CHAPTER 1: READING AND YOUR BRAIN – THE TRANSACTIVE MODEL

Andrew P. Johnson, Ph.D.
Minnesota State University, Mankato

I could while away the hours
Conferrin with the flowers
Consultin with the rain
And my head I'd be scratchin
While my thoughts were busy hatchin
If I only had a brain

Over the course of the next three chapters I will describe the process of reading. Only by understanding the process our brains use to create meaning with text can we adequately plan effective instruction.

DEFINING READING

Reading can best be understood by first describing what it is not.

What Reading Is Not

Contrary to common thought, reading is not simply sounding out or decoding words. While being able to sound out words is of some importance, it is only a part of actual reading process (I will explain below). Defining reading as sounding out words is like defining football as kicking field goals. Both are necessary parts of the whole, but neither is sufficient by itself. This very limited view of reading is called a *phonological processing model.* Much of the bad or ineffective reading instruction dumped on our students is based on this very limited view.

Figure 1.1 contains some common assumptions about reading and the teaching reading based on the phonological processing model. Based on this mode, students with reading disabilities are usually given a whole lot of sounding-out practice with the mistaken assumption that this will help them learn to read. It does not happen. These types of phonics-based programs are minimally effective (Johannessen & McCann, 2009). Sounding-out practice may improve students' ability to sound out words in isolation, but by themselves they actually inhibit more than enhance students' ability to create meaning with text (Strauss, 2011).

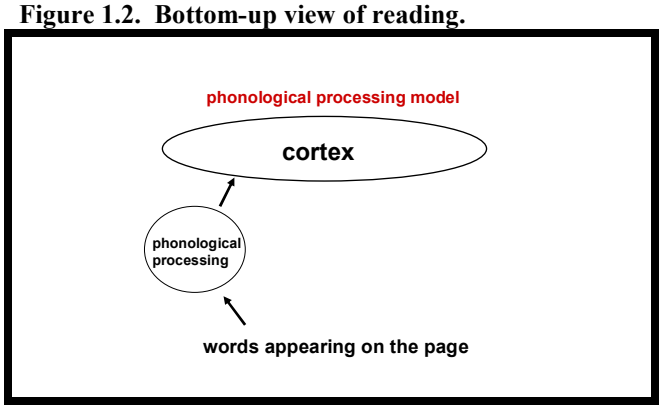
Figure 1.1. Common myths about reading.

Nonsensical Ideas That Seem to Make Sense

1. Reading is sounding out words.
2. Poor reader need more practice sounding out words.
3. Practicing sounding out words makes learn to read easier.
4. If readers stumble on a word you should tell them to sound it out.
5. There is one approach to reading instruction that works best.

According to the phonological processing model reading is a bottom-up process. Here information flows one way, from the page (the bottom) through the eyes, and up to the higher regions of the brain or the cortex (the top), (Figure 1.2). This one-way flow is like putting people on an escalator and moving them up to the next floor. Not a very efficient way to move a lot of information.

Figure 1.2. Bottom-up view of reading.



The phonological processing model is wholly inadequate in describing or explaining the complex process of reading. According to this model our eyeballs move in a straight line from left to right along the page as we 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 then each sentence is put in the context of a greater idea and comprehended. That is a whole lot of small working parts to try to assemble in working memory in the microseconds available to us as we read words and sentences.

What Reading Is

Reading is creating meaning with text. This is different from sounding out words. For example, if you read the text in Figure 1.3 you could examine the arrangement of letter groupings and make the appropriate sounds for each, but unless you knew Latin, you would simply be creating sound. As such, you would *not* be reading. Simply barking sounds into the air on cue like a trained seal is not reading. Further, instruction that focuses solely on seal behaviors does little to enhance students' ability to create meaning with text. We want to develop readers who create meaning not trained seals. Reading is a thinking process. Barking at letters is not.

Figure 1.3 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.

