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The critical role of instructional response in defining and identifying students with dyslexia: a case for updating existing definitions

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Abstract
We address defining and identifying students with dyslexia within the context of multi-tier systems of support (MTSS). We review proposed definitions of dyslexia, evidence for proposed definitional attributes, and emphasize the role of instructional response in identifying students with dyslexia. We identify dyslexia as individuals with specific deficits in reading and spelling single words combined with inadequate response to evidence-based instruction. We propose a hybrid identification process in which assessment is utilized within school-wide MTSS allowing for integration of routinely collected progress monitoring data as well integrating with more formal diagnostic measures. This proposed "hybrid" method demonstrates strong evidence for valid decision-making and directly informs instruction. We close proposing a revised definition of dyslexia that incorporates these elements.

Keywords Dyslexia definitions · assessment · intervention response · identification

Definitions of dyslexia

This paper reviews existing definitions of dyslexia and proposes a revised definition that emphasizes the role of effective reading instruction in defining individuals as dyslexic. We provide in Box 1 two current US definitions of dyslexia, one originating in the US Senate, the First Step Act definition (Cassidy, 2019b) and the second from the International Dyslexia Association definition (Lyon et al., 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 present in Box 1 the British Dyslexia Association (BDA) (2007) and the United Kingdom Rose Report (Rose, 2009) definitions of dyslexia.

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Box 1 Definitions of dyslexia

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 characterized 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 organization, 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)."*

Comparing current definitions

As we noted in a previous paper (Miciak & Fletcher, 2021), Tonnessen (1997) organized diverse definitions around three principles on which definitions 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 the definitions along each of these principles, while using language more consistent with contemporary discussions of dyslexia.

Attributes of dyslexia The primary manifestation of dyslexia is difficulty accurately and with automaticity reading and spelling single words. The First Step and IDA definitions for dyslexia further specify that this difficulty in reading is *unexpected* because the individual demonstrates intellectual or cognitive strengths inconsistent with such difficulties or because they have not learned to read despite provision of generally effective instruction. The BDA definition and the Rose Report do not refer to the concept of unexpectedness, which is uniquely North American (Elliott and Grigorenko, 2024) and most likely related to broader formulations of defining students with specific learning disabilities emanating from Kirk (1963). Among the definitions reviewed, only the First Step definition identifies a role for intelligence as an attribute of dyslexia. In contrast, the IDA definition allows for unexpectedness in reading difficulties in relation to other cognitive variables, such as math. While all 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 IQ scores (with intellectual disability as an exclusionary factor).

Etiology of dyslexia In Tonnessen's (1997) review of definitions, he would consider the comparisons of reading and cognitive attributes as examples of symptoms (see Elliott & Grigorenko, 2024). Older definitions such as the World Federation of Neurology (Critchley, 1970) definition have been subject to considerable criticism. One central concern centered on its attempt to specify a static etiology (i.e., "constitutional origin"). In response to this longstanding criticism, most recent definitions do not specify etiology. 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 because of its focus on a static etiology. 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 word reading difficulties (Liberman, 1996), but these deficits are best understood as symptoms in Tonnessen's review. On average, children identified with dyslexia show significant difficulties with phonological processing, but there are always exceptions (e.g., Pennington et al., 2012) that may reflect measurement error or often debated ideas about additional causal factors, such as visual processing (see Elliott and Grigorenko, 2024; Fletcher et al., 2019). There is little evidence suggesting that phonological processing problems in isolation can be used to reliably identify dyslexia and other SLDs (Torgesen, 2002); some skilled readers perform poorly on phonological tasks (Scarborough et al., 1998), and for struggling readers, low performance on complex phonological tasks (especially those used with students beyond initial grades) may be at least partly due to underdeveloped orthographic knowledge (Castles et al., 2003).

Instructional factors The third component is prognosis or the persistence of the disorder (Tonnessen, 1997). In the Rose Report and the BDA definitions, dyslexia is viewed as a lifelong disorder. 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 youngsters. In contrast, the First Step definition does not include reference to instructional factors, instead criticizing consideration of instructional factors as a means for just blaming teachers (Cassidy, 2019a).

