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The Critical Role of Instructional Response for Identifying Dyslexia and Other Learning Disabilities

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Abstract

This paper addresses the nature of dyslexia and best practices for identification and treatment within the context of multi-tier systems of support (MTSS). We initially review proposed definitions of dyslexia to identify key commonalities and differences in proposed attributes. We then review empirical evidence for proposed definitional attributes, focusing on key sources of controversy, including the role of IQ, instructional response, as well as issues of etiology and immutability. We argue that current empirical evidence supports a dyslexia classification marked by specific deficits in reading and spelling words combined with inadequate response to evidence-based instruction. We then propose a "hybrid" dyslexia identification process built to gather data relevant to these markers of dyslexia. We argue that this assessment process is best implemented within school-wide MTSS because it leverages data routinely collected in well-implemented MTSS, including documentation of student progress and fidelity of implementation. In contrast with other proposed methods for LD identification, the proposed "hybrid" method demonstrates strong evidence for valid decision-making and directly informs intervention.

The Critical Role of Instructional Response for Identifying Dyslexia and Other Learning Disabilities

There is renewed interest in dyslexia screening, assessment, identification, and treatment at the local, state, and federal level of the U.S., as well as internationally. In the U.S., advocacy groups have successfully lobbied for the creation and implementation of dyslexia-specific processes for the identification and treatment of students with dyslexia in at least 42 states (Petscher et al., 2019). However, these state-specific processes are also associated with substantial variation in identification and practice for children at-risk for or identified with dyslexia. This variation in practice and advocacy often reflects misconceptions about the essential nature of dyslexia, including: (1) definitional variability and the process by which definitions are derived from empirically validated scientific classifications (Cassidy, 2019a; Elliot & Grigorenko, 2014; Tolleson, 1997); and (2) the neurobiological and environmental basis for dyslexia, especially when considering the role of reading instruction (British Dyslexia Association, 2007; Cassidy, 2019a;). These misconceptions may result from a tendency among well-meaning dyslexia advocates to separate research and practice around dyslexia from the broader corpus of research around specific learning disabilities (SLDs) and reading disabilities more broadly (Cassidy, 2019b; Yale Center for Dyslexia & Creativity, 2017). As a result, the presence of separate legislation implies that dyslexia identification and treatment practices should be independent of those outlined in the Individual with Disabilities in Education Act (IDEA, 2004), the legislation that guides special education in the U.S. It also implies that other initiatives involving improved reading skills in all children, especially those that involve enhanced general education instruction, do not apply or are somehow inadequate for meeting the needs of students at-risk for dyslexia, especially in the early grades. In the present paper, we

review research relevant to the misconceptions outlined above. We conclude that dyslexia identification and treatment processes should be built within well-implemented multi-tier systems of support (MTSS) that include universal screening, evidence-based Tier I instruction, preventative intervention, ongoing progress monitoring for high-risk students, and mechanisms to intensify interventions for students who demonstrate inadequate response to quality instruction similar to those that occur with other SLDs.

Definitions of Dyslexia

We begin with two current U.S. definitions of dyslexia, beginning with a newer definition that originated in the U.S. Senate, the First Step Act definition (Cassidy, 2019b). We also focus on the well-known International Dyslexia Association definition (Lyon, Shaywitz, & Shaywitz, 2003) that is used in many state-level definitions of dyslexia. To ensure that our discussion of definitions is not uniquely North American, we also consider a definition of dyslexia previously put forth by the British Dyslexia Association [BDA] (2007) and another definition of dyslexia in the United Kingdom Rose Report (Rose, 2009). Finally, we will briefly discuss how dyslexia is addressed in other diagnostic nomenclatures. We will consider the classification hypotheses that underpin these definitions, highlighting the commonalities and differences of different definitions. Where differences emerge, we evaluate the evidence for classifications based upon these proposed criteria. To do this, we follow models for classification research outlined by Morris (1998). These models identify definitional attributes based on the definition emanating from the classification and compare the hypothesized groups' performance on important external attributes (e.g., subsequent academic outcomes, cognition, neurobiological characteristics). To the extent that the proposed criteria are meaningful and scientifically valid, the resulting groups should be different in educationally meaningful ways.

First Step Act definition

"*Dyslexia means an unexpected difficulty in reading for an individual who has the intelligence to be a much better reader, most commonly caused by a difficulty in the phonological processing (the appreciation of the individual sounds of spoken language), which affects the ability of an individual to speak, read, and spell* (Cassidy, 2019b)."