A model that more accurately explains the reading as meaning-making process is the *transactive model*. This model will be described in more detail below, but the basics are that the information in our head is used to make sense of the information on the page during the reading process. What is in our heads transacts with what is on the page to help us create meaning. So, instead of bottom-up movement, there is a simultaneous two-way flow of information. More on this below.

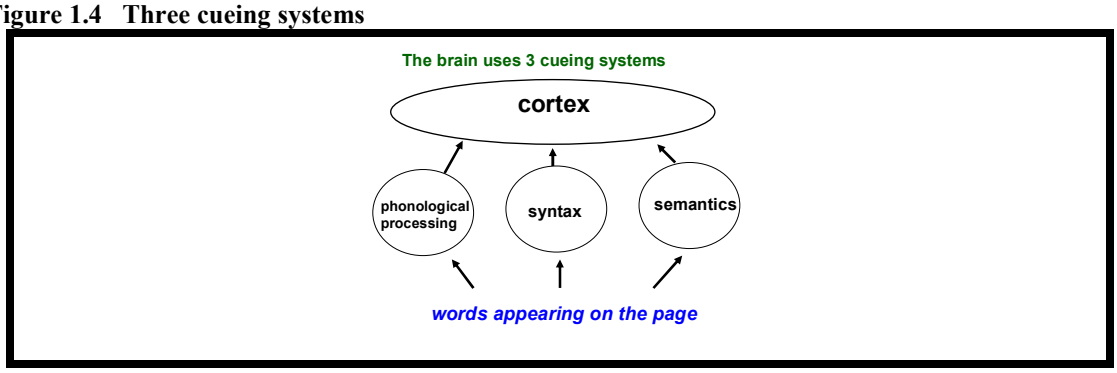
READING: A NEUROLOGICAL PERSPECTIVE

We turn now to understanding how our brain functions during the thinking process we call reading.

Cueing Systems

In the act of reading we use the knowledge stored in our cortex to constantly reach out and predict the meanings of words in the sentences we are about to read. Cueing systems provide the brain clues (or cues) as to what the word or sentence might be. Our brain uses three cuing systems to make these predications: (a) semantic, (b) syntactic, and (c) grapho-phonetic (Figure 1.4).

Figure 1.4 Three cueing systems



1. Semantic. The semantic cueing system is the most efficient of the three in terms of speed and processing space required to recognize words. Semantics refers to meaning. As you read, you use context and background knowledge to figure out what the next word might be. (You are doing it right now.) 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 word '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 predict what the next word might be. 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 by showing you an example taken from Sandra Wilde's book, *Miscue Analysis Made Easy* (2000). Read the short nonsense story in Figure 1.4 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 (answers are at the end of this chapter).

Figure 1.4. Using syntax to create meaning.

A Mardsan Giberter for Farfie

Using Syntax to Create meaning

Glis was very fraper. She had denarpen Farfie's mardsan. She didn't talp a giberter for him. So she conlanted to plimp a mardsan binky for him. She had just aparved the binky when he jibbled in the gorger.

"Clorsty mardson!" she boffed.

"That's a crouistish mardsan bink," boffed Farfie, "but my mardsan is on Stansan. Agsan is Kelsan."

"In that ruspen," boffed Glis, "I won't whank you your giberter until Stansan."

Comprehension Questions
1. Why was Glis fraper?
2. What did Glis plimp?
3. Who jibbled in the gorer when Glis sparved the binky?
4. What did Farfie bof about the mardsan binky?
5. Why didn't Glis whank Farfie his giberter?

3. Grapho-phonetic. 'Grapho' refers to symbols, 'phono' refers to sounds. The grapho-phonetic cueing systems 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 short term 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 text? Let me give you a hint: An idea is much bigger than a letter. There are far more things contained in an idea than in a letter.

We think letters are so very important, especially vowel sounds. We spend hours and hours teaching them with the mistaken assumption that they are the key to unlocking the reading process. Oops. Much of this time and energy could be spent doing something else (like reading good books). Allow me to demonstrate how really unimportant letters really are. Figure 1.5 contains a short email message that I sent to the undergraduate students in my literacy class 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?

