RESEARCH-BASED PRACTICE

It's Time for a Multiple Deficit View of Dyslexia

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Although many school psychologists explore multiple factors when doing a comprehensive evaluation for dyslexia, some states and definitions still focus only on a single deficit: phonological awareness. A comprehensive evaluation for dyslexia should, however, include multiple linguistic risk factors.

OVER THE LAST FEW DECADES, several definitions of dyslexia have centered on phonological awareness as the sole linguistic risk factor for developing dyslexia. This focus is reflected in the International Dyslexia Association (IDA) definition, as well as many state definitions. The IDA specifies that the difficulties in reading development "… typically result from a deficit in the phonological component of language" (IDA, 2002). Pennington et al. (2012) cautioned, however, that adherence to a single deficit model (i.e., using only poor phonological awareness as the criterion) would result in missing about one half of cases.

Although, clearly, difficulties with the acquisition and application of speech sounds can affect reading and spelling development, additional factors can as well and are included in other international definitions. For example, the British Dyslexia Association describes the characteristic linguistic risk factors for dyslexia as phonological awareness, verbal memory, and verbal processing speed (Rose, 2009). Catts et al. (2024) proposed that revisions to the IDA definition would address: (a) the multifactorial causal basis and include factors beyond phonological awareness, (b) severe and persistent problems in word reading accuracy and speed, (c) the importance of exploring cognitive precursors for early intervention and treatment, (d) comorbidity with other disorders, and (e) the psychosocial impact of dyslexia.

The awareness that multiple factors can affect reading development was noted as early as 90 years ago. After examining numerous cases of individuals with reading disabilities, Monroe (1932) noted that, "No one factor was present in all cases. It is probable that the reading defect is caused by a constellation of factors rather than

by one isolated factor" (p. 110). Because additional specific linguistic risk factors can contribute to reading difficulties, they should all be included as part of a comprehensive dyslexia evaluation.

Examples of Additional Linguistic Risk Factors

In addition to phonological awareness, three additional linguistic risk factors include orthographic processing, rapid automatized naming (RAN), and working memory. Other possible correlates include processing speed and visual–verbal paired associate learning. Both the number of risk factors and the severity of weaknesses in these underlying linguistic risk factors increase the probability of dyslexia.

Orthographic Processing

Orthography refers to the writing system of a language and includes both spelling patterns and punctuation and capitalization rules. Regarding reading and spelling, orthographic processing is the cognitive process of recalling the letters and words that we see. Memory of a word's spelling is created from repeated exposures that require pairing the graphemes (letters and letter patterns) with the phonemes (speech sounds) and then blending the sounds to pronounce a word. The recall of letters and their sounds, letter combinations, and whole words is facilitated by orthographic processing, which contributes to the development of a robust sight word vocabulary and accurate spelling.

Readers with weaknesses in orthographic processing have difficulty recalling letter orientations, spelling patterns, and words with both accuracy and speed (Mather & Jaffe, 2021). These individuals tend to reverse letters and numbers, are slow to acquire a sight word vocabulary, and tend to spell words the way that they sound rather than the way that they look. For example, when spelling exception words, they regularize the irregular element, such as spelling the word *said* as *sed* or *they* as *thay*. Findings from a recent meta-analysis indicated that individuals with dyslexia have a deficit in their orthographic knowledge of printed words that is as large as that of phonological awareness and RAN (Georgiou et al., 2021).

Both phonological awareness and orthographic processing are central components of orthographic mapping (Ehri, 2014; Kilpatrick, 2015). Warmington and Hulme (2012) explained that "the learning of mappings between orthography and phonology is critical for learning to read…, including the process of learning

letter–sound correspondences and the learning of mappings at the level of single letters, letter groups, and whole words" (p. 47). Thus, orthographic mapping involves first identifying the sequence of graphemes in a word and then mapping these letters onto their corresponding sequence of phonemes (Ehri, 2024). Kilpatrick (2015) explained that orthographic mapping is "the process readers use to store written words for immediate, effortless retrieval. It is the means by which readers turn unfamiliar written words into familiar, instantaneously accessible sight words" (p. 81). Once typically developing readers have seen a word several times, it becomes stored as a sight word.

This mapping process is much slower for students with dyslexia. It is not uncommon to encounter a bright second-grade student who is still sounding out small words like *it*. One must wonder, for such a common word that has been seen so many times, why doesn't the student recognize it instantly by sight?

Rapid Automatized Naming

RAN involves naming symbols (letters and numbers), colors, or objects quickly. Almost 25 years ago, Wolf and Bowers (1999) proposed what they called the "double-deficit hypothesis" indicating that reading development could be affected by poor phonological awareness or slow rapid naming. Wolf (1999) also noted that other factors could play a role, stating that, "The history of dyslexia research, the heterogeneity of our dyslexic children, and the very complexity of the reading process argue against any single-factor, two-factor, or even three-factor explanation" (p. 5).

Since that time, slow naming speed has been described as a significant risk factor for dyslexia in all languages, supporting the inclusion of RAN tasks in neuropsychological and educational assessments for reading disorders (Araújo & Faísca, 2019). Although objects and colors are often used to assess younger children, alphanumeric RAN tasks are stronger predictors of future reading achievement than nonalphanumeric tasks. Additionally, RAN is a better predictor of real-word reading than nonsense-word reading (McWeeny et al., 2022) and of reading fluency than reading comprehension (Araújo et al., 2015; Nelson, 2015).