IDA definition

"*Dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge* (Lyon et al., 2003, p. 2)."

United Kingdom definitions

The British Dyslexia Association (BDA) previously defined dyslexia as "*a specific learning difficulty which mainly affects the development of literacy and language-related skills. It is likely to be present at birth and to be lifelong in its effects. It is characterised by difficulties with phonological processing, rapid naming, working memory, processing speed, and the automatic development of skills that may not match up to an individual's other cognitive abilities. It tends to be resistant to conventional teaching methods, but its effects can be mitigated by appropriately specific intervention, including the application of information technology and supportive counselling.*"(British Dyslexia Association, 2007).

The Rose Report (2009), a major United Kingdom national report, gave a somewhat different definition: *"Dyslexia is a learning difficulty that primarily affects the skills involved in accurate and fluent word reading and spelling. Characteristic features of dyslexia are difficulties in phonological awareness, verbal memory and verbal processing speed. Dyslexia occurs across the range of intellectual abilities. It is best thought of as a continuum, not a distinct category, and there are no clear cut-off points. Co-occurring difficulties may be seen in aspects of language, motor co-ordination, mental calculation, concentration and personal organisation, but these are not, by themselves, markers of dyslexia. A good indication of the severity and persistence of dyslexic difficulties can be gained by examining how the individual responds or has responded to well-founded intervention (p. 9-10)."*

Other definitions

Before comparing these definitions, it is instructive to consider other proposed definitions of dyslexia. Perhaps best known historically is the World Federation of Neurology definition: *"A disorder manifested by difficulties in learning to read despite conventional instruction, adequate intelligence, and socio-economic opportunity. It is dependent upon fundamental cognitive disabilities, which are frequently of constitutional origin"* (Critchley, 1970, p. 11).

This definition is similar to the one employed by the International Classification of Diseases-10 (World Health Organization, 2013) and the now discontinued DSM-IV definitions of academic skills disorders (APA, 1994). Both relied on discrepancies between IQ and achievement as a marker for the unexpected nature of dyslexia. In the DSM-5 (American Psychiatric Association, 2013), definitions based on IQ-achievement discrepancy criteria were rejected due to a lack of evidence for the validity of the classification. However, an inclusionary threshold specifying that IQ had to be within two standard deviations of average was included as

an inclusionary criterion to differentiate an intellectual disability from a learning disability. The DSM-5 identified difficulties in word-reading accuracy, reading fluency, and reading comprehension as specifiers for a reading disability. Difficulties with the accuracy and fluency of single word-reading skills were linked to dyslexia, but it was not a specific category in the DSM-V. IDEA (2004) also does not explicitly address dyslexia, but identifies a category of "basic reading skills." Both the DSM5 and IDEA (2004) identify lack of appropriate instruction as an exclusionary condition for SLD.

Comparing current definitions

Tonnessen (1997) argued that definitions of dyslexia should be formulated and treated as hypotheses. He organized diverse definitions around three principles on which they may be constructed: (1) the symptom principle; (2) the causality principle; and (3) the prognosis principle (p. 80). In the sections that follow, we compare and contrast definitions along each of these principles, while adopting updated language more consistent with contemporary discussions of dyslexia. We then review current empirical evidence for models built on definitional attributes that differ across these three principles.

Attributes of dyslexia. The primary manifestation of dyslexia is difficulty accurately and fluently reading text, and difficulty with spelling—foundational skills that involve the ability to read and spell words. All four of the more recent definitions outlined above include reference to difficulties in this domain. The First Step and IDA definitions for dyslexia further specify that this difficulty in reading is *unexpected*, indicating the existence of cognitive strengths as a marker of unexpectedness. The BDA definition and the Rose Report do not refer to the concept of unexpectedness, which is uniquely North American (Elliot & Grigorenko, 2014) and most likely related to broader formulations of SLD emanating from Kirk (1963). Among the

definitions reviewed, only the First Step definition and World Federation of Neurology definition identify a role for intelligence as an attribute of dyslexia. This role was eliminated in the DSM-V nomenclature and IDEA 2004 moved away from older regulatory definitions that required a discrepancy in IQ and achievement for eligibility. For example, the First Step definition indicates "having the intelligence to be a much better reader" as a primary marker of dyslexia. In contrast, the IDA definition allows for unexpectedness in reading difficulties in relation to other cognitive variables, such as math. While all of these definitions can be broadly understood as cognitive discrepancy models, the IDA and BDA definitions allow for a more flexible framework and reflect the fact that many children with dyslexia—but not all—will demonstrate strengths in different cognitive domains.

