

Dyslexia: Why Precise Definitions Are Important and How We Have Achieved Them

by Jack M. Fletcher and G. Reid Lyon

Of all the definitions of different types of learning disability (LD), dyslexia stands out as a type of LD for which clear criteria for identification have been specified (Lyon, 1995; Lyon, Shaywitz, & Shaywitz, 2003). The International Dyslexia Association (IDA) has taken the lead over the past decade in improving the definition of dyslexia by arguing successfully for anchoring the definition in evidence-based inclusionary characteristics that represent specific criteria for identification, such as a word reading problem. Specifically, dyslexia is more precisely identified and distinguished from other types of LD on the basis of difficulties with accurate and fluent reading of single words and spelling. When children with a well-defined form of LD can be reliably identified and differentiated from children who are typically developing or have other disabilities, studies can then be undertaken of the cognitive, linguistic, and neurobiological correlates of the disorder, along with interventions that are tied to that specific type of LD. The advances in dyslexia research and treatment in the past two decades are directly linked to studies that identify dyslexia on the basis of word-level reading skills (Fletcher, Lyon, Fuchs, & Barnes, 2007).

Historical Perspective

Although some would characterize IDA's definition cited by Louisa Moats in this issue's Theme Editor's Summary as narrow, the need for greater definitional precision is non-negotiable if we are to ever fully and effectively understand dyslexia. Historically, one of the most significant and persistent problems impeding progress in the field of LDs (including dyslexia) has been the difficulty in establishing a precise inclusionary definition that provides specific criteria for identifying dyslexia, such as a word reading problem, as part of a broader framework for 1) identification of different types of LDs and 2) recognizing distinctions and interrelationships between LD (including dyslexia) and other learning, sensory, social, and behavioral disorders. In the absence of this framework, the various definitions of LDs (including dyslexia) developed over the past two decades have been characterized by vague and ambiguous identification criteria based on little scientific research (Fletcher et al., 2007). The inability of historical definitions of LDs in general, and dyslexia in particular, to improve identification, distinguish different types of LDs from each other and from other disabilities, foster communication among professionals, and predict response to different instructional approaches, represents an overreliance on exclusionary criteria that only tell us what conditions aren't LD or dyslexia and the inappropriate use of an IQ-achievement discrepancy model in the identification process.

During the last 20 years, dyslexia has become an example of a form of LD that has seen rapid scientific advances in understanding the etiology, developmental course, and instructional response characteristic of the disorder. We now know that the

principal cognitive impairments associated with dyslexia involve different aspects of phonological processing and we have developed sophisticated tools for measuring these skills. We know a great deal about neurobiological factors involved in dyslexia through structural and functional neuroimaging studies. Genetic investigations are flourishing and the array of data on both preventative and remedial interventions is extensive (Fletcher et al., 2007; Shaywitz, 2004). It is possible to construct an inclusionary definition that contains the characteristics noted above, so that we can reliably determine that a person has dyslexia; know a great deal about cognition and the brain; and have a good idea of the sort of intervention that should be considered depending on the age and reading/writing levels of the child. There is more to be learned, but we now know a great deal.

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Definitions and Classifications

To understand the importance of definition, it is important first to understand the explicit linkages of classification, definition, and identification. Classifications are abstract conceptual organizers that order, in a hierarchy, a large group of members (e.g., children) into a number of progressively smaller, more homogeneous groups (LD vs. nonLD, reading vs. math LD, word-level (dyslexia) vs. text-level (comprehension) reading difficulties). The differentiation of groups is based on a set of attributes that indicate how individual differences relate to membership in a larger or smaller subgroup. When individuals are assigned to different subgroups within a classification, this process is based on a definition that encompasses the defining attributes, representing criteria for *identification*. If we "diagnose" dyslexia, relying on the characteristics included in the IDA definition, we have identified the person as a member of the "dyslexic subgroup" of our overarching classification of LD. We then can communicate with other clinicians about the individual with dyslexia, predict response to instruction, or organize our research around groups of people who share or do not share subgroup membership.