The consideration of instructional opportunity is actually intended to rule out reading difficulties resulting from weak instruction that does not remedy early reading difficulties (Miciak and Fletcher, 2021). In addition, instructional response makes the definition inclusionary because the assessment must document that the reading problem occurs in the face of generally effective instruction. For this reason, documentation of inadequate instructional response to scientifically based instruction is a key factor in the identification of dyslexia and makes the assessment and definition framework dynamic. How can dyslexia be identified in the absence of an evaluation of instructional response give that learning to read is not natural and requires instruction in order to program the reading centers in the brain (Dehaene, 2009)? Instructional response data are most efficiently collected in a school-wide multi-tier system of support (MTSS) approach that organizes service delivery around universal screening, tiered interventions of increasing intensity, and ongoing progress monitoring. However, the purpose of MTSS is not to identify dyslexia and considerations of instructional response do not necessarily depend on fully implemented MTSS.

Response to research-based instruction and intervention

A critical criteria for defining and identifying students with dyslexia is based on documenting inadequate instructional response, initially referred to as response to intervention. However, previous use of the term "response to intervention" described both identification approaches that require inadequate instructional response and a school-wide service delivery system. More recently, the term MTSS has been widely adopted to refer to the elements of a school system. Implementation of MTSS complements instructional response approaches to identification, because necessary data documenting instructional delivery and response emerge from this system.

There is considerable evidence that classifications based on instructional response results in groups that differ in educationally meaningful ways. For example, students who are minimal responders to what is typically highly effective small group intervention may require additional instructional supports such as intervention twice a day for 30 min rather than once a day (Wanzek & Vaughn, 2008), very small group instruction or one-on-one tutoring (Hall & Burns, 2018; Suggate, 2016), or a more customized intervention that focuses more explicitly on their instructional needs (Vaughn, Wexler et al., 2012). Research studies that have conducted comparisons of students who demonstrate adequate and inadequate response to evidence-based interventions suggest that student groups resulting from response to intervention classifications 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 et al., 2014a, b), behavior (Al Otaiba and Fuchs, 2006), and even brain activation patterns (Barquero et al., 2014). These data provide strong evidence for the validity of classifications based on instructional response. Though we consider response to intervention as necessary for identifying students with dyslexia, instructional response alone is not adequate for the identification of dyslexia.

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 of dyslexia to emphasize that the observed difficulties learning to read are *not* a result of lack of motivation, engagement, or willingness to try and work hard. 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 (Pennington et al., 2012). However, recognizing that there are innate explanations for dyslexia contributes to questions about when and how dyslexia might be remedied. Definitions of dyslexia that are overly precise about the etiology of dyslexia are difficult to support as prognostic considerations can arise that are difficult to assess. Issues that might emerge related to considerations of the etiology of dyslexia include that: (1) dyslexia identification needs to occur early and perhaps only identified once since it is considered a permanent, lifelong condition, and (2) that our definitions and identification criteria of dyslexia need to only consider the effects of research-based 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 that contribute to dyslexia (Elliott & Grigorenko, 2024; Fletcher et al., 2019). Catts and Petscher (2022), for example, proposed a risk-resilience model in which dyslexia and its severity is the result of genetic and environmental risk factors (e.g., phonological processing or attention deficits, family history of reading problems, ineffective early reading instruction) that are potentially offset or buffered by resilience factors that may also be environmental or genetic (e.g., instruction and intervention, engagement, social-emotional coping skills, family and peer support). By acknowledging the significant role of environmental factors in the occurrence and severity of dyslexia, multifactorial models highlight the importance of intervention for prevention, remediation, and a basis for formal identification.

Schooling and definitions of dyslexia

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 (e.g., word reading, spelling) 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 (Mathes et al., 2005; Petrill et al., 2006), it is imperative to evaluate the history of reading instruction (e.g., quality of teaching as well as scientifically based approaches) within the context of assessing individual change over time in developing reading skills. In consideration of the definition and identification practices we have previously presented, we propose a three-pronged "hybrid" approach to the identification of dyslexia that incorporates information on "symptoms" involving individual achievement and instructional response (Fletcher & Miciak, 2024). This approach is termed "hybrid" because it incorporates methods based on (a) low reading and spelling achievement, (b) assessment and data on individual student's instructional response including