In an explicit rebuke of definitions that rely on normal intelligence as a marker of dyslexia, the Rose Report definition emphasizes that dyslexia occurs across a full range of intelligence scores (with intellectual disability as exclusionary). The DSM-5 definition of SLD also dropped the notion of intelligence as a key attribute, although all definitions would exclude those with intellectual disabilities as exclusionary of dyslexia or SLD.

Definitions that rely on attributes like "having the intelligence to be a better reader" have been criticized as a capacity notion of dyslexia and other SLDs. These concepts are often described as "milk and jug thinking" (Share, McGee, & Silva 1989) because of earlier work by Sir Cyril Burt (1937), who stated that "*Capacity must obviously limit content. It is impossible for a pint jug to hold more than a pint of milk and it is equally impossible for a child's educational attainment to rise higher than his educable capacity"* (p. 477). However, the idea that measured intelligence determines how much a child can learn is an unproven assumption. It has not been shown that IQ sets an upper or lower limit on educational outcomes. Achievement and IQ are

correlated, but in learning disabilities and specifically dyslexia, they are “uncoupled.” (Ferrer et al., 2010). Although Ferrer et al. interpret these findings to support cognitive referencing of achievement to IQ, the evidence we review below suggests that this uncoupling indicates no relation between IQ and dyslexia. We will return to questions of the validity of IQ-discrepancy methods below.

Etiology of dyslexia. In Tonnessen’s (1997) review of definitions, he would consider the comparisons of reading and cognitive attributes examples of symptoms (see Elliott & Grigorenko, 2014). He also pointed out that many definitions have an etiology specifier. While historically important, the World Federation of Neurology definition has been subject to considerable criticism. One central concern centered on its attempt to specify etiology (i.e., constitutional origin, a concept that dates as far back as Still [1902]). In response to this longstanding criticism, most recent definitions do not specify etiology. Etiological content is absent from the ICD-10, DSM-5, and IDEA statutory and regulatory definitions. The IDA definition was specifically intended to address concerns about etiology and other criticisms of the World Federation of Neurology definition and serve as a replacement (Lyon et al., 2003). In this sense, the First Step definition is conceptually more aligned with the World Federation of Neurology definition than with more contemporary definitions. Similar to the First Step and IDA definitions, the BDA definition specifies general etiological origins in the brain, but includes a statement that dyslexia is present at birth. This concept of dyslexia was also implicit in an influential press release by Sen. Cassidy (2019a), who questioned whether dyslexia screening needed to occur more than once and characterized methods that rely on inadequate instructional response as a marker of dyslexia as “blaming the teacher.” This simplistic view of the difficulties schools experience in implementing reading instruction is widely understood as a systemic

problem related to inadequate teacher preparation and post-service support, as well as outright rejection of the science of reading (Seidenberg, 2017).

Several definitions justifiably point to the important role of phonological processing as the proximal cause for these difficulties (Liberman, 1996), but these deficits are best understood as symptoms in Tonnessenn's review. However, some definitions use conditional language regarding the role of phonological processing in causing reading deficits (e.g., "most commonly caused", "these difficulties typically result") and others expand the domains in which impaired cognitive processing may occur (e.g., working memory). This conditional language within the definitions leaves open the possibility that a child with dyslexia may not demonstrate specific deficits in phonological processing and that there may be other proximal causes for the reading difficulties. However, there is little evidence suggesting that phonological processing problems in isolation of a reading and spelling measures can be used to reliably identify dyslexia and other SLDs (Torgesen, 2002). On average, children identified with dyslexia show significant difficulties with phonological processing, but there are always exceptions that may reflect measurement error or often debated ideas about additional causal factors, such as visual processing (see Fletcher et al., 2019, Chapter 6, for a detailed discussion of the evidence for and against these hypotheses).

Instructional factors. The third component of Tonnessen (1997) is prognosis, which relates to hypotheses about the persistence of the disorder. In the Rose Report and the BDA definitions, dyslexia is viewed as a lifelong disorder. In recent years, definitions of dyslexia and other SLDs have foregrounded instructional factors as definitional attributes. For example, both the Rose Report definition and IDA definition specify that dyslexia cannot be due to the failure to provide effective classroom instruction, a recognition that ineffective reading instruction will

lead to reading difficulties for many children. This concept is also present in broader definitions of LDs, including in the regulatory guidance that accompanied IDEA (2004), which mandates that identification procedures include documentation of adequate instructional opportunity. In contrast, the First Step definition does not include reference to instructional factors, instead (as we discussed above) criticizing consideration of instructional factors (Cassidy, 2019a).