Figured 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?

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 is 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?

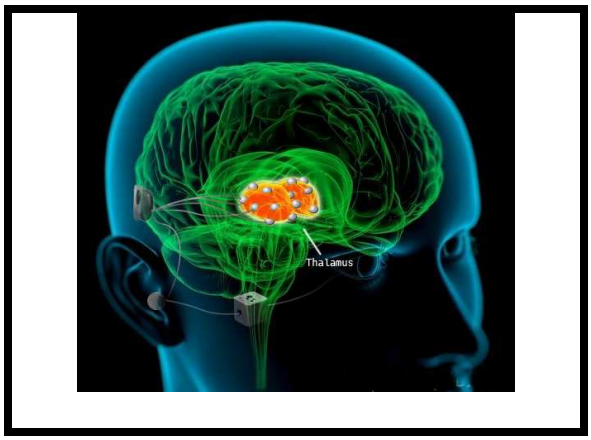
Figure 1.7. Vowels vs. consonants.

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

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

Two-Way Flow

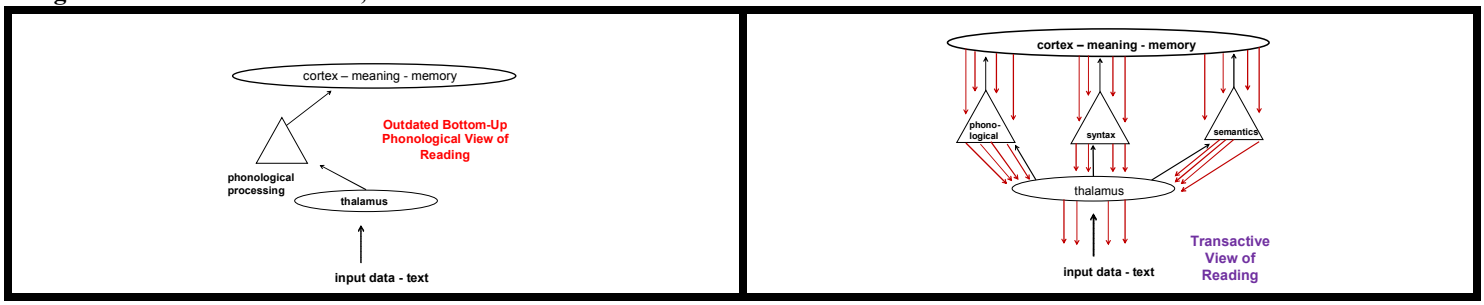
So here is how it all works: As visual data is taken in from the eyes, it moves to the relay station in the brain called the thalamus. All three cuing systems are then used to make sense of this data before it moves to the cortex. This is the part of the brain responsible for higher thinking and memory.



But wait … as stated above, information does not flow just one way from the page up to the cortex (bottom-up). Brain imaging research shows that as we process data taken in by the various senses, information flows from the cortex down to the thalamus as well as from the thalamus up to the cortex (Hawkins, 2004; Hruby, – Koch, 2004; include others). As a matter of fact, there is almost 10 times more information flowing down from that cortex to the thalamus than up from the thalamus to the cortex (Figure 1.7). But what does this means?

In essence we perceive all of reality (including reading) in terms of stored information, images, and patterns stored in our cortex. Our brain is essentially a memory machine. These various forms of data are used to reach out and make predictions about what we are about to perceive, experience, or encounter. Sense data is then used to confirm, revise, or deconstruct these predictions and construct our current reality. (I will describe how this relates to reading below.). For example, if you are about to enter a restaurant your brain has already made predictions as to what this restaurant will look like based on the all restaurants you have experienced in your life. This restaurant data is called a *schema* (plural is schemata). Schemata are the file folders in your head related to specific concepts and experiences. You use schemata to help you understand what you are experiencing, but also to predict what you are about to experience. (This will be explained further in Chapter 2).

