Trust the Science of Reading to Inform Instruction

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In spite of the fact that we learn to listen and speak without explicit, systematic, and cumulative instruction, it should not be assumed that we learn to read and write in the same manner. Indeed, although spoken and written language may seem to be inverse operations similar to addition and subtraction, they are not (Adams, 1990; Gough & Hillinger, 1980; Seidenberg, 2017; Wolf, 2008). Spoken language is a natural act that evolved over thousands and thousands of years, causing our brains to become "wired" for listening and speaking; conversely, written language was only invented a few thousand years ago, meaning our brains are *not* wired for reading and writing. The Science of Reading has shown that learning to read and write is not a natural act—rather, this undertaking requires explicit, systematic, and cumulative instruction (Castles, Rastle, & Nation, 2018; Gough & Hillinger, 1980; National Institute of Child Health and Human Development [NICHD], 2000; Seidenberg, 2017).

What is the Science of Reading? It is evidence: Evidence from the accumulation of research on reading acquisition and instruction that has been conducted using gold-standard methodologies and has identified effective practices (Reyna, 2004; Seidenberg, 2017). Simply put, the Science of Reading is not an opinion, nor is it a philosophical belief. The accumulated Science of Reading evidence should be trusted to inform the *why, what*, and *how* of reading instruction. This paper considers the impact of the Science of Reading on reading instruction.

The *WHY* of instruction

Why do we teach what we teach? We teach it because the accumulation of scientific evidence from high-quality, well-designed research has proven it to be effective in helping all students learn to read and write. Regrettably, the reading instruction in many of today's Whole Language/Balanced Literacy classrooms is not well informed by the Science of Reading as it is guided by views rather than the evidence behind the acquisition and effective instruction of reading (Adams, 1990; NICHD, 2000; Snow, Burns, & Griffin, 1998). For instance, some teachers encourage students to use pictures or semantic and syntactic cues to guess unfamiliar words in texts because they believe these strategies preserve meaning, which is counter to how skilled readers actually process printed words (Adams, 1990). In another example, teachers

may offer no or limited grammar instruction under the belief that grammatical rules interfere with the flow of ideas in writing even though knowledge of grammar has been shown to support both written composition and reading comprehension (Foorman, Koon, Petscher, Mitchell, & Truckenmiller, 2015). If there is evidence of sound instructional practices, then why are unproven practices still in use? Seidenberg (2017) suggested, "Whereas science is adversarial and theories compete, on the education side, greater effort goes into maintaining a shared belief system" (p. 260).

Castles, Rastle, and Nation (2018) proposed "an agenda for instruction and research in reading acquisition that is balanced, developmentally informed, and based on a deep understanding of how language and writing systems work" (p. 5). The researchers concluded that understanding *why* certain skills are important to teach has been obscured by a singular—and polarizing—focus on phonics. Without a deep understanding of language and writing systems, it is difficult to understand *why* phonics works, as well as *why* there is more beyond phonics that needs to be taught.

The *WHAT* of instruction

The Simple View of Reading (Gough & Tunmer, 1986; Hoover & Gough, 1990) is a validated framework that deepens understanding of how language and writing systems work, along with how these systems inform *what* we teach—which both includes and goes beyond phonics.

The Simple View of Reading proposes that reading comprehension is **the product of decoding** (or word recognition) **and linguistic comprehension** (or language comprehension). Neither component is sufficient on its own, which means inefficiency in one aspect may lead to overall reading failure, and each component is made up of its own underpinning components that are supported by scientific evidence. Teaching all components is critical to ensuring reading success.

$$\textit{Decoding} \ \times \ \textit{linguistic comprehension} \ = \ \textit{reading comprehension}$$

Decoding

Decoding is the reader's linkage of the printed words on a page to their spoken equivalents, which is dependent on the reader's understanding that the letters in printed words represent individual speech sounds in spoken words (i.e., the alphabetic principle). Without the ability to decode words, the reader will not be able to derive meaning from the printed page. Decoding begins with the reader's understanding of the sound system of language and proceeds to an understanding of the writing system based on the underpinning components of **phonology**, **orthography**, and **morphology**.

- **Phonology** is the sound system of language. The English language is composed of approximately 44 speech sounds, or phonemes, defined as the smallest unit of sound that makes a difference in the meaning of a word (e.g., changing /s/ in *sat* to /m/). The importance of a beginning or struggling reader's ability to detect and manipulate the individual phonemes in spoken words (i.e., phonemic awareness) is well documented, as is the importance of the instruction that develops these skills (Blachman, 1995; Bradley & Bryant, 1983; Catts, Neilsen, Bridges, Liu, & Bontempo, 2015; Liberman & Liberman, 1990; NICHD, 2000).

