1

Creating Meaning With Print

The Neurocognitive Model

Reading is creating meaning with print.

Over the course of the next three chapters, I will describe the process of reading first from a neurological perspective and then from a cognitive perspective. Understanding the process our brains use to create meaning with text will enable you to design and plan effective reading instruction. As stated in the Introduction, the content contained in these first chapters tends to generate questions and sometimes even controversy. Thus, I have included many more reference citations in these first chapters than I do in later chapters.

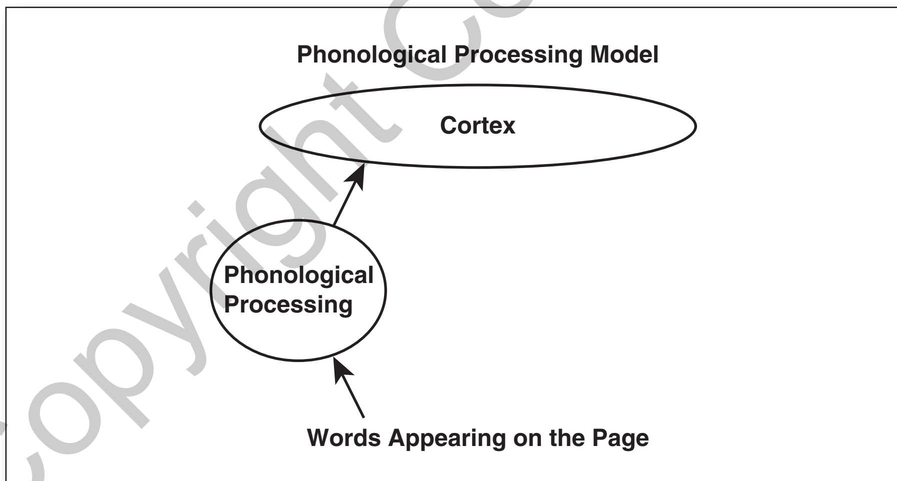
UNDERSTANDING READING

The Phonological Processing Model of Reading

The *phonological processing model* (described briefly in the Introduction) defines reading as simply sounding out words. According to this model, reading is a bottom-up process. Here information flows one way, from the page (the bottom) through the eyes, to the thalamus, and up to the higher regions of the brain or the cortex (the top) (Figure 1.1). According to this model, our eyeballs move in a straight line from left to right along the page as we perceive, and then process each individual letter in our working memory. Each letter is then converted into a sound, the sounds are pasted together to form words, each word is put into a sentence, and each sentence is then put in the context of a greater idea and comprehended. However, that's a whole lot of small moving parts to try to assemble in working memory in the microseconds available to us as we read words and sentences.

Based on the phonological processing model, students with reading disabilities are often given a lot of sounding-out instruction with the assumption that this will help them learn to read. These types of phonics-based programs may improve students' ability to sound out words in isolation, but by themselves, they tend to be minimally effective (Johannessen & McCann, 2009; Strauss, 2011).

Figure 1.1 Bottom-Up View of Reading



The Neurocognitive Model of Reading

The *interactive* or *neurocognitive model* defines reading as creating meaning with print. Sounding out words is seen as only part of the process of creating meaning with print. To illustrate, when you hear somebody speak, you perceive the individual sounds of each word and the individual words, but listening in this sense is different from perceiving individual sounds or putting sounds together to form words. To listen here is to ascribe meaning to the message. You pay minimal attention to the individual sounds and words and instead focus on meaning or what these are pointing you toward. Indeed, the sounds and words carry little meaning by themselves. Instead, these are always found within a meaningful context. As you listen, you use semantics (meaning or context), along with syntax (word order and grammar), and background knowledge (schemata) to understand what the speaker is trying to tell you.

Reading is much the same. We use what's in our head along with the little squiggly shapes appearing on the page to create meaning. Expert readers do not attend to every letter (Paulson & Freeman, 2003; Weaver, 2009); instead, they use minimal letter clues along with context (semantics), the information in our heads (schemata), and syntax to create meaning with print (Binder, Duffy, & Rayner, 2001; Hruby & Goswami, 2013; Rayner & Well, 1996). Right now, as you are reading this page, you are not processing each individual letter. Your eyeballs are actually stopping to focus or fixate on approximately 85% of the content words and approximately 35% of the function words (Rayner, Juhasz, & Pollatestk, 2007). Your eyeballs are making small backward movements (regressions) to refocus on certain content words that may be less familiar to you as well.