The consideration of instructional opportunity is actually intended to rule out reading difficulties primarily due to instructional methods (both in general education classrooms and interventions) that do not teach the alphabetic principle explicitly, use phonics incidentally, and do not advance those students most at risk (NICHD, 2002; International Literacy Association, 2019). As we argue below, documenting the appropriateness of instruction is a key factor in the identification of dyslexia and other SLDs, required in IDEA (2004), and highlighted in the Rose Report.

Summary of definitional variation

There is no doubt that dyslexia exists as the lower part of a continuous distribution of basic reading skills. Comparisons of classification hypotheses based on external variables not used to form the groups support the validity of classifications of dyslexia and other LDs based on differences in academic skills, instructional response, and other attributes (Fletcher et al., 2019). Controversies primarily arise when hypothesizing a group of children with dyslexia who are different from other children with decoding and spelling problems who are not considered dyslexic due to the absence of hypothesized markers (e.g., a cognitive discrepancy) or different etiologies (e.g,, no phonological processing deficits). It is because of these controversies that researchers such as Elliot and Grigorenko (2014) questioned the value of the term dyslexia. Elliot and Grigorenko do not question the existence of a group of children with significant

difficulties in reading words and spelling, just the classifications that attempt to subdivide children into dyslexic and non-dyslexic groups based on IQ, cognitive discrepancies, and other hypothesized markers of unexpectedness or etiology.

It is on these central questions about the role of IQ and cognitive discrepancies that much of the debate around the identification of dyslexia and other SLDs hinges. Some definitions, like the First Step and the BDA definition, seem to mandate use of an IQ test as part of the criteria. This raises the question of whether IQ is directly related to dyslexia as a defining attribute. In addition to discrepancies of IQ and achievement, other definitions seem to indicate that a cognitive discrepancy of some sort should be present, such as a discrepancy between phonological processing and other cognitive and academic skills. This type of definition would indicate that the identification of dyslexia requires a broad assessment of cognitive skills. Other definitions imply that an assessment of instructional response is necessary, representing an alternative instructional conceptualization of dyslexia and SLD. In the next section, we focus upon the role of IQ, cognitive discrepancies, and instructional response as key attributes of a definition of dyslexia. We also discuss the role of etiological components of the definition.

Identification Methods for Dyslexia and SLDs

IQ-achievement discrepancy

Different identification processes have been proposed to operationalize a cognitive discrepancy as a marker of unexpectedness (Fletcher et al., 2019). Traditionally, a cognitive discrepancy has been marked by a difference (e.g., absolute difference, regression adjusted difference) between the child's full-scale IQ (an indicator of cognitive ability) and his or her achievement (in the case of dyslexia, reading achievement). Despite a long history in special education practice in the U.S., in current practice IQ–achievement discrepancy methods are

largely discredited and few advocate for their continued use (Bradley, Danielson, & Hallahan, 2002). Numerous studies have documented that IQ-achievement methods are unreliable for identifying individuals due to differences in measurement occasion (e.g., imperfect test-retest reliability), differences in measures selection, and differences in the calculation of a significant discrepancy (Francis et al., 2005; Macmann, Barnett, Lombard, Belton-Kocher, & Sharpe, 1989; Stuebing et al., 2002).

Problems with reliable identification are not unique to IQ-achievement discrepancy methods (see below). A more significant issue is that there are very few studies to support the validity of an IQ-achievement discrepancy or even level of IQ (excluding intellectual disability) as an inclusionary criterion for dyslexia or other SLDs. Students with reading difficulties--with and without an IQ–achievement discrepancy—are largely similar on theoretically important, external dimensions, including their behavioral, cognitive, and academic performance (Hoskyn & Swanson, 2000; Stuebing et al., 2002) or their neurobiological profiles, as demonstrated in neuroimaging studies of children with reading difficulties with and without reading an IQ-achievement discrepancy (Simos, Rezaie, Papanicolaou, & Fletcher, 2014; Tanaka et al., 2011; but see Hancock, Gabrieli, & Hoeft, 2016). More generally, IQ is not a stronger marker of prognosis (Shaywitz et al., 1999) or growth in response to reading interventions (Stuebing et al., 2009).

