motor handicaps, or mental retardation, or emotional disturbance, or of environmental, cultural, or economic disadvantage. (U.S. Office of Education, 1968, p. 34)

Regulatory Definition

The statutory definition did not provide criteria for defining LDs as an entity. In 1977, the U.S. Office of Education (now the U.S. Department of Education) provided the first regulatory definition of LDs, which was remarkable because it moved the underlying classification model from a neurological framework focusing on special signs indicative of presumed neurological dysfunction (e.g., perceptual–motor problems, letter and number reversals) to a psychometric framework focusing on cognitive discrepancies:

> [A child must exhibit] severe discrepancy between achievement and intellectual ability in one or more of the areas: (1) oral expression; (2) listening comprehension; (3) written expression; (4) basic reading skill; (5) reading comprehension; (6) mathematics calculation; or (7) mathematic reasoning. The child may not be identified as having a specific learning disability if the discrepancy between ability and achievement is primarily the result of: (1) a visual, hearing, or motor

> handicap; (2) mental retardation; (3) emotional disturbance; or (4) environmental, cultural, or economic disadvantage. (U.S. Office of Education, 1977, p. G1082)

The use of IQ–achievement discrepancy as an inclusionary marker for LDs had a profound impact on how LDs were conceptualized. There was some research at the time validating an IQ–achievement discrepancy method (Rutter & Yule, 1975), but these findings have not stood up over time (see Chapter 3). However, researchers, practitioners, and the public continued to assume that such a discrepancy was a marker for specific types of LDs that were unexpected and categorically distinct from other forms of underachievement. The impact of IQ–achievement discrepancy was clearly apparent in the regulations concerning LD identification in the 1992 and 1997 reauthorizations of the Individuals with Disabilities Education Act (IDEA), the name of the general special education statute that followed in subsequent reauthorizations of Public Law 94-142. The statute maintained the definition of LDs formulated in the 1968 legislation, and the regulations maintained the 1977 procedures until the 2004 reauthorization of IDEA.

IDEA 2004

In the most recent revision of IDEA (U.S. Department of Education, 2004), the regulatory definition of LDs was revised for the first time in 40 years. This occurred because the U.S. Congress passed statutes that permitted alterations of the 1977 regulations, indicating specifically that (1) states could not require districts to use IQ tests for the identification of students for special education in the LDs category, and (2) states had to permit districts to implement identification models that incorporated response to scientifically based instruction. In addition, the statute indicated that children could not be identified for special education if poor achievement was due to lack of appropriate instruction in reading or math, or to limited proficiency in English:

> A State must adopt . . . criteria for determining whether a child has a specific learning disability. . . . In addition, the criteria adopted by the State:
>
> - Must not require the use of a severe discrepancy between intellectual ability and achievement for determining whether a child has a specific learning disability. . . .
> - Must permit the use of a process based on the child's response to scientific, research-based intervention; and
> - May permit the use of other alternative research-based procedures for determining whether a child has a specific learning disability. (U.S. Department of Education, 2006, p. 46786)

In response to the statute, the Office of Special Education and Rehabilitative Services (OSERS) within the U.S. Department of Education (2006) published federal regulations for the revision of rules for the identification of LDs. The revision was partly a response to the converging scientific evidence bearing on the limited value of IQ–achievement discrepancies in identifying LDs (see Chapter 3). At the