Just because we can create classifications and subgroups does not mean that the subdivisions are reliable or valid. When we identify people into a classification subgroup, we have

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essentially exercised a hypothesis. We can validate the classification by comparing different subgroups on specific cognitive, linguistic, and neurobiological characteristics, and instructional response (Morris & Fletcher, 1988). The key methodological issue is that once the criteria for subgroup membership are determined, comparisons must be made on variables not used to assign the person into a particular subgroup. For example, if dyslexia is defined as a word-level reading disorder and then we compare people on the defining attributes of dyslexia (e.g., accurate and fluent word reading, spelling), differences between dyslexic and non-dyslexic individuals will emerge because these measures were used to create the subgroups. It is only when comparisons of subgroups are made on attributes that were *not used* in the initial classification that we can evaluate the validity of a classification. An example is defining dyslexia based on identification criteria like accurate and fluent word reading and spelling and the reliable and predictable differences that emerge on cognitive phonological skills, genetic, and brain imaging assessments that are not used to create the classification.

Why Is Dyslexia Difficult to Define?

There are three issues that have made dyslexia and other LDs hard to define and that, almost by default, led to heavy reliance on definition by excluding people with characteristics strongly associated with low achievement (e.g., mental retardation, economic disadvantage) when researchers and practitioners first sought to define these disorders. First, dyslexia, like LD, is an unobservable construct that cannot exist independently of our imperfect efforts to measure it. Self-reports of individuals who are frustrated by reading and spelling, although clinically important for counseling and management, are not sufficiently objective to support a science of definition. Second, dyslexia is dimensional; a person can be "a little" or severely dyslexic and everything in between. Where we "draw the line" for who is and who is not dyslexic is a context-based decision dependent on arbitrary attempts to divide this dimension. Third, it has been difficult to pinpoint the essential inclusionary and exclusionary characteristics that should be used for identification. Each of these points is elaborated below.

Dyslexia is an unobservable construct

The essential concept underlying any form of LD is *unexpected underachievement*. This term connotes any individual who is not able to master an academic skill generally expected of others with similar aptitude and adequate opportunity to learn. Thus, initial attempts in the early history of efforts to identify LD simply excluded known causes of low achievement (sensory and physical problems, mental retardation, emotional difficulties, economic disadvantage, and inadequate instruction). These efforts were not successful because the characteristics of the resultant subgroup were too heterogeneous. In addition, some exclusionary criteria have been difficult to justify or even measure because they commonly co-occur with LD. Chief among these are behavioral and emotional disorders.

In addition, some definitional exclusions have not held up well in objective research, such as the assumption that economically disadvantaged children cannot be dyslexic. This state of affairs (reliance on exclusionary criteria to define a disorder because it is not directly observable) is quite common in psychological (and even medical) diagnoses; other unobservable constructs include IQ and Attention-Deficit/Hyperactivity Disorder AD/HD (Francis et al., 2005).

Dimensional nature of LD

The second issue in developing a precise definition concerns the dimensional nature of LDs, including dyslexia. The traits representing LDs likely exist on a continuum and do not represent discrete categories (Ellis, 1984). Research from several countries supports the hypothesis that reading, spelling, and other kinds of academic achievement are normally distributed in the population (Fletcher et al., 2007; Shaywitz, 2004). Because reading disabilities are by definition at the lower end of a normal continuum of reading ability, a researcher, administrator, or policy maker must decide how many individuals to include in the category. Do we include 5% of the most severely affected, or the lower 25% called "below average," or the 40% whose reading, writing, and language skills are weak to poor?