documentation of reading instructional approaches, and (c) consideration of contextual factors and other disorders. It is not just an assessment of instructional response, which is how many critics view identification in a method based on response to instruction (Reynolds and Shaywitz, 2009). This approach incorporates multiple measures for identification, which improves reliability and complement contextual evidence, such as instructional observations and an educational history review. This educational history review can evaluate family risk, such as whether direct relatives were also identified with dyslexia. But the primary focus should be an evaluation of instructional programming for the student, including type of program, intensity, and if possible, quality of implementation. Any approach to identification of dyslexia must consider these factors, even outside an MTSS framework. We do not regard the assessment of instructional response is 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 regulations for assessment in IDEA 2004 (Fletcher & Miciak, 2024) and consistent with the consensus emerging from the Learning Disabilities Summit (Bradley et al., 2002), which recommended documentation of three criteria, including evidence of (1) low academic achievement, (2) inadequate instructional response to typically effective instruction and intervention, and (3) a consideration of exclusionary factors, co-occurring conditions, and their potential impact on student learning. Data relevant to documenting these three criteria are required by US 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 Patterns of Processing Strengths and Weaknesses (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. This focus on symptoms directly informs treatment planning. We would not invoke concepts of etiology or specify prognosis. Assessment of other cognitive processes (e.g., working memory, IQ) would not be necessary as part of a comprehensive evaluation designed to diagnose dyslexia, except to rule out other contraindicative conditions such as intellectual disability or pervasive developmental disorders (Fletcher & Miciak, 2017).

Documenting inadequate instructional response

MTSS can be an effective framework for students with dyslexia (Coyne et al., 2018; Fien et al., 2014; Foorman et al., 2016; Smith et al., 2016; VanDerHeyden et al., 2007) and represents an efficient process by which to collect data for dyslexia identification and treatment planning. Even considering the well documented challenges related to school-based implementation of MTSS (Balu et al., 2015; Fuchs & Fuchs, 2017), a dyslexia identification approach that relies on achievement and instructional data generated within MTSS is preventative, multi-disciplinary, and treatment oriented. Moreover, because of its recursive and sequential nature, an MTSS approach to identifying students with dyslexia ameliorates the consequences of well documented reliability challenges associated with all identification methods, but which are particularly impactful in more static approaches with greater reliance on imperfect psychometric data (for a review, see Fletcher et al., 2019).

All methods for the identification of risk or disability that apply a strict cut point to imperfect, continuous psychometric data will demonstrate unreliability in identification at the individual level (Francis et al., 2005; Macmann et al., 1989). Individuals close to the threshold will shift group membership due to natural differences in performance, the choice of measure, or based on small amounts of measurement error that impact test reliability. This limitation applies to methods that rely on the identification of inadequate instructional response when inadequate instructional response is indicated by different measures or by different performance criteria (Barth et al., 2008; Fletcher et al., 2014; Waesche et al., 2011). Studies documenting this unreliability at the individual level are frequently cited in criticisms of instructional response methods for identification (Flanagan et al., 2006). Further criticism focuses on disagreements in research and practice about optimal ways to document inadequate instructional response, with different measurement proposals cited as demonstrating a lack of coherence in the construct (Hale et al., 2010; Kavale et al., 2008).

Such criticism is misguided because it conflates measurement challenges and variability with flaws in the underlying latent construct and the classification hypothesis that emerges. In educational psychology, many common latent constructs are measured in different ways with robust debate about optimal measurement procedures. For example, reading comprehension is often measured through tests that include reading passages and answering questions, cloze items, or sentence verification tasks. The existence of multiple indicators of the latent construct (reading comprehension) is not interpreted as a conceptual flaw in the underlying latent construct, but instead indicative of the complexity of the construct. Further, we commonly accept that that there are multiple measurement procedures with persuasive validity arguments as indicators of the latent construct. Inadequate instructional response should be viewed as a complex construct that may be measured in multiple ways and that requires evidence to support multiple claims.

Kane (1992, 2013) proposed an argument-based approach to validity in which test score uses and interpretations that are clearly stated and are supported by appropriate evidence are considered as arguments for validity. When considering inadequate instructional opportunity, we must view the individual's instructional opportunity in its entirety as a "test" (Grigorenko, 2009), which generates multiple data points that may provide evidence of varying strength to support the underlying interpretation, claims, and use. Unpacking these interpretations and claims is helpful in pointing toward the sorts of evidence that would support an argument of inadequate instructional response. In the sections that follow, we identify two fundamental claims underlying a determination of inadequate response and briefly discuss the kinds of evidence that might support these claims.