Dr. Martha Denckla, who helped establish the important role of RAN in predicting poor reading, described RAN as a way to measure the disruption in the "visual–verbal highway," or the "see it-say-it circuit" (Mather & Sammons, 2005). Thus, the speed between the eyes seeing a symbol and the mouth producing the name of the symbol is slow. Essentially, RAN measures the automaticity in which known

symbols can be retrieved and named and is a significant predictor of automatic word recognition (Jones et al., 2016; Mundy & Hannant, 2020).

For students in kindergarten and first grade, early naming speed deficits predict which children will struggle with reading fluency later in school (Onochie-Quintanilla et al., 2019; Wolf, 2007). Upon school entry, a good screening battery for dyslexia should include measures of letter–sound knowledge, phoneme awareness, and RAN (Clayton et al., 2020; Hamilton & Hayiou-Thomas, 2022).

Working Memory

Many different definitions of working memory have been proposed, causing some confusion among both researchers and practitioners (Cowan, 2017). Dehn (2015) defined working memory as "the cognitive ability to briefly hold, maintain, or store information while processing the same or other information" (p. 1). Cowan (2014) explained that it "is the small amount of information that can be held in mind and used in the execution of cognitive tasks, in contrast with long-term memory, the vast amount of information saved in one's life" (p. 197). Schneider and McGrew (2018) described working memory capacity as the "ability to manipulate information in primary memory" (p. 99) that requires both short-term storage and attentional control.

In addition to varied definitions, some theories consider working memory to be part of executive functioning, whereas others present it as an independent construct (Lervåg & Melby-Lervåg, 2022). Working memory is often measured with tests that require both simultaneous storage and processing demands (Schneider & McGrew, 2018). In evaluations, tests often require holding information in immediate awareness (storage) while manipulating or transforming that information in some way (processing), such as repeating a string of digits or words in reverse order.

Low scores on working memory tests appear to predict difficulties in many areas of achievement, including word reading, reading comprehension, mathematics, and writing. These measures also can discriminate between readers with dyslexia and typically developing readers (Knoop-van Campen et al., 2018). In addition, working memory deficits are often found in readers with comorbid disorders. For example, Gray et al. (2019) found that children with dyslexia and developmental language disorders (DLD) were more likely to have working memory deficits than children with only one disorder. These deficits did not, however, always co-occur with either dyslexia or DLD and were sometimes present in typically developing

readers. They further suggested that scores on working memory tests may also provide information about how well a child can deal with the challenges that are presented by dyslexia or DLD. As another example, results from a meta-analysis indicated that individuals with reading, math, and reading/math difficulties all had weaknesses in working memory (Peng & Fuchs, 2016).

Comorbidity

High comorbidity exists between dyslexia, ADHD, DLD, and dyscalculia, and these disorders can further impact both reading and writing development (Moll, 2022). In fact, about 40% of children with dyslexia have another learning disorder (Moll et al., 2020). When a student has multiple disorders, results from an evaluation often reveal shared linguistic risks factors that contribute to these varied difficulties, such as working memory weakness, poor orthographic processing, slow processing speed, or slow RAN. Multiple predictors contribute to neurodevelopmental disorders, and these shared risk factors contribute to comorbidity (McGrath et al., 2020). As noted by Amland et al. (2021), "cognitive strengths and weaknesses cut across disorders and difficulties" (p. 10).

Conclusion

Multiple neurological, behavioral, and environmental factors interact to cause difficulty in learning to read (Catts & Petscher, 2022). Therefore, no one linguistic risk factor can rule in or rule out a diagnosis of dyslexia (Pennington et al., 2019). The phonological deficit view that has dominated the field for years is inadequate for explaining all cases of reading disorders (Peterson & Pennington, 2012; Snowling & Hulme, 2012). Although phonological awareness is an established risk factor for dyslexia, other linguistic risk factors can impede reading and spelling development as well.

Kaufman et al. (2005) described the need for cognitive assessment, as it helps us to answer the questions "What is wrong? And how can we help?" (p. 211). In addition to identifying areas of difficulty, evaluation of these abilities can have implications for intervention. For example, a student with a phonological disorder will typically require instruction in phonemic awareness and phonics, whereas a student with slow RAN will typically require an intervention to increase reading fluency and is likely to need extended time on tests.

In addition to assessing linguistic risk factors and reading and spelling (untimed and timed), an evaluator should explore family history (a strong predictor of dyslexia) and the existence of comorbid conditions, such as ADHD and early speech and language difficulties. The evaluation report should describe any needed accommodations and document the specific reading and spelling skills that require intervention (e.g., phonological awareness, phonics, structural analysis, reading fluency, spelling).

Early identification of linguistic risk factors helps ensure the accurate identification of dyslexia so the student can receive appropriate interventions. Ozernov-Palchik and Gaab (2016) described what they called the "dyslexia paradox," where dyslexia is typically not identified until second grade when the child has not learned to read as expected. The paradox is that early intervention is most effective in pre-K–1, prior to reading failure. As Monroe (1932) observed, reading difficulties are truly caused by a constellation of factors, and the earlier we can provide intervention, the better.

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