Creating Meaning With Print

To illustrate further, take a minute to read the text in Figure 1.2. Notice the difference between reading this and the text in the preceding paragraph. Below your reading was most likely much slower and choppier, your eyeballs made more fixations and regressions, you needed to stop to process and review individual letters, and you sounded out each part of the big words before you put them together. In essence, your reading was very much like that of a struggling reader. And, unless you know Latin, you were not creating meaning with print. Thus, you were unable to use syntax and semantics to try to make sense of this.

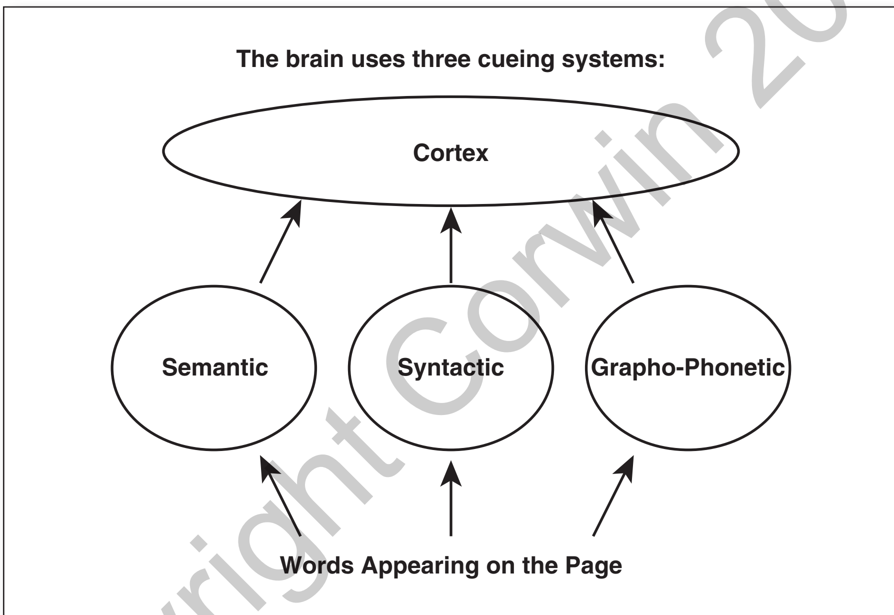
Figure 1.2 Sound This Out

Mea no mucius omittam lobortis, ex eam copiosae vivendum disputando. An est amet inciderint, ne tale etiam adolescens vel, idque postea neglegentur vix eu. Eius nemore ad vel, his veritus eleifend no. Tantas periculis maiestatis sit ne, id eum modo assueverit dissentiet, dicat quaerendum no pro. Id nonumes luptatum percipitur nec, at nec maiorum expetenda abhorreant, bonorum luptatum his an.

READING: A NEUROLOGICAL PERSPECTIVE

We read with our brain. As we read, our brain is constantly reaching out to fill in the blanks or predict the meanings of words in the sentences we are reading (Hawkins, 2004; Paulson & Goodman, 2008). Words are verified using three cueing systems: (a) semantic, (b) syntactic, and (c) grapho-phonetic (Anderson, 2013; Hruby & Goswami, 2013; Strauss, 2011) (Figure 1.3).

Figure 1.3 Three Cueing Systems



The Three Cueing Systems

1. Semantic

The semantic cueing system is the most efficient of the three in terms of speed and space required in working memory to recognize words. Semantics refers to meaning. As you read, you use context and background knowledge to identify words and figure out what the next word might be. For example:

The monkey ate a _ _ _ _ _ _.

You most likely know what the next word is in the sentence above. As your brain read the sentence, it focused on the words "monkey" and "ate." This narrowed the possibilities of the word to something monkeys eat. Based on your knowledge of monkey stereotypes, cartoons, and Tarzan movies, you most likely inserted the word "banana." If you did not immediately insert the word "banana," your brain would have then used the first letter to figure it out. If the word "banana" fit with what went before and after you would have continued. We use the knowledge in our head to predict meanings and confirm meanings or make revisions during the reading process.

