How the Brain Learns to Read

Second Edition

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Chapter 8. Putting It All Together. Finally, this chapter examines the essential pieces that are needed to develop, select, implement, and support an effective reading program, based on our current scientific understandings of how the brain learns to read. It suggests what beginning readers need to learn, what teachers need to know about teaching reading, and what kind of professional development needs to be implemented to support the reading program. Some suggestions for closing the reading achievement gap are proposed.

Most of the chapters contain suggestions for translating the research on reading into instructional practice.

Resources and Common Core State Standards

The Resources section contains useful information on reading, most of it available on the Internet. At the end of this section are the Common Core State Standards for English Language Arts and Literacy College and Career Readiness Anchor Standards for Reading, along with references to the chapters in this book that address each anchor standard.

The information in this book was current at the time of publication. However, as scientists continue to explore the inner workings of the brain, they will likely discover more about the cerebral mechanisms involved in learning to read. These discoveries should help parents and educators understand more about reading, reading problems, and effective reading instruction.

ASSESSING YOUR CURRENT KNOWLEDGE OF READING

The value of this book can be measured in part by how much it enhances your knowledge about reading. This might be a good time for you to take the following true-false test and assess your current understanding of some concepts related to language, learning to read, reading difficulties, and reading instruction. Decide whether the statements are generally true or false and circle *T* or *F*. Explanations for the answers are identified throughout the book in special boxes.

1.	**T**	**F**	The brain's ability to learn spoken language improves for most people as they age.
2.	**T**	**F**	Learning to read, like learning spoken language, is a natural ability.
3.	**T**	**F**	There are about 200 ways to spell the sounds of the 44 phonemes in English.
4.	**T**	**F**	Research studies have concluded that neither the phonological approach nor the whole-language approach is more effective in teaching most children how to read.
5.	**T**	**F**	Non-English-speaking children can be taught to read English even if their spoken English vocabulary is weak.

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about the author's meaning. Information that does not fit into our memory networks may not be understood or may be understood incorrectly. This is one reason why readers may have problems comprehending text on a subject in which they have no experiences even though they understand the meaning of every word in the text. Memory networks are greatly influenced by an individual's culture. Thus, young readers who were not brought up in the United States may have a difficult time reading and answering questions about George Washington.

Memory networks store not just information, but also images. Our visual lexicon contains thousands of images from our past encounters. Some are vivid, and some are blurry, depending on how many times we recalled them. Recalling an image or a memory strengthens the neural pathways containing the elements of that image, thereby making it easier to recall and more intense. If I told you that I am now going to read you a story about a cat, chances are your brain instantly created a mental image of a cat, most likely one you know. You might even see its color, and hear its meows, or sense the softness of its fur. These images are not only essential to understanding language but are important components of reading comprehension.

Modifying Our Memory Networks

Our memory networks are created through repeated experiences with events, people, and objects that we encounter in our world. When we encounter a new experience, our networks can be modified in any of the following three ways (Figure 2.5):

- *Accretion:* The learner incorporates the new information into an existing schema without altering that schema. For example, suppose I visited a public library, and all that I experienced there fit into my long-held schema of a library as a place with just print material and a card catalog. As a result, I did not alter my library schema in any appreciable way.
- *Tuning:* The learner realizes that the existing schema is inadequate to accommodate the new information and alters the existing schema to be more consistent with the new experience. For example, when I visited a modern public library and realized that the card catalog was replaced by a computer database, I had to modify my library network to accommodate this experience.
- *Restructuring:* The learner realizes that the new information is so inconsistent with the existing schema that a new schema has to be created. For example, now my ability to access the print information at the local public library directly from my computer at home any time of the day or night has forced me to create a new schema.

WHAT DOES NEW RESEARCH REVEAL ABOUT READING?