Processing strengths and weaknesses

In recent years, some in the U.S. school psychology community have begun to propose more complex approaches for the documentation of a cognitive discrepancy that rely on multiple intraindividual comparisons (e.g., Flanagan, Ortiz, & Alfonso, 2007; Hale & Fiorello, 2004; Naglieri, 2010). These methods, commonly referred to as Patterns of Processing Strengths and

Weaknesses approaches (PSW methods) generally hold that deficits in specific cognitive processes in the presence of other, unrelated cognitive strengths can serve as a marker of unexpectedness and establish etiology (Hale et al., 2010; Johnson, Humphrey, Mellard, Woods, & Swanson, 2010). For dyslexia, these approaches would require documentation of academic deficits in word reading accuracy and/or fluency and spelling, a related cognitive processing deficit in phonological processing, and the existence of other, relatively strong cognitive processes. This conceptualization potentially best captures the "Sea of Strengths" model of dyslexia (Shaywitz, 2004), which posits that dyslexia represents highly specific deficits in decoding offset by high levels of creativity and critical thinking.

There are certainly students with dyslexia who cannot read adequately despite evidence of strengths and even superior ability in other domains. Despite the popularity of this conceptualization of dyslexia and the existence of these prototypes, there is little empirical evidence to validate identification models built upon the identification of intraindividual strengths and weaknesses. PSW methods do nothing to improve the reliability of individual identification issues and in fact may exacerbate these issues due to the complexity of the proposed methods (Miciak, Fletcher, et al., 2014; Miciak et al., 2016; Taylor et al., 2016). Additionally, little research exists to show that an intraindividual pattern of strengths and weaknesses as a marker of SLDs is educationally meaningful (Schneider & Kaufman, 2017). Comparisons of groups of struggling readers formed on the presence or absence of a pattern of strengths and weaknesses do not demonstrate distinct academic needs (Miciak, Fletcher, et al., 2014) and do not respond differently to intensive interventions (Miciak et al., 2016). Although intuitively appealing, recent reviews have highlighted the paucity of empirical support for PSW

methods for SLD and dyslexia identification (McGill, Styck, Palomares, & Hass, 2016; Schneider & Kaufman, 2017).

Instructional response

Methods based on documenting inadequate instructional response for the identification of dyslexia, often referred to as response to intervention (RTI) methods, do not overcome the reliability challenges associated with individual identification. Different measures, cut-points, criteria and methods for identifying inadequate responders will demonstrate unreliability for individual decisions (Brown Waesche, Schatschneider, Maner, Ahmed, & Wagner, 2011). However, and in contrast with cognitive discrepancy approaches to SLD identification, there is considerable evidence that classifications based on instructional response result in educationally meaningful groups. Empirical comparisons of children who demonstrate adequate and inadequate response to evidence-based interventions suggest that resulting groups can be differentiated on a number of educationally meaningful attributes, including academic achievement on measures not utilized to form groups (Al Otaiba & Fuchs, 2006; Vellutino et al., 2006), cognitive performance (Fletcher et al., 2011; Miciak, Stuebing, et al., 2014), behavior (Al Otaiba & Fuchs), and even brain activation patterns (Barquero, Davis, & Cutting, 2014). These data provide strong evidence for the validity of classifications based on instructional response. However, as we discuss below, instructional response alone is not adequate for the identification of dyslexia or other SLDs.

The Causes of Dyslexia and its Immutability

Do concepts of the etiology of dyslexia belong in definitions of dyslexia? Many advocates regard dyslexia as an innate, permanent condition (British Dyslexia Association, 2007; Cassidy, 2019a). Historically, terms like “constitutional origin” and “neurological in origin” have

appeared in definitions to highlight that children with dyslexia are not motivated and that there is neurobiological risk related to the heritability of reading skills and difficulty developing the neural systems needed to mediate an acquired skill like reading. When definitions try to be overly precise about the etiology of dyslexia, prognostic considerations can arise that are difficult to assess and problematic for the field of dyslexia research and practice: (1) that dyslexia need only be identified once because it is a permanent, lifelong condition; and (2) that our definitions and conceptualizations of dyslexia and its identification need not consider the effects of instruction. Both these conclusions are wrong, because they are based on an untenable assumption that dyslexia is an immutable condition pre-determined by neurobiological factors. In fact, current evidence supports the notion that there are both environmental and genetic factors contributive of reading difficulties (for a full discussion, see Fletcher et al., 2019).