Receipt of generally effective instruction One of the central claims in a determination that a student has demonstrated inadequate instructional response indicative of dyslexia is that the student received generally effective reading instruction. Multiple data may lend support to this claim, including attendance records to establish sufficient opportunity. Documentation of the instructional delivery in general education and in the context of intervention, including instructional foci and evidence for effectiveness, provide further support for the claim. Resources such as the What Works Clearinghouse, the National Center on Intensive Intervention Academic Intervention Tools Chart, and Institute of Education Sciences Practices Guides may all be cited to support the general effectiveness of delivered intervention. Fidelity of implementation data collected over the course of the intervention would bolster an argument for the delivery of effective instruction (Johnson et al., 2006; Keller-Margulis, 2012).

Demonstration of inadequate instructional response Multiple student data may be provided to support the claim that a student demonstrated inadequate instructional response. Since the initial proposal of methods for LD identification based on instructional response, there has been considerable research and debate about optimal ways to identify inadequate instructional response (Burns & Senesac, 2005; Fuchs & Deshler, 2007). In other forums, we have argued for the parsimony and coverage of final status indicators following intervention response (Fletcher et al., 2014; Miciak & Fletcher, 2021). This is because final status indicators incorporate information about growth that occurs during intervention (Schatschneider et al., 2008) and often can incorporate more psychometrically sound measures. However, this recommendation need not be dogma, and we find claims of inadequate response to generally effective instruction based on documentation of limited growth on curriculum-based measures persuasive, as well. The fundamental point is that there is no single "valid" way to document inadequate instructional response, as validity is not a categorical determination. Instead, we urge practitioners and clinicians to think about documentation of inadequate instructional response as argument building, which accrues validity based on accumulating evidence of varying strength and reliability. It is analogous to the diagnosis of hypertension in medicine, which relies on repeated (and imperfect) measures of blood pressure, often across different contexts. It is the accrual of data points suggesting high blood pressure that permits confidence in the diagnosis.

Considering exclusionary factors

As part of the comprehensive assessment for dyslexia identification, school-based teams should also collect data and information related to exclusionary factors and other comorbid conditions (e.g., ADHD, anxiety). This part of the evaluation is used 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 severe hearing or vision impairments, intellectual disability, 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 et al., 2005). Such considerations are required by federal statute. 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 students who are emerging bilinguals.

The need to assess for other conditions is not truly exclusionary, but recognizes that dyslexia often co-occurs with other conditions, especially ADHD and oral language disorders. Students do not need to be tested for each possible comorbidity. Rather, as part of the evaluation, the principal question is only partly to establish the presence of dyslexia. Another major reason for assessment is to ask why the student is not responding to intervention. This question permits the design of more effective interventions. It is well established that simply treating dyslexia as a reading disorder is less effective than treatment protocols that consider comorbid conditions (Fletcher & Miciak, 2024).

Conclusions and proposed definition

We have argued that much of the controversy and confusion related to dyslexia definition and identification result from a misunderstanding of the inherent attributes of dyslexia. Current evidence supports a dynamic, treatment-focused model for defining and identifying students with dyslexia, which is best implemented within a MTSS framework. Within this model, all children should be screened for reading problems in kindergarten, Grade 1, and Grade 2. Screening need not be overly complicated (Fletcher et al., 2021). After the onset of formal reading instruction, dyslexia risk can be established by asking youngsters to read and spell words under timed and untimed conditions. Identification requires a comprehensive evaluation but does not require cognitive assessments or attempts to specify the etiology of reading difficulties. The most important considerations are low achievement in reading and spelling words in isolation 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 and thus identification for dyslexia.

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, 2024). 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 interventions that explicitly teach the alphabetic code and provide extensive supported practice in reading. 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 time and costs associated with comprehensive assessment. For these reasons, we have argued that approaches to defining and identifying dyslexia that emanate from MTSS service delivery models may be the most effective approach.

We recommend revisions to existing definitions of dyslexia that reflect the central importance of instructional response to generally effective instruction. This proposed definition is consistent with Tonnessen's (1997) recommendation that a definition should lend itself to operationalization and hypothesis testing. It is parsimonious and focuses on primary symptoms, while minimizing the definitional importance of secondary symptoms. We propose the following updated definition:

Dyslexia is a learning disability that involves significant difficulties in reading and spelling single words accurately and with automaticity. These difficulties are observed despite the provision of generally effective reading instruction and supplemental interventions. Word reading and spelling difficulties in dyslexia are often associated with difficulties in phonological processing, but dyslexia is not identified when reading difficulties are the result of second language learning, problems with vision or hearing, or intellectual disability.

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Declarations

Conflict of interest The authors declare no competing interests.

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