  Phonemic awareness tasks include identifying the initial or final sound in a word, blending sounds into a word, segmenting a word into sounds, and changing a sound in a word to produce a different word. Prior to engaging in tasks that require the detection or manipulation of individual speech sounds, beginning and struggling readers undertake tasks such as identifying rhyming words, blending spoken syllables into words, and segmenting spoken words into syllables (i.e., *phonological* awareness), all of which can be completed without the presence of letters or print. Early identification of and intervention with difficulties in phonological or phonemic awareness prevent difficulties in learning to read (NICHD, 2000; Snow, Burns, & Griffin, 1998).

- **Orthography** is the writing system of language. The English writing system is composed of 26 letters that represent the phonemes in spoken words, either singular or grouped (e.g., *th, ng, tch*), and there are constraints about where and how letters can occur in words—for instance, the letters *ck* do not occur in initial position, while the letters *h, y, j,* and *w* do not double. Phonics, the method of instruction that teaches the associations of letters and phonemes (i.e., letter-sound patterns or correspondences), is crucial for beginning and struggling readers to become proficient readers (Ehri, 2014; Foorman,

Francis, Fletcher, Schatschneider, & Mehta, 1998; NICHD, 2002). Paired with sufficient practice, explicit instruction builds letter-sound patterns in memory. Students' spelling errors on tests or in daily writing provide insight into their understanding of letter-sound patterns and inform responsive instruction (Ehri, 2014).

For beginning, struggling, and skilled readers alike, it is more productive to "sound out" an unfamiliar word than to guess the word based on semantic or syntactic cues alone (Adams, 1990; Seindenberg, 2017). Once words are held in memory because of repeated exposure and increased knowledge of letter-sound patterns, readers can instantly recognize them without needing to sound them out. Automatic word recognition leads to fluent reading, which frees cognitive resources to focus on meaning (Ehri, 2014; Perfetti, 1985). Students with dyslexia often experience difficulties with the acquisition of automatic word recognition skills due to deficits in the phonological and/or orthographic components of language (Hook & Carreker, 2019).

- **Morphology** deals with the meaningful units of words (prefixes, roots, suffixes, and combining forms), which are called morphemes. Instruction of morphemes has a unique role in synthesizing several aspects of the Simple View of Reading (Henry, 2018; Kirby & Bowers, 2017) as morphemes combine phonology, orthography, and semantics (meaning). For example, while learning the Greek combining form *phono*, students identify the initial sound as /f/, notice the pronunciation of *ph* as /f/ and the spelling of /f/ as *ph*, and establish the meaning as sound as in *phonology, phoneme, symphony,* and *cacophony*. A meta-analysis of morphological interventions (Goodwin & Ahns, 2013) found positive effects of morphological knowledge on phonological awareness, decoding, spelling, and vocabulary.

Linguistic comprehension

Linguistic comprehension—the other necessary component of reading comprehension, according to the Simple View of Reading—has its own components that must also be taught, with Hoover and Gough (1990) describing it as "... the ability to take lexical information (i.e., semantic information at the word level) and derive sentence and discourse interpretations through listening" (p. 131). For the most part, the reader with adequate decoding skills and adequate linguistic comprehension will demonstrate adequate reading comprehension (Hulme &

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Snowling, 2009; Nation, 2005). However, it cannot be assumed that all students will achieve adequate linguistic comprehension without instruction, as adequate linguistic comprehension requires ample vocabulary, identification of semantic relationships, sensitivity to causal structures, use of language in a particular context, background knowledge, and ability to make inferences. These elements are taught through the underpinning components of **semantics**, **pragmatics**, **syntax**, and **discourse**.

- **Semantics** pertains to the meanings of words and the relationships among words. Given that a reader's breadth and depth of vocabulary contributes to reading achievement (NICHD, 2000), Beck and colleagues suggested broadening vocabulary by focusing instruction on high-frequency, high-utility words found across the curriculum (Beck, McKeown, & Kucan, 2013). Instruction that focuses on academic language, which includes understanding nuances in word meanings and multiple-meaning words in addition to utilizing precise word choice and other sophisticated words and phrases, deepens students' vocabulary and further promotes success in reading across the curriculum (Friedberg, Mitchell, & Brooke, 2017). It is also beneficial to teach word-learning strategies, such as contextual cues, synonyms, and morphology (Friedberg, Mitchell, & Brooke, 2017; Henry, 2018; NICHD, 2000).