Heritability

Dyslexia is a highly heritable condition, but the heritability is clearly influenced by the home literacy environment and by instruction. In young children, the heritability is about 50%, but this increases with age because of the leveling effects of instruction, so that heritability estimates in older children indicate that heritable factors account for about 80% of the variance in reading skills (Olson, Keenan, Byrne, & Samuelsson, 2014). There is also variability due to environmental influences, including teacher effects, socioeconomic status, and parental level of reading (Petrill, 2006; Friend et al., 2009). Although there are multiple candidate genes for dyslexia, individual gene effects are small and the mode of inheritance is multifactorial and polygenetic (Grigorenko et al., 2020).

Dimensionality

In one of the first papers on the dimensionality of the attributes of dyslexia, Ellis (1984) likened dyslexia to obesity or hypertension, conditions that are dimensional, depend on how they are measured, have a polygenetic inheritance, and where static attempts to screen or even diagnose independently of consideration of environmental factors such as diet would be highly questionable. People are born at risk for obesity or high blood pressure, but different combinations of genes may be present; the manifestation of this risk depends on environmental factors (e.g., diet, exercise).

Dyslexia is similar. Individuals are born with combinations of genes that may manifest as more or less risk for dyslexia because of their impact on the brain's capacity to reorganize to support reading, an acquired skill with no direct evolutionary basis. However, even a person with very low genetic risk would demonstrate symptoms of dyslexia if they were never shown print or taught to read. Among individuals with elevated genetic risk, not all will manifest symptoms of dyslexia. Early intervention may prevent or minimize reading difficulties; much hinges on instruction. Continuing the obesity analogy, just as some people will be obese despite a healthy diet or exercise, some individuals will manifest dyslexia no matter how well they are taught. Outcomes depend upon both genetic and environmental factors. But such factors are difficult to measure at this point in time and not obviously needed for a definition of dyslexia.

This interaction is most apparent when considering early reading intervention, which requires a dynamic approach to screening that changes over time and which can be critically important for preventing dyslexia. Risk characteristics change over time because of the influence of instruction and development. For example, prior to the onset of instruction, alphabetic knowledge and phonological awareness are uniquely predictive. By first grade, most children at-risk have mastered alphabetic knowledge, but phonological awareness remains predictive. At the

end of Grade 1, after a year of formal instruction, accuracy and fluency of word reading is the most uniquely predictive skill. Identifying risk is critical because in many children, the reading problem can be prevented or at least ameliorated. When risk for dyslexia is identified before Grade 3, the number of children who do not respond to explicit core and supplemental reading instruction has been reported as 2-5% of children depending on the quality and intensity of the interventions (Mathes et al., 2005; Torgesen, 2002). Other studies have found that when either explicit core instruction (including phonics) (Connor et al., 2013) or remedial instruction (Lovett et al., 2017) is delayed to third grade, additional intervention time may be required to close the gap relative to age appropriate reading skills.

The role of the brain

Neuroimaging research helps explain this difference and highlights the critical role of early intervention. In order to learn to read, children must learn the alphabetic principle, which means developing an understanding that words are composed of sounds like the ones we use to process auditory language. Speech is an evolutionary skill, but reading is acquired. The evolutionary neural systems that support language and visual processing must reorganize to support reading (Dehaene, 2009), showing substantial malleability in development and in response to intervention (Fletcher et al., 2019). Dyslexia most commonly occurs because the child struggles to make sense of the phonological structure of speech and apply it to print (alphabetic principle; Liberman, 1996). This is mediated by a complex neural network that processes words initially at a sublexical level with indirect access to the meaning of a word, often referred to as a *dorsal* system in the middle temporal and inferior parietal regions of the brain. Indeed, the only way a child (or adult illiterate) can make sense of print as words is by accessing the shared sound structure of oral and written language. As soon as the child or

illiterate begins to understand the alphabetic principle, a lexical system begins to develop in a left occipitotemporal *ventral* system in the brain.. This system is evolutionarily designed for object and face processing, but is a general visual expertise system capable of reorganizing to support many types of visual processing, like map reading (Vogel, Miezin, Petersen, & Schlagger, 2012). The ventral system operates in parallel with the dorsal system as a rapid orthographic processor based in part on the statistical properties that determine how letters and letter combinations are formed in writing (Seidenberg, 2017).

Both neural systems operate in parallel depending on the properties of the word. However, the dorsal system is the immediate source of difficulty for most children with dyslexia. The ventral system requires repeated exposure to predictable patterns of print in order to achieve automatic word recognition and immediate access to meaning recognized as proficient reading, which is necessary for immediate, on-line comprehension of print. Children with dyslexia are delayed in their access to print because of their phonological awareness problems and the effect on the dorsal system. The ventral system does not acquire sufficient experience to establish rapid processing of print and this leads to the commonly observed problem with automaticity even when an older child with dyslexia is taught decoding skills. It is difficult to provide sufficient reading experience if a child experiences 1-3 years of school with limited ability to read (Torgesen et al., 2001).