Figure 1.7 Information flow, cortex to thalamus to cortex



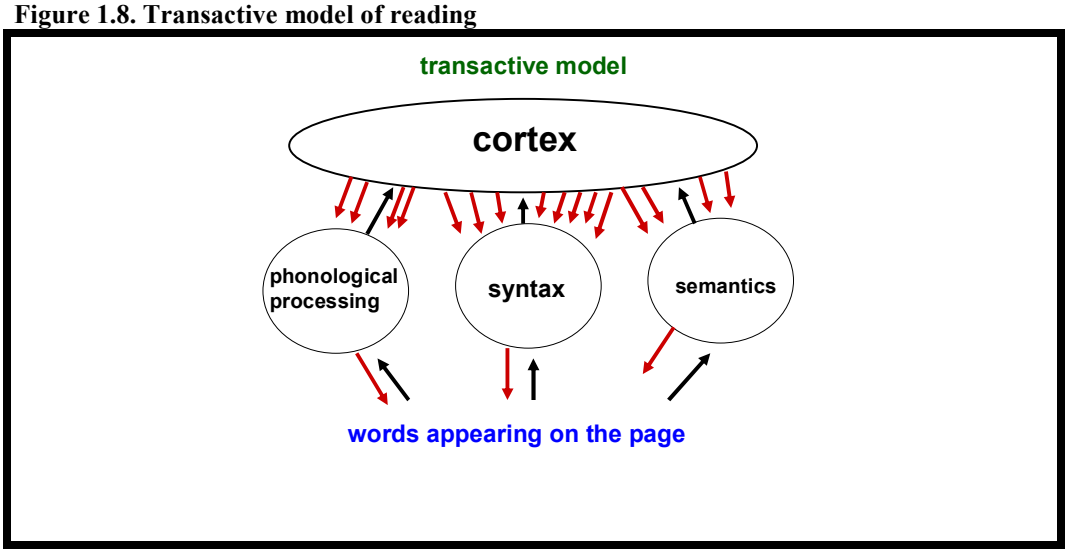
The Transactive Model

We turn now to reading and the transactive model. In a business transaction, both parties give something in order to get something. The transaction model of reading is similar in that it recognizes that there is a transaction between the information contained in the cortex (long term memory) and the information contained in text during the reading process. Both the reader and the text give something (information) in order

to get something (meaning). Thus, there is a two-way flow of information as readers construct meaning with text.

The phonological processing model of reading (Figure 1.7), which defines reading as merely sounding out words, does not account for this two-way flow of information, nor does it incorporate two of the three cueing systems. However, the transactive model of reading does (Figure 1.8), and it is more in alignment with a fairly broad body of research related to the reading process (miscue analysis, eye movement research, brain imaging) (cite Good, etc.).

Figure 1.8. Transactive model of reading



LESS IS MORE

"*So what*?" you ask. "*What does this have to do with helping my child or my students learn to read*?"

The Problem with Overemphasizing Phonics

Reading programs that use only a phonics-based approach develop the least efficient cueing system while ignoring the development of the two more efficient cueing systems. This actually makes it harder for children to learn to read (Strauss, 2011). You are asking them to learn to read with only one third of their reading brain. All children, especially students with reading disabilities, benefit most from instructional programs that develop all three cueing systems simultaneously.

However, students with reading disabilities are often force fed a steady diet of pure phonics (Johannessen & McCann, 2009). And when this does not work, they are given more phonics so that they can not succeed at an even higher rate. And when this does not work, they are sent out of the classroom for "special" remedial help or to a special education teacher where they get even more phonics heaped on them at a slower pace with the idea that they will be able to someday catch up with their peers. Two questions for you: Do they ever catch up? In what universe would you tell somebody to slow down so they could catch up? This sounds more like a Buddhist Koan. What is the sound of one hand clapping?

And by the time schools realize that this uber-phonics approach does not work with students with reading disabilities, it is time for them to graduate from high school … or in most cases, it is time for them to not graduate from high school.