- **Pragmatics** deals with the rules of conversation (e.g., eye contact, taking turns) and the use and interpretation of language in a particular context, wherein "context" refers to the circumstances before and after a particular event. In spoken language, the speaker's tone of voice, facial expressions, gestures, and body language provide cues that the listener can use to determine meaning, which may be non-literal (e.g., sarcasm, metaphors, idioms). These features of spoken language can be imitated in print with dialogue, bolded words, italics, capitalization, and punctuation. When taught systematically, pragmatics facilitates the social use of language, fluent reading, and comprehension; this component is particularly important for English learners, students with deficits in executive function, and students with developmental language disorder (Gordon-Pershey, 2018; Pershey, 1997).

- **Syntax**, which is subsumed under grammar, refers to the order and relationships of words in oral and written sentences, along with the structure of sentences in oral and

written language. Because the order of words may impact the meaning of a sentence (i.e., *The baby sleeps soundly* and *The baby soundly sleeps* convey the same meaning whereas *Dinner is at six* conveys a different meaning from *Is dinner at six*), success with complex texts is dependent on a reader's understanding of sentences with multiple clauses, and particularly of the connective words that signal the relationships of clauses within and across complex sentences (Foorman, Koon, et al., 2015). For example, connective words may signal additional information (*and, also, in addition to*), contrasting information (*but, although, however*), or causal relationships (*because, so, therefore*). A reader's knowledge of pronoun references, verb tenses, and subject-verb agreement is predictive of reading comprehension (Foorman, Herrera, Petscher, Mitchell, & Truckenmiller, 2015; Foorman, Koon, et al., 2015); thus, instruction that includes the parts of speech and syntax supports reading comprehension and written composition.

- **Discourse** refers to the organization of spoken and written communication. Students' proficiency with words, phrases, and text at an oral and listening level predicts reading comprehension (Gough & Tunmer, 1986; Hoover & Gough, 1990). Students learn about written discourse through reading high-quality and engaging books. To support comprehension of written discourse, the National Reading Panel (NICHD, 2000) recommended using multiple strategies proven to be successful in developing metacognitive skills: comprehension monitoring, graphic organizers, question-answering and generation, cooperative learning, story structures, and summarization tasks.

  However, because deep meaning of written discourse comes from relating what is being read to what is already known, it is also important to spend instructional time boosting students' background knowledge (Willingham, 2006). Defined as "the prepotent determinant of comprehension" (Adams, 2009, p. 184), knowledge can be increased through explicit instruction and deep reading in multiple domains and about multiple topics (Adams, 2009; Willingham, 2006). The ability to make inferences—which are implied by a text and require students to integrate their knowledge with the information in the text (Cain & Oakhill, 1999)—best differentiates students with good comprehension from students with poor comprehension at all ages (Oakhill & Cain, 2007; Yuill & Oakhill, 1988) and can be taught explicitly.

The *HOW* of instruction

How we teach reading instruction (i.e., instruction of all the aforementioned components) is characterized by these principles: *explicit, systematic, cumulative, diagnostic,* and *responsive* (Birsh & Carreker, 2018; NICHD, 2000). *Explicit* means that concepts and skills are directly taught and practiced; it should not be assumed that students learn these on their own. *Systematic* refers to a logically ordered presentation of skills and concepts that progresses from simple to complex, and *cumulative* indicates that new learning is built on prior learning. *Diagnostic* and *responsive* indicate that students' instructional needs and strengths are identified, instruction is designed accordingly, and progress is monitored, with adjustments to or supplements to instruction as needed.

Summary

Learning to read is not a natural act; rather, it requires explicit, systematic, and cumulative instruction that is also diagnostic and responsive. The Science of Reading solidifies an understanding of how language and writing systems work by informing the *why, what,* and *how* of effective instruction, both including and going beyond phonics. Although instruction informed by reading science is necessary for all students, it is *essential* for students who are at risk for reading difficulties due to dyslexia, developmental language disorder, deficits in executive function, status as an English learner, or other factors. Ultimately, instruction that is informed by the Science of Reading is the only proven way to ensure students can become proficient readers and confident learners across the curriculum.

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