For this reason, children at-risk for dyslexia must be identified early and as discussed above, the nature of screening may change depending on age and exposure to reading instruction. When identified early, strong instruction can provide the basis for mastering the alphabetic principle and developing automaticity. In studies that combine neuroimaging and instruction, over 20 studies show normalization of brain function in the dorsal and ventral systems when the

child responds to instruction, with less evidence of a compensatory effect. The differences in activation are quantitative—a matter of degree—and not qualitative (see review in Fletcher et al., 2019). The idea that people are born with dyslexia because they have bad genes and bad brains is an outmoded notion that should be replaced with concepts of risk and malleability that are dependent on instruction and early intervention. Children may need to be screened multiple times for dyslexia, but once risk is identified, long-term monitoring of instructional response is critical (Fuchs, 2003). Persistent reading difficulty is a strong and reliable marker of unexpected reading difficulty.

Identifying Dyslexia in Schools

From this review of definitions and the attributes of dyslexia, it is apparent that the strongest empirical support is found for definitions that focus on the academic deficits as key attributes of dyslexia. In addition, given that dyslexia has both environmental and genetic components and is affected (both positively and negatively) through early literacy instruction (Petrill et al., 2006; Mathes et al., 2005), it is imperative to evaluate instructional components in addition to individual change and development of reading skills over time. In consideration of the classification evidence reviewed above, we propose a three-pronged “hybrid” approach to the identification of dyslexia that incorporates information on “symptoms” involving individual achievement and instructional response. This approach is termed “hybrid” because it incorporates methods based on simple low achievement, assessment of instructional response, and consideration of contextual factors and other disorders. It is not just an assessment of instructional response, which is how many critics view identification of LDs in a method based on response to instruction (Reynolds & Shaywitz, 2008) and also permits use of more than one measure for identification, which improves reliability. We do not regard the assessment of

instructional response as an assessment of prognosis, but would argue that persistent lack of adequate response to quality instruction is a marker of disability and educational need, the second prong of any disability determination.

This approach is aligned with recommendations of the 2001 LD Summit and the statutory regulations of IDEA 2004 (Bradley et al., 2002; for a full discussion of the proposed hybrid approach, see Fletcher & Miciak, 2019). This approach relies on the documentation of three criteria, including evidence of: (1) low reading achievement, particularly in relation to accurate and fluent word reading and spelling for dyslexia; (2) inadequate instructional response to generally effective instruction; and (3) a consideration of exclusionary factors and their potential impact on student learning. Data relevant to documenting these three criteria are required by U.S. federal statutes regardless of whether a district or state chooses to implement an approach based on instructional response or a cognitive discrepancy approach, such as PSW methods. They are explicit in the Rose Report, the IDA definition, and DSM-V. They are best implemented through a MTSS service delivery model that prioritizes general education instruction with increasingly intense intervention as children struggle, which is identified in relation to instruction. Our definition would focus on symptoms that involve the actual academic skills impaired in dyslexia, instructional response, and evidence of contraindicative symptoms. We would not invoke concepts of etiology or specify prognosis. Assessment of other cognitive skills would not be necessary as part of a comprehensive evaluation designed to diagnose dyslexia and other LDs.

Although critics of MTSS assert MTSS service delivery models are generally ineffective (Cassidy, 2019a; Reynolds & Shaywitz, 2009), we argue MTSS can be effective for children with dyslexia and other SLDs (Coyne et al., 2018; Fien et al., 2014; Foorman et al., 2016; Smith et al., 2016) and represent an efficient process by which to collect data necessary for dyslexia

identification and treatment planning. There are well documented challenges related to school-based implementation of MTSS (Balu et al., 2015; Fuchs & Fuchs, 2017) and many schools will require technical assistance and considerable professional development in order to fully implement high-quality, school-wide MTSS, which requires not only targeted interventions but evidence-based Tier 1 instruction including explicit instruction in phonics in early elementary grades. However, a dyslexia identification approach that relies on achievement and instructional data generated within MTSS is dynamic, treatment oriented, preventative, and less likely to result in diagnostic problems because of its recursive and sequential nature (for a review, see Fletcher et al., 2019).