Although studies using brain imaging and other types of scans have helped researchers understand more about how the human brain learns to read, there are still limits as to what these technologies can do. For example, they

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alphabetic principle to recognize familiar words automatically and accurately, and to decode unfamiliar words. Critics of phonics say that English spellings are too irregular for phonics instruction to be of any value. Nonetheless, phonics instruction teaches children a system for remembering how to read words. For example, when children learn that *ghost* is spelled this way and not *goast,* their memory helps them to remember the spelling and to recognize the word instantly. Although many words are spelled irregularly, most of them contain some regular letter-sound relationships that help children learn to read them. Moreover, students at risk for reading failure, such as those in special education and Title I programs, benefit the most from phonics-based programs (Foorman, Francis, Fletcher, Schatschneider, & Mehta, 1998). An examination of 22 studies showed that phonics instruction resulted in significantly higher achievement for elementary students, especially minority students (Jeynes, 2008). Phonics instruction that is systematic and explicit does all of the following:

- Makes a bigger contribution to a child's growth in reading than little or no phonics instruction.
- Significantly improves kindergarten and Grade 1 children's word recognition and spelling when compared to children who do not receive systematic instruction. It should be noted that the effects of phonics instruction on students in Grades 2 through 6 are limited to improving their oral text and word reading skills. Explicit phonics instruction beyond Grade 6 is not generally productive for most students.
- Significantly improves children's reading comprehension. This is because their increased ability for automatic word recognition allows them more time to focus on and process the meaning of text. Contrary to what some believe, research studies indicate that phonics instruction contributes to comprehension skills rather than inhibiting them.
- Is effective for children from various economic and social levels.
- Particularly helps children who are having difficulty learning to read and who are at risk for developing future reading problems.
- Is most effective when introduced in kindergarten or Grade 1.

How Do I Teach Phonics?

Systematic instruction is characterized by the direct teaching of the letter-sound relationships of both consonants and vowels in a clearly defined sequence. Such programs give children substantial practice in applying these relationships as they read and write, as well as opportunities to spell words and write their own stories. Several approaches to teaching phonics exist, depending on the unit of analysis or how letter-sound combinations are presented to the student:

- *Analogy-based phonics*—using parts of word families to identify unknown words that have similar parts
- *Analytic phonics*—analyzing letter-sound relationships in previously learned words
- *Embedded phonics*—learning letter-sound relationships during the reading of connected text

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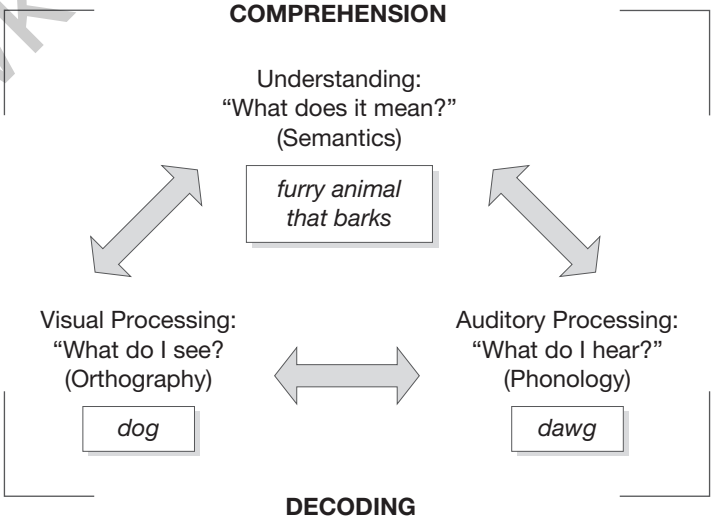
by three neural systems. Figure 5.4 is a simplified illustration of how these three systems interact. Decoding written text into sounds that represent words results when the visual recognition and auditory processing systems see and sound out the words in the reader's head. The frontal lobe interprets the meaning conveyed by those word form representations.

Problems with any one or more of these systems can cause reading difficulties. In some children, the problems occur during early brain development and affect their ability to process the sounds of language and, eventually, to decode written text. This developmental deficit appears to be the most common cause of reading difficulties, and usually results in a lifelong struggle with reading. Less common are problems with reading caused by organic impairments in hearing and vision that can occur at any time in a person's life.