Abraham Maslow once said, if the only tool you have is a hammer, all the world becomes a nail. If the only tool you have in your toolbox is phonics all the world becomes one giant phonics worksheet. Phonics instruction is necessary but far from sufficient. A little phonics is good. That does not mean that a whole lot of phonics is better.

Minimal Letter Cues.

As alluded to above, letters are overrated. As you read your brain is constantly making predictions as to the meaning of words and sentences. It reaches out a little in front of where your eyeballs are at (cite) in its attempts to create meaning. Letter cues, along with semantic and syntactical cues are simply used to confirm or

revise predictions. In this meaning-making-prediction process, mature readers do not look at all the letters. As you saw in the examples above, we use minimal letter cues as we read. And having background knowledge related to what we are reading and being able to use semantic and syntactical clues makes us even less reliant on letter clues to create meaning with text. And this is a good thing because if our limited short term memory is filled with letters, there is not a lot of room for ideas and hence, it becomes much harder to create meaning with text.

Remember, our brains are essential memory machines (Hawkins, 2004). Everything we ever experience or encounter is stored in long term memory (see Chapter 3). It is not a matter of putting it in there (storage); rather it is a matter of getting it out (retrieval). If we encounter a word only once that word is buried in our long term memory. The neural pathways to that word do not have a chance to develop and chances are that we will have a very hard time retrieving it. Since retrieval is difficult, for all practical purposes we have forgotten that word. But the more times we encounter a word (hearing it, using it, seeing it in print), the more developed that pathway becomes and the easier it is to retrieve it from long term memory. And if that word becomes associated with other things, neural networks form providing multiple pathways to that word. Retrieval becomes even easier. When we now encounter that word in print we need minimal clues to recognize it.

The vast majority of words we read we have encountered before (in verbal or written form) and are already stored in long term memory. We use our various cueing systems to instantly provide access to these words as we are reading. But here is an important point: words are encoded and stored in long term memory primarily around meaning not around letter patterns. For example, when you hear the word cat – all sorts of things associated with cat instantly come to mind: pet, furry, cat food, paws, Puff, purr, etc. You do not believe me? Try this little experiment. First, have a friend give you a noun at random. Without thinking, write down the first things that pop into your mind in the first 10 seconds. You most likely are able to quickly identify four or five associations. This means in the cognitive web, these things are connected or stored together.

For second part of this experiment, have your friend give you a diagraph, dipthong, vowel, letter pattern, or phonogram at random. Then quickly write down the first things that come to mind. Chances are that after one word you will have to stop and think. The images and words do not come quickly. Why? Again, we tend to encode and store words according to meaning, not letter patterns. We create schemata based on ideas and related experiences. Remember, our brain naturally seeks order and tries to create meaning. This is another reason why a cueing system based on meaning (semantics) is the most efficient cueing systems followed by syntax.

NECESSARY BUT NOT SUFFICIENT

So what are we to take from all of this? Teaching phonics and letter-sound relationships is necessary but far from sufficient in helping children learn to read. Many children learn to read without any phonics instruction at all. One of the reasons why some children have such a hard time learning to read is that they have been force fed a steady diet of phonics with nothing else to supplement it. To an adult mind, phonics makes perfect sense. You see a little symbol. It stands for a sound. You put together all the little symbols and sounds. You create a word, and there you are … reading. It is a s simple as that.

But to a young mind operating at the concrete operational level, this whole symbol-sound thing is a very abstract endeavor. And to make matters worse, in a pure phonics-based approach students are often given texts to read that are not designed to be interesting or meaningful; rather, they are designed to reinforce whatever letter-sound the teachers is currently working on. For example, when working on the short /a/ sounds students might be assigned to read text like this:

Dan the man sat on a fan.

Who talks like that? Nobody. This is an example of a *controlled vocabulary*. This is when words used in the story are controlled or manipulated in order to teach or reinforce a particular letter sound. While this sounds good in theory, it does not work in reality. The problem is that controlled language like this does not sound like the language children hear around them. This makes learning to read even more abstract (and also

very, very dull) because the language that children see on the page is nonsense. It is very hard to make sense out of nonsense.