The monkey ate a b _ _ _ _ _.

2. Syntactic

Syntax has to do with the grammatical structure of the language. As your brain reads, you also use your knowledge of grammar, sentence structure, word order, tense and plurality, prefixes and suffixes, nouns and verbs, and function words (prepositions, pronouns, etc.) to identify words. This is the second most efficient cueing system.

For example, in the monkey sentence above you focused on the word "monkey" (noun) and "ate" (verb). Your brain knew the missing word had to be a noun of some sort. Using syntax together with semantics you were able to easily fill in the missing word. This is how reading works. Your brain works holistically to create meaning with print.

Let me illustrate the idea of syntax further. Read the short nonsense story in Figure 1.4 on the next page and answer the comprehension questions. Even though it is meaningless, you will discover that you can still answer all the questions simply by examining the syntax. (The answers are at the end of this chapter.)

3. Grapho-Phonetic

"Grapho" refers to symbols; "phono" refers to sounds. The grapho-phonetic cueing system uses letter sounds to predict what the next word might be. Of the three cueing systems, this one is the least efficient. Why? Because it focuses on individual letters and letter patterns instead of words and ideas. As you will see in Chapter 3, your working memory has very limited capacity. You can try to stuff a few letters in there, a few words, or a few ideas, but which would be the most efficient in terms of creating meaning with print? An idea is much bigger than a letter. There are far more things contained in an idea than in a letter.

Figure 1.4 Using Syntax to Create Meaning

A Plumple for Luffy

Flam was very nurff. She had smacken Luffy's plumple. She didn't flink a fushat for him. So, she clepped a plumple for him. She had just atturd the flecker when he ralfed in the smarcker.

"Scrad flammet!" Flam ressed.

Luffy ressed, "That's a smerrest plumple. But my plumple is on Klacky. Murd is Seeland."

"In that relt," ressed Flam, "I won't flink your fushat until Klacky."

Comprehension Questions

1. Why was Flam nurff?
2. What did Flam clepp?
3. Who ralfed in the smarcker when Flam clepped the plumple?
4. What did Flam do to the flecker?
5. Why didn't Flam flink Luffy's fushat?

Source: Based on an example from Sandra Wilde's book, *Miscue Analysis Made Easy* (2000).

The Relative Unimportance of Letters

Letters are not nearly as important as you might think. Figure 1.5 contains a short email message that I sent to students in one of my literacy classes at Minnesota State University, Mankato. I kept the first and last letters the same but scrambled up the inside ones. Are you able to create meaning? How is this possible?

Figure 1.5 Scrambled Inside Letters

I tnihk tihs is a wnuerdfol casls. You are gniog to be geart scapeil eatoucidn tahecres. You are all tlury aaingzmg hamun bgenis. You are aslo good ppoel.

Let me again demonstrate the relative unimportance of letters. Figure 1.6 is a short fairy tale. All the vowels except the initial vowels have been removed. Can you still create meaning with this text? How is this possible?

Figure 1.6 Text With All but the Initial Vowels Removed

Onc upn a tm thr ws a hndsm prnc. H lvd in a cstle. On dy an evl wzrd cm and trnd h int a frg. Th princ crd ot, “Hlp m!”

A btfl prncss cm t th cstl. Sh kssd hm on th lps. H trnd bck int a prnc. Thy lvd hppl vr aftr.

Which are the more unimportant, vowels or consonants? I will let you be the judge. Compare the top sentence, which contains only vowels, with the bottom sentence, which contains only consonants, in Figure 1.7. They are both the same sentence. Which one enables you to best create meaning? Based on this, how much time should we spend on diagraphs, diphthongs, magic *e* syllables, vowel pairs, controlled *r* syllables, and the schwa sound?