Most research studies on reading have focused primarily on developmental reading problems that scientists refer to as *developmental dyslexia.* (There are several other types of dyslexia, such as trauma dyslexia, which is caused by trauma during childhood affecting the brain's reading areas.) In developmental dyslexia, the child experiences unexpected difficulty in learning to read despite adequate intelligence, environment, and normal senses. It is a spectrum disorder, varying from mild to severe, that has a genetic component. Estimates of the percentage of U.S. schoolchildren with dyslexia vary widely, from 5 to 15 percent. This range seems high, but that may be because there is not full agreement on the threshold used to define the impairment. But neuroscience is helping with this dilemma. Neuroimaging studies have established that there are significant differences in the way normal and dyslexic brains respond to specific spoken and written language tasks. Furthermore, there is adequate research evidence that these differences may lessen with appropriate instructional interventions.

Figure 5.4 Successful reading requires the coordination of three systems: (1) Visual recognition and (2) auditory processing to decode the words, and (3) frontal lobe processing to determine meaning.



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1. The student first writes the whole word down, *transcontinental.*
2. If it is a compound word, such as *butterfingers,* the student writes down each word part, *butter* and *fingers.*
3. If it is not a compound word, the student puts an *x* on these lines and moves to the nest step, which is to write down the root word and any prefixes and suffixes so that *transcontinental* becomes *trans, continent,* and *al.*
4. Next, the student breaks down the root word into its syllables (*continent = con, ti,* and *nent*) and writes down all the word parts, *trans, con, ti, nent,* and *al.*
5. Now the student writes the whole word again while saying it aloud and blending the syllable sounds, *transcontinental.*
6. Finally, the student uses the new word in a sentence: *The transcontinental railroad connected the eastern and western parts of the United States.*

Using Context Clues. The context in which an unfamiliar word is used can often give hints as to its meaning. Help students use context clues by doing the following:

- Select an authentic text passage containing the unfamiliar words that can be defined through context. Ensure that the students have enough prior knowledge that they can reasonably determine the words' meanings.
- Model the process of using context clues to determine meaning by going through the steps of the Context Clues Strategy (see box).
- Think aloud as you use the strategy so that students can follow your reasoning.
- Explain how you used the clues to arrive at the meaning of the word.
- Identify the key words surrounding the target word that helped you decide on its meaning.
- Verify the word's meaning in the dictionary.
- Have students practice the model by giving them a page of text with three unknown words highlighted.

Context Clues Strategy

1. When you come to a word you don't know, continue reading to a good stopping place.
2. Use the context to figure out the meaning of the new word.
3. Guess what the meaning might be.
4. Test your guess by asking if the meaning

   looks right;
   sounds right; and
   makes sense.
5. Check your guess in the dictionary.

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children learned through using concept maps, they spread slowly to other subject areas (Hyerle & Alper, 2011). Studies show that concept mapping also improves content-area text comprehension and summarization for intermediate, middle, and high school students—including those with reading and learning difficulties (e.g., Gajria, Jitendra, Sood, & Sacks, 2007)—as well as improves these students' retention and transfer of learning (e.g., Nesbit & Adesope, 2006). Concept maps are now becoming more popular. There are multiple Internet sites that offer numerous examples of concept maps in many subject areas.

Concept maps are used to do each of the following:

- Develop an understanding of a body of knowledge
- Explore new information and relationships
- Access prior knowledge
- Gather new knowledge and information
- Share knowledge and information generated

Share the guidelines included in the box on tips for making a concept map. Computer programs that build graphic organizers would be more efficient than paper-and-pencil versions, but both are equally effective at improving learning. Cooperative learning teams find Post-its are very useful because they allow items to be moved around on a board or chart until the students are satisfied that they have the best arrangement. The Post-its also make revisions easy. Once completed, the scheme can be put into a computer template.

Tips for Making a Concept Map

Before students get started with their concept map, they should answer the following questions:

- What is the central word, concept, research question, or problem around which to build the map?
- What are the concepts, items, descriptive words, or important questions that one can associate with the concept, topic, research question, or problem?

Here are some suggestions that will help them construct the map:

- Consider using a computer program, such as *Inspiration*, to construct the map. If that is not available, Post-its are handy and allow you to move the concepts around a board easily.
- Use a top-down approach, working from general to specific, or use a free association approach by brainstorming items and then develop the links and explain the relationships.
- If possible, use different colors and shapes for items and links to identify different types of information.
- Use different-colored items to identify prior and new information.
- Experiment with a variety of different layouts until you find one that is compelling, understandable, and attractive.
- Be prepared to revise the map several times. This is another reason why computer software is helpful.

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