Oh, oh. Look, look. See the child. See the child fail. Fail child fail.

So how much phonics instruction should you provide most students? The least amount necessary. What about students with reading disabilities? The answer is the same: The least amount necessary to get them up and reading. However, reading instruction should never be simply phonics … unless you are purposely trying help students become alliterate or illiterate.

TEACHING TIPS

Here are four simple teaching tips based on the ideas presented in this chapter:

1. Read about familiar things. One way to make reading easier for adolescents with reading disabilities is to have them practice reading things of which they know a lot about. In the next chapter you will be introduced to the language experience approach (LEA). Here students dictate an experience to you that they have had. They then practice reading using their own words and experiences. Also, look for short paragraphs about motorcycles, dating, fashion tips, mixed martial arts, or whatever is of interest and known to the adolescents with whom you are working.

2. Use schemata as a pre-reading strategy. We use the information in our head to make sense of the information on the page. So, one common strategy to use with struggling readers is to pre-teach important concepts before students read about them. Give them as much information before they read. You might also include important vocabulary words or present concept maps, semantic maps, or labeled diagrams. A related strategy is to simply activate relevant schemata. That is, have students brainstorm and list everything they know about a topic before reading. When reading narrative text, tell students the character names, settings, and important events before reading the story (this is called story grammar).

Also, find reading material related to students' lives or interests. What things do they know a lot about? Two simple strategies here are student-written stories. These use words and experiences taken directly from students' lives. You can create books of these for students to read and practice reading from year to year. Also, the language experience approach (describes ***) where students dictate their experiences to you. You write them up on a computer, overhead projector, board, or chart. Students then practice reading using their own dictated story.

3. Take a multi-dimensional approach to literacy instruction. Reading instruction should NEVER be simply phonics. Always include activities that develop semantic and syntactical cueing systems (described in Chapter 7). Chapter 8 describes the eight essential elements that should be included in literacy instruction of any kind.

4. Use semantic clues first. Sounding out a word is the least efficient method to use in recognizing it. If a student does not know what a word is, the first thing to ask is, "What word makes sense in the sentences?" This gets the student focused on the more efficient semantic and syntactical cueing systems rather than the less efficient grapho-phonological cuing system.

References

Ducket, P. (2008). Seeing the story for the words: The eye movements of beginning readers. In A Flurky, E. Paulson & K Goodman (Eds.) *Scientific Realism in Studies of Reading,* 113-128. New York: LEA

Johannessen, L.R. & McCann, T.M. (2009). Dolescents who struggle with literacy. (pp 65-79. In > Christenbury, R. Bomer, and P. Smagorinsky's (Eds.). *Handbook of Adolescent Literacy Research*. New York: Guildford Press.

Koch. C. (2004). *The quest for consciousness: A neurobiological approach.* Englewood, CO: Roberts and Company Publishers.

Paulson, E.J. & Goodman, K.S. (2008). Re-reading eye-movement research: Support for transactional models of reading, 25-50. In A Flurky, E. Paulson & K Goodman (Eds.) *Scientific Realism in Studies of Reading,* New York: LEA

Strauss, S.L. (2001). Neuroscience and dyslexia (pp 79-90). In A. McGill-Franzen and R.L. Allington (Eds.), *Handbook of reading disability research*. New York: Routledge.

Wilde, S. (2000). *Miscue analysis made easy: Building on student strengths.* Portsmouth, NH: Heinemann.

Answer to Figure 1.4. Answers to comprehension questions.

1. Why was Glis fraper?
   RE: Because she had denarpen Farfie's mardsan.

2. What did Glis plimp?
   RE: A mardsan binky.

3. Who jibbled in the gorer when Glis sparved the binky?
   RE: Farfie.

4. What did Farfie bof about the mardsan binky?
   RE: "That's a crouistish mardsan binky."

5. Why didn't Glis whank Farfie his giberter?
   RE: Because his mardsan was on Stansan.

Answer to 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. Text with the inner vowels removed.

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. Vowels vs. consonants.

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