Emerging Research Reveals the Role Brain Words Play in Reading Success

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Learning to read is a complex cognitive and neurological process—it is no easy task! The sheer complexity of reading has long captured the interest of researchers and scientists across many fields including cognitive, educational, and neuro-psychology. The result? A substantial—and growing—scientific understanding of reading processes and of the reading brain. At the same time, a host of instructional approaches and educational products have emerged to assist with the vitally important task of teaching children to read. But there is a problem. The scientific/research and the educational/teaching worlds have remained stubbornly separate and disconnected from one another. Researchers are often unaware of the realities of the daily classroom and teachers may be equally unaware of what the science of reading has to contribute to childhood education. As research accumulates and our understanding of the reading brain increases, it becomes all the more critical that these two worlds collide. Here we present three vital lessons from the science of reading. These lessons tell us much about the importance of brain words—representations stored in the brain for word meaning, sound, and spelling—and how we can help students develop them.

LESSON 1. Learning to read is not the same as learning to speak—but oral and written language are connected!

We now know that while speaking and reading share many processing domains and brain areas, the actual brain development for reading and speaking is inherently different. This means that oral and written language are acquired very differently. While meaningful immersion triggers and guides the development of oral language, the development of reading brain circuitry requires explicit instruction.

Learning to speak is natural—the human brain is wired up for it, but for most children learning to read has to be explicitly taught—it’s really that simple. Most children will not learn to read, write, or spell
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without direct teaching because they are not born with the necessary neurological reading circuitry. They don’t learn the full intricacies of written language by osmosis, inferring, “picking it up”, hypothesizing the rules or patterns, or figuring out how phonics and the complex English spelling system works—without instruction. For most kids, reading and spelling are not “caught” simply from immersion—even in the most language-rich environment with support. They have to be taught. Despite contentions that reading is “a psycholinguistic guessing game” driven by meaning (Goodman, 1967), learning to read and write is not a guessing game at all. It is a highly complex cognitive, neurologically-based process that integrates various brain regions in connecting print to sound and meaning.

While oral and written language are learned in very different ways, they are still very much related and interconnected in the brain. Think of it this way, when we learn oral language, we learn the speech sounds (pronunciation) and meaning of words (and how to combine those words). When we learn written language, we must also learn an alphabetic code, learning how letters and sounds map onto each other; we learn sequences or chunks of letters and the sounds they make; we learn the printed form (orthography) for words—words that are also part of our oral language system. Learning written language adds a layer of complexity to the system—adding spelling to go along with pronunciation and meaning (Seidenberg, 2017).

It is important to point out that a word’s orthography, linked to sound and meaning, is what we call a brain word—a spelling pattern that is stored in the brain, scaffolded onto or connected to oral language vocabulary. We now know that for reading, accurate spelling patterns stored in the brain, connected to pronunciation and meaning, are a very big deal. They are the key component to word reading success and fluency, freeing up cognitive resources for higher level processes including comprehension. We can help students develop brain words through spelling, while also ensuring pronunciation and meaning are known (Gentry & Ouellette, 2019).

LESSON 2. Cracking the Code: Brain Changes Are Revealed Through Phase Observation

Phase observation solves many of the challenges related to how reading develops. It helps us understand when and what to teach beginners and how to track their development. The instructional technique is for teachers to look for expected outcomes of reading circuitry development in children’s early writing during kindergarten and first grade. We now know that learning to read is a developmental process ignited by English spelling (Adams, 1990; Gentry & Ouellette, 2019; Ouellette & Sénéchal, 2017; Seidenberg, 2017). If we know what to look for in children’s early invented spelling we see evidence of what they have learned, where they are on the early developmental trajectory, whether or not they are having problems, and what we need to teach.
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Beginning writers go through five phases in learning how to combine alphabet letters as they try to figure out how orthography relates to phonology and meaning. It’s no small task when dealing with English. The brains of beginning writers have to integrate orthography with phonology, vocabulary, and grammar.

Using this five phase trajectory, teachers can observe outcomes of how the reading circuitry is developing by looking for changes in invented spelling. It’s been shown that the five invented spelling phases develop in parallel with five early phases of word reading (Ehri 1997, 2000; Gentry & Ouellette, 2019). As reading researcher Linnea Ehri has said, these five phases of word reading and early writing “are one and the same, almost” (Ehri, 1997, 2000). Early support and scaffolding using a spelling-to-read process enables teachers to guide children as they move from one phase to the next (Gentry & Ouellette, 2019). For typical development, it’s reasonable to expect that most children are reading independently with fluency and comprehension by the end of first grade (or at least by the beginning of second grade) as they build a dictionary of brain words—300 to 400 words along with high frequency chunks of syllables and phonics patterns that they use automatically for both reading (decoding) and spelling (encoding) (Gentry & Ouelette, 2019).

Figure 1 presents samples of writing and illustrates the differences in how children represent words in each of the five phase samples.