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Given that reading ability is normally distributed, the challenge is to determine reliably where on this continuum dyslexia resides. Such decisions are inherently arbitrary if a specific score is used to subdivide the distribution into those with or without dyslexia. The decision about the cut point demarcating dyslexia, for example, from "normal reading ability" affects both the assessment of low achievement and the determination of an individual's response to instruction (Francis et al., 2005). In research, which is based on the average performances of groups with and without dyslexia, the use of cut points is not a major problem because individuals clustered around a particular cut point are similar and measurement error is expressed as the variability around the statistical mean. However, if we must categorize people for access to legal, educational, or medical services, some room for variable test performance must be made. People who are identified as "dyslexic" may move above and below the selected test score on repeated assessments because of the measurement error of the tests and other factors (Stuebing et al., 2002).

These problems are related to efforts to measure dyslexia with tests and do not necessarily apply to the diagnostic decisions made by experts, who must formulate recommendations for an individual based on many kinds of information, includ-

ing the knowledge of the environment in which the individual functions. In clinical and educational practice, the measurement issues described above can be addressed by the use of multiple assessments, procedures that take into account variability around the test score used to subdivide the distribution and provide a range of test scores, and the use of multiple criteria for identifying members into the subgroup. Since unexpected underachievement cannot be adequately defined solely by exclusionary criteria, the critical question has been what kinds of inclusionary and exclusionary criteria are needed to better define LD.

Inclusionary and exclusionary characteristics

Aptitude-achievement discrepancy. One prominent hypothesis is that a significant discrepancy between IQ and achievement is a marker for unexpected underachievement (Rutter & Yule, 1975). This hypothesis has not held up, largely because individuals with reading difficulties with and without discrepancies between IQ and reading achievement do not differ with respect to essential cognitive and linguistic abilities known to be critical to the reading process (e.g., phonological awareness) once pervasive limitations in cognitive abilities (i.e., mental retardation) have been excluded (Stuebing et al., 2002). Indeed, it has been difficult to demonstrate that IQ has a strong relation with LD and dyslexia, including intervention response (Fletcher et al., 2007). Our field made a major conceptual error in allowing IQ-achievement discrepancies to define children's access to specialized instruction.

Academic strengths and weaknesses. Another hypothesis is that assessments of academic skills that allow the partitioning of people with LD into subgroups representing different problems with reading, math, and writing skills represent a set of inclusionary criteria. As the example of dyslexia shows, there is great support for this hypothesis. However, academic assessments only tell us who has low achievement. They do not tell us that the low achievement is unexpected or why it might be unexpected. To many, academic assessment criteria alone seem like an incomplete and unsatisfactory way to identify dyslexia. But let us consider what role other kinds of assessment should and should not play.

Cognitive skills. Another proposal to measure unexpected underachievement as an inclusionary criterion has been to incorporate assessments of cognitive and linguistic skills, such as phonological awareness, rapid naming, and working memory into the identification process. This position is predicated to some degree on the Individuals with Disabilities in Education Act (IDEA) statutory definition, which associates language and academic disorders with "psychological processes." Similarly, the IDA definition indicates that the word-level reading disorder is due to an impairment in phonological processing. So measuring cognitive processes may indicate that the problem with achievement is unexpected if the person shows an academic disorder and a cognitive processing problem.

There are three problems with this argument. First, just because the IDEA statute mentions psychological processes does not mandate automatic assessment of cognitive skills. Such a requirement has never been part of the regulations because there is no converging scientific evidence that such

measurement is important to the identification of LDs, including dyslexia. Would we identify children as dyslexic solely because they demonstrated a phonological processing problem and no problem with word reading or spelling? That would be unwise, because identifying LD solely on the basis of a cognitive deficit yields many false positive errors (Torgesen, 2002). Many children show processing weaknesses on various tests but do not show the defining problems of dyslexia—poor word recognition and spelling. *Achievement* is unexpected in LD, whereas weaknesses in cognition are actually quite common and can be of little practical import. Why doesn't a deficit in word recognition or spelling demonstrate a cognitive deficit?