Figure 1.7 Vowels vs. Consonants

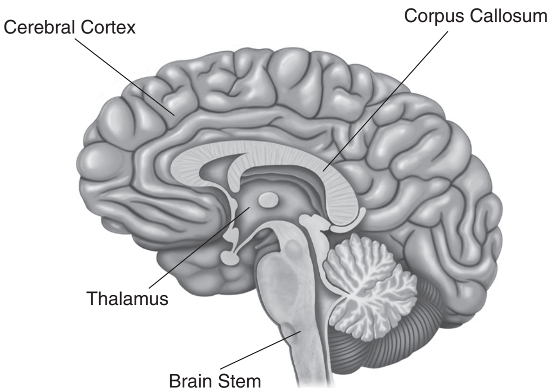
Vowels only: E ee a ae ae e e ooa ea i e. e ae a ea uaea.

Consonants only: Th Grn By Pckrs r th bst ftbll tm n th NFL. Thy hv a grt qrtrbck.

THE NEUROCOGNITIVE PROCESSES

So here is how it all works: As visual data is taken in from the eyes, it moves to the relay station in the brain called the thalamus. All three cueing systems are then used to make sense of this data before it moves to the cortex (see Figure 1.8). The cortex is the part of the brain responsible for higher-level thinking and memory. A system here is not a particular location or part of the brain but a series of interconnected parts or regions (Fischer, Immordino-Yang, & Waber 2007; Xu et al., 2005).

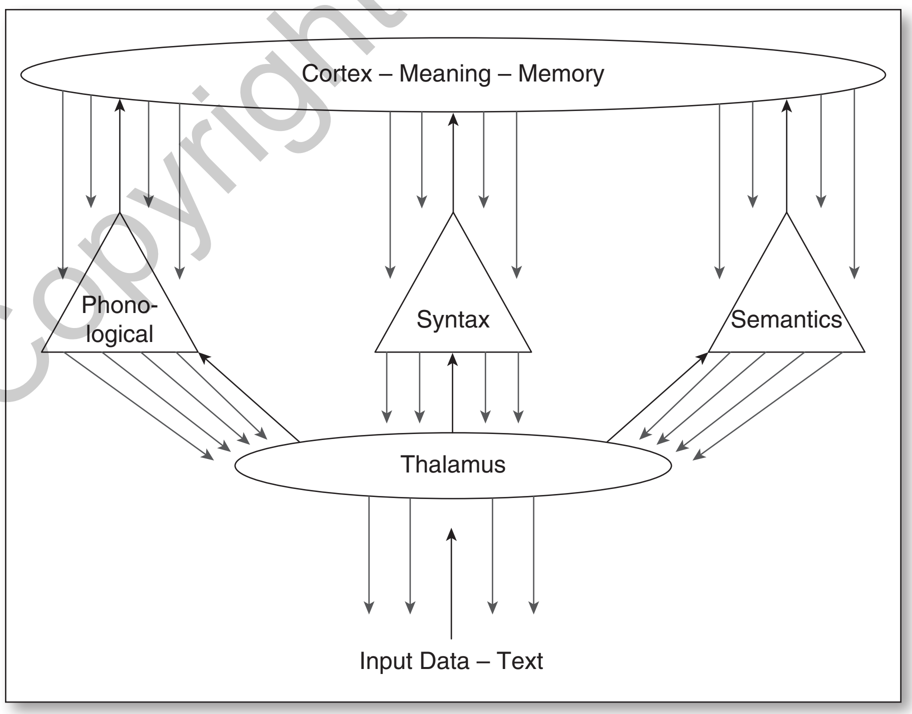
But wait . . . as stated above, information does not flow just one way from the page to the thalamus and up to the cortex. Brain imaging research shows that as we process data taken in by the various senses, information also flows from the cortex down to the thalamus



Source: ©iStockphoto.com/alexluengo

(Engel, Fries, & Singer, 2001; Hawkins, 2004; Hruby, 2009; Koch, 2004). As a matter of fact, there is almost 10 times more information flowing down from the cortex to the thalamus than up from the thalamus to the cortex (Alitto & Usrey, 2003; Destexhe, 2000; Gilbert & Sigman, 2007; Koch, 2004; Sherman & Guillery, 2004; Strauss, 2011) (Figure 1.8). This means that higher structures of the brain (those involved in thought and reasoning) control or influence the lower structures during the act of processing visual information (Ducket, 2008; Gilbert & Sigman, 2007; Hawkins, 2004).