Schoolwide MTSS routinely collect performance data relevant for documenting low achievement and inadequate instructional response. These data include universal screening data and individual progress monitoring with curriculum-based measures or mastery measures (Compton, Fuchs, Fuchs, & Bryant, 2006; Speece, Mills, Ritchey, & Hillman, 2003; Stecker, Fuchs, & Fuchs, 2008). These data have use not only as part of the identification process, but can also be utilized to evaluate the effectiveness of instruction across grades and tiers (Baker, Fien, & Baker, 2010). It is also important to ensure that the progress monitoring measures are reliable and valid; standardized tests like those used in the first box may be sensitive to change over a longer period of time as before and after intervention assessments (e.g., Torgesen et al., 2001), but do not have enough items to reliably assess instructional response for the goal of adjusting instruction. Specific to individual identification processes, school based teams may wish to supplement individual response data collected as part of school-wide MTSS interventions with diagnostic measures of academic achievement to inform the comprehensive assessment for special education eligibility (Fletcher et al., 2019; Fletcher & Miciak, 2019). However, statutory

guidance provides schools considerable flexibility in how low achievement and inadequate instructional response are documented.

In addition to student performance data, well-implemented MTSS will collect data about implementation integrity across key features of the service delivery model (VanDerHeyden, Witt, & Gilbertson, 2007). Keller-Margulis (2012) identified three critical components of intervention integrity for RTI: (1) assessment integrity; (2) instructional and intervention integrity; (3) procedural integrity (i.e., the extent to which implementation matched the school or district plan). These data are particularly important given the importance of evidence-based assessment and instructional methods for RTI methods for dyslexia (and other SLDs) identification. More generally, these data can help schools implement a MTSS service delivery model that improves school-wide achievement. Specific to instruction, many commercially-available Tier 1 and Tier 2 curricula include specific fidelity of implementation checklists, which can be completed and used to inform individual identification decisions and improve instruction more generally. In the absence of published fidelity instruments, schools should identify key structural and instructional features for interventions at each tier and collect data related to implementation (for examples and templates, see Baker et al., (2010); Kovaleski, VanDerheyden, & Shapiro (2013)).

As part of the comprehensive assessment for dyslexia identification, school-based teams should also collect data and information related to exclusionary clauses, to demonstrate that the team considered and ruled out the possibility that the child's reading difficulties are due to other conditions or disorders, such as sensory disorders or second language acquisition. Specific to second language acquisition, any valid dyslexia identification process must consider the cultural and linguistic sensitivity of the measure(s) utilized (American Educational Research Association,

American Psychological Association, & National Council on Measurement in Education, 2014) as well as the language of instruction that the student has received (Wagner, Francis, & Morris, 2005). Such considerations are required by federal statute, as well. Parsing the effects of language learning, instructional opportunity, and individual differences is difficult and no error-free method exists. However, early intervention with ELs at risk for dyslexia or other reading disabilities can still occur within a school-wide MTSS and holds potential to prevent persistent reading difficulties among ELs. Particular care should be taken in early screening for reading problems in ELs because of the influence of oral language proficiency. We are aware of few brief screening assessments specifically geared to ELs.

Conclusions

We have argued that much of the controversy and confusion related to dyslexia identification and treatment results from a misunderstanding of the inherent attributes of dyslexia and SLDs more generally. Current evidence supports a dynamic, treatment focused model for dyslexia identification treatment, best implemented in MTSS. Within this model, all children should be screened for reading problems in kindergarten, Grade 1, and Grade 2. Screening need not be overly complicated. After the onset of formal reading instruction, dyslexia risk can be established by simply reading and spelling words under timed and untimed conditions. Diagnosis requires a comprehensive evaluation, but does not require cognitive assessments. The most important considerations are low achievement in reading and spelling (with expected impacts on comprehension) and the documentation of inadequate response to intervention. In this formulation, it is the intractability to generally effective reading instruction and the persistence of the reading problem that marks unexpectedness.

The use of cognitive referencing, deficits in a sea of strengths, and other discrepancy models have been unsuccessful in identifying educationally meaningful subgroups of poor readers as dyslexic or not dyslexic (Elliott & Grigorenko, 2014). Further, there is little evidence for the specificity of dyslexia interventions. Children with word reading and spelling problems with and without other proposed markers of dyslexia respond similarly to these interventions. Thus, the search for dyslexia-specific interventions potentially limits access to effective reading instruction for some children. Most importantly, the framework for dyslexia highlighted above focuses on instruction first and reduces the costs of comprehensive assessments. For these reasons, we have argued that assessment and treatment methods that emanate from MTSS service delivery models may accomplish hold potential to improve outcomes for children with dyslexia and other SLDs.

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