Second, once we assess academic achievement, what value do assessments of cognitive processes add that is unique? For example, individuals with dyslexia (by definition) have word reading and spelling problems. Research converges on the finding that, on average, people with word reading and spelling problems have significant difficulties with phonological processing. As such, the assessment of phonological processing abilities does not add to intervention planning or prediction of outcomes beyond the measurement of word reading and spelling. It is not that phonological processing does not correlate with word reading and spelling; it is just that there is nothing unique to explain once we have measured word reading

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and spelling. Such assessments will not establish that the word reading problem is unique since phonological processing relates to word reading and spelling across age, language, and social class. We can reduce the time and expense involved in the identification of dyslexia by assessing only those skills that reflect the severity of the reading and spelling deficit and have the capability to predict outcomes. The exception, of course, is that the assessment of phonological processing in young children prior to the onset of formal reading instruction may identify children who are at risk for reading and spelling problems.

This leads to the third issue, which is the faulty assumption that the presence of a cognitive deficit affirms that the achievement deficit is biological in origin (Hale, Naglieri, Kaufman, & Kavale, 2004). Even economically disadvantaged children with word reading problems respond to explicit reading and writing instruction, display phonological processing and related language problems, and fail to activate the temporoparietal areas of the left hemisphere in a functional neuroimaging scan when the activation task involves word reading. It is our position that dyslexia results from an interaction of neurobiological factors

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that make the brain at risk and environmental factors that moderate this risk. The environmental factors include the language and literacy environment in which a person develops as well as issues pertaining to schooling and instruction. The argument that cognitive and linguistic assessments should be used to establish the neurobiological basis of any LDs in the identification process results in an expensive and time-consuming set of procedures that will tell us much less than measuring an individual's response to instruction – a topic that we address in the next section.

Instructional response. These examples show that low achievement is necessary but not sufficient to identify LDs, including dyslexia. Discrepancies with IQ and other academic and cognitive skills do not adequately measure “unexpected underachievement.” Thus, additional criteria are necessary to measure this construct. We take the position that the most important additional criterion is inadequate response to high quality instruction. Most definitions of dyslexia and other LDs indicate that LDs should not be identified in the absence of adequate instruction; for example, the IDA definition of dyslexia indicates that the problem with word reading and spelling is unexpected in relation to “conventional classroom instruction.” Since instructional response can be measured by assessing

particularly sensory impairments and pervasive cognitive disabilities. Exclusions such as emotional disturbance and economic disadvantage should be more formally assessed and are probably less important in the identification of children for services, which is also reflected in the IDA definition. Terms like *dyslexia*, or at least *word-level reading disability*, should be used because these terms facilitate communication and lead to more rapid provision of interventions tied to different forms of LD. The key to effective intervention for dyslexia is to provide evidence-based intervention as early as possible. A precise definition with clear inclusionary and exclusionary characteristics minimizes the amount of time and the cost of assessment, maximally benefitting all children struggling to learn to read.

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growth in academic skills in relation to attempts to teach the individual, which includes assessments of the quality of the instruction, the measurement of inadequate response can be used to identify individuals for whom instruction is adequate, but who are hard to teach (Fuchs & Fuchs, 1998). As such, inadequate instruction is not an exclusionary criterion; rather, since it is formally assessed, it is an *inclusionary* criterion. People are identified as LD when they demonstrate low achievement AND intractability (limited positive response) to appropriate instruction. The next step in research is to systematically evaluate the cognitive, neurobiological, and instructional characteristics of individuals who explicitly meet these criteria for dyslexia and other LDs.

Conclusions

As indicated by the IDA definition in this issue's Theme Editor's Summary by Louisa Moats, dyslexia can be precisely defined using a multicriteria definition that includes specific inclusionary characteristics involving single word reading and spelling and an assessment of instructional response. Other disabilities should be eliminated as causes of low achievement,

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