Figure 1.8 Information Flow: Cortex to Thalamus to Cortex



Speed and Efficiency

So what does this mean? We perceive and interpret reality (including text) in terms of the information, images, and patterns stored in our cortex (Engel, Fries, & Singer, 2001; Siegel, 2007). These various forms of data are used to reach out and make predictions about what we are about to experience or encounter (Hawkins, 2004; Schwartz & Begley, 2002). Sense data is then used to confirm or revise these predictions and to encode our current version of reality. As well, we perceive only the salient aspects of any situation and use relevant information in our cortex to fill in the blanks (Baars & Gage, 2007). Our brains have evolved to operate this way for the purpose of speed and efficiency (LeDoux, 1996).

When used to create meaning with print, this process has been described as a psycholinguistic guessing game (Goodman, 1986). However, this phrase has been misunderstood and misinterpreted by some. It does not mean to imply that we randomly guess at words during the act of reading or that we teach children to guess at words. Rather, it means that cognitive efficiency and accuracy are achieved when the knowledge structures and higher-level processes are used to make sense of incoming data. In terms of reading, effective readers use the information in their head along with semantic and syntactic information to make sense of what's on the page.

The Meaninglessness of Individual Words

If you are locked into the phonological model and believe that reading is simply sounding out words, the three-cueing systems model will make no sense. Much of the research used to support the phonological model of reading is based on the assumption that reading is sounding out words (Hruby, 2009; Schulz et al., 2008; Strauss, Goodman, & Paulson, 2009). These studies commonly asked students to identify single words or nonsense words apart from any meaningful context. However, rarely (if ever) do we encounter single words in isolation. Even signs or labels that contain single words are seen in some context. For example, stop signs, signs for fast-food restaurants, or product labels are all encountered in a meaningful context. Indeed, about the only time we ever encounter individual words outside of a meaningful context is when we ask students to read lists of words or nonsense words for some type of reading test.

Research to support the three-cueing systems model comes from a variety of areas including eye movement studies (Binder, Duffy, & Rayner, 2001; Paulson & Goodman, 2008; Rayner & Well, 1996), schema studies in cognitive psychology (Anderson, 2013; Andersson & Barnitz, 1984; McVee, Dunsmore, & Gauelek, 2013), priming studies in psycholinguistics and cognitive psychology (Chernove, 1979; Münte, Heinze, & Mangun, 1993; Osterhout & Holcomb, 1992; Trueswell, 1996), miscue analysis studies (Goodman & Goodman, 2013), various brain imaging studies (Flegal, Marin-Gutierrex, Ragland, & Ranganath, 2014; Friederici & Kotz, 2003; Friederici & Weissenborn, 2007; Hogoort, 2003; Kuperberg, 2007; Poldrack et al., 1999; Sakai, Noguchi, Takeuchi, & Watanabe, 2002; Schulz et al., 2008; Van Berkum, Hagoort, & Brown, 1999), and studies related to reading instruction (Clay 1991; Isakson & Miller, 1976; Kennedy & Weener, 1974; Weaver, 1979). This list of studies and research reviews is a sampling and by no means comprehensive. It does, in my view, provide overwhelming support for the three-cueing systems model.

Last Word

The last thing to mention about the three-cueing systems model described above is that it is not an approach or a method of reading instruction. It's a model that describes how the brain identifies words during the act of creating meaning with print. To help all readers reach their full reading potential, all three cueing systems must be developed. The chapters that follow will present a variety of strategies for doing just this.

Answers

Figure 1.4 Comprehension Questions:

1. Why was Flam nurff?

   Because she had smacken Luffy's plumple.

2. What did Flam clepp?

   A plumple.

3. Who ralfed in the smarcker when Flam clepped the plumple?

   Luffy.

4. What did Flam do to the flecker?

   She atturd it.

5. Why didn't Flam flink Luffy's fushat?

   Because his plumple was on Klacky.

Figure 1.5:

I think this is a wonderful class. You are going to be great special education teachers. You are all truly amazing human beings. You are also good people.

Figure 1.6:

Once upon a time there was a handsome prince. He lived in a castle. One day an evil wizard came and turned him into a frog. The prince cried out, "Help me!"

A beautiful princess came to the castle. She kissed him on the lips. He turned back into a prince. They lived happily ever after.

Figure 1.7:

The Green Bay Packers are the best football team in the NFL. They have a great quarterback.