FIGURE 1. Five Phases of Developmental Spelling

(Adapted from Gentry & Ouellette, 2019)

Each phase sample represents an advancement on the pathway to literacy. Each illustrates outcomes of brain changes as children move through the beginning reading trajectory from no reading to what is expected in Phase 4, which is proficient end-of-first-grade reading. Each phase sample shows a different example of how a child’s brain thinks spelling represents words.
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| PHASE 0 | In the Phase 0 sample the child doesn’t know or use the alphabet. Writing attempts are simply scribbling sometimes with letter-like forms. Often this is a preschool phase where the child has neither learned to write his or her name nor the alphabet principle that letters represent sounds. |
| PHASE 1 | In the Phase 1 sample a beginner in the first half of kindergarten makes a grocery list. He can write his name but his spelling—ILEGOS for milk—shows that he doesn’t yet match letters to sounds. |
| PHASE 2 | In the Phase 2 sample an end of kindergarten writer knows how to represent part of the sounds in the word. One can read HMT as Humpty with the aid of the picture along with her partial alphabetic spelling of Humpty Dumpty. Changes in her brain are moving her forward on the beginning reading/writing trajectory. |
| PHASE 3 | In the Phase 3 sample a midyear first grader has matched one letter to each sound in a slow and laborious process resulting in the Tooth Fairy story. It’s a remarkable accomplishment and one can read it but this full phonetic spelling with a letter for each sound is not quite how English works. |
| PHASE 4 | In the Phase 4 sample the child’s brain has made a giant cognitive leap. His word form area has stored many brain words such as my, foot, feet, like, trees, and school which he both reads and spells automatically along with high frequency chunks of phonics patterns which enable him to write bill-dings (buildings) and ev-re-whair (everywhere) in consolidated chunks of English spelling patterns. |

Taken together, the five samples illustrate remarkable evidence of brain changes in the formation of reading circuitry that occurs over the first years of school. After first grade the reading brain continues to change. It builds circuits for new vocabulary, concepts, and background knowledge; it becomes more efficient, integrating oral and written language processing; it allows for more sophisticated thinking necessary for more advanced level reading. But the basic circuitry and foundational skills should already have been in place by this time. The five phase trajectory built in kindergarten and first grade are prerequisites for more advanced learning and brain changes. This neural network and emergence of the Word Form Area in the brain aligns with the learning of brain words—accurate and detailed representations stored in the brain that connect spelling, sound, and meaning.

LESSON 3. Word reading matters; all words can—and should—be brain words.

Independent reading depends foremost on the ability to read words. As eloquently described by Marilyn Adams (1998), “Words, as it turns out, are the raw data of text. It is the words of a text that evoke the starter set of concepts and relationships from which its meaning must be built.” (p.73) Word reading excels when the reader can build a dictionary of brain words—precise spellings in the brain anchored to pronunciation and meaning. Brain words connect with our spoken language system allowing us to make meaning from
words on a page. Without efficient word reading—that is to say brain words—comprehension and fluency are compromised. Without automatic spelling expertise it’s very difficult to write with fluency and cogency even if the student has a high level of reasoning skill and oral expression (Gentry & Ouellette, 2019).

It has long been recognized that words can be read in different ways, by sounding them out or by more rapid word recognition, seemingly by sight. Unfortunately this valid observation has lead educators down the mistaken path that different words can or should be taught in different ways. We may have phonics lessons to teach sounding out for some words yet have other “sight words” that we ask students to memorize. Yet the science of reading clearly shows us the error of our ways in this regard. It turns out decoding and sight word reading are interconnected processes. It is through decoding and linking letters and sounds to meaning that sight words are established. It is not a one way or the other dichotomy—the processes are linked and reliant on each other.

In reading theory we can differentiate between what are referred to as sub-lexical and lexical processes. Sub-lexical processing is what readers do when they decode a word or spell a word using phonics or chunks of phonics patterns to “sound out” the word from beginning sounds moving on through to the ending sounds. It’s called “sub-lexical” because it involves breaking the word or lexicon into its smaller parts. A lexicon is the stock of words in a language. Lexical processes therefore refer to storing and recognizing entire syllables or words. What developmental theory is clear on is that the creation of lexical representations for word reading very much depends on sub-lexical processing and decoding (Ehri, 2015; Share, 2004). In other words, it is through attempting to sound out words in decoding or analyzing the sound-letter relations in spelling that lexical level representations are formed. If we simply ask children to memorize words without an analysis of the letter and sound patterns (i.e., a sub-lexical focus), a fully detailed brain based representation for that word (lexical representation) is far less likely to be created.

What the science of reading is telling us is that word reading requires decoding and spelling knowledge—and hence integrates alphabetic knowledge, phonological awareness and phonics knowledge/skills to connect pronunciations to strings of letters in long-term memory. Through sub-lexical processes, lexical representations are created. These are the brain words that we know are so important for reading and writing success.

To clarify, we (along with a growing list of others, including Ehri (2015); Rawlins & Ivernizzi (2019); Weakland (2019)), consider sight-words to simply be words that are recognized immediately and without apparent effort, regardless of their spelling pattern. These are the brain words so critical to reading and writing. Essentially, the goal is to make all words sight-words, but not through inefficient memorization. Brain words are best created through interactive explorations of print that affords opportunity to connect spelling, sound, and meaning in the reading brain. This can be accomplished through decoding and through guided spelling within a spelling-to-read approach (Gentry & Ouellette, 2019).
The ultimate goal of word study for all beginning readers and for all word types is to build a store of detailed and accurate spelling representations in each child’s brain. That is, to establish brain words. Word reading proficiency and the development of automaticity using brain words, the deepest level of complete word representations in the Word Form Area of the brain, should be on the top of everyone’s list when it comes to instructional goals. Yet many approaches to teaching reading do not take notice of the scientific study of reading and the brain and building brain words is currently neither a goal of teaching nor an outcome of student learning common to many of the practices that persist in today’s classrooms. This needn’t be the situation. Lessons from the science of reading have much to tell us about how to teach brain words through decoding and spelling.

For more details on what the science of reading has to say about teaching, and step-by-step guidelines on the spell-to-read instructional approach, see the new book by Gentry & Ouellette, *Brain Words: How the Science of Reading Informs Teaching* (Stenhouse, 2019).

**REFERENCES**


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