Brain Function, Spell Reading, and Sweep-Sweep-Spell

by Abigail Marshall, March 2005

"This is not phonics or a phonetic process; it is simply letter and word recognition." – Ronald D. Davis

Two of the most important Davis tools for building reading fluency and word recognition skills are Spell-Reading and Sweep-Sweep-Spell.[1] During these reading exercises, the student reads a passage out loud in the company of his support person. When he encounters an unfamiliar word, he spells it out letter by letter; after he says the name of the last letter, if he recognizes the word, he says the word, and then moves on. If he does not recognize the word, his helper supplies it for him, and the student repeats the word – and then continues.

Spell-Reading and Sweep-Sweep-Spell are important because they build a vital center for reading in the brain. Beginning readers often rely exclusively on phonetic decoding strategies for all words, a process usually centered in the mid-temporal lobe of the left hemisphere, where letter sounds are connected to words. This is a workable means of decoding words, but it is slow – and it is particularly difficult for most dyslexics.

The Importance of Visual Word Form Recognition

Fluent readers use a different part of their brain to recognize familiar words – an area in the rear left-hemisphere occipital lobe, dubbed by scientists the "Visual Word Form Area" (VWFA).[2] Essentially, this part of the brain is a storage bin for all of the familiar, known words – what teachers call "sight words". It is located in the visual cortex – the part of the brain that responds to all visual stimuli – and for typical readers, it is the first part of the brain to activate when the eyes perceive a word. Thus, known words are recognized and understood in subliminal time, even before the reader is aware of having seen the word or capable of speaking it. Generally, the VWFA activates and completes its work of matching the letter string to a known letter pattern within the first quarter-second of exposure to a letter string.

From there, the whole word can be sent to parts of the brain where meaning is ascertained. For typical readers, this is probably the same left-hemisphere temporal region as where sounding out occurs; but with development of the VWFA the process becomes one of matching the sounds of whole words to their meaning, rather than sounding out letters or small word segments.

In typical readers, the VWFA is developed and begins to activate regularly in response to exposure to letter strings at around the age of 8 – the time most children are transitioning

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from early decoding skills to fluent and meaningful reading. But unfortunately, this is the part of the brain that doesn't seem to work for uncorrected dyslexic readers. Research shows that this area is largely bypassed, with higher activity occurring in right brain and frontal regions, important for discerning patterns and solving puzzles.[3] These areas don't even begin to activate until after the VWFA has already done its job for more skilled readers.

So the brain picture shows us that while the typical reader relies on an instant word-recognition system, the dyslexic reader must use time-consuming, analytical thought processes. Where for others reading is a matter of recognizing the familiar, for dyslexics it is a constant and exhausting exercise in puzzle-solving.

Training the Brain

Davis Spell Reading and Sweep-Sweep-Spell are exercises for the eyes and brain. They are designed to train the brain to develop the instantaneous, visual word recognition system that non-dyslexics acquire naturally. These techniques are not intended to entirely supplant other strategies; ideally, the student will only practice Spell-Reading and Sweep-Sweep-Spell for 10 minutes at a time – just enough time to exercise and reinforce the important neural pathways that they build.

Many students are tempted to use their sound-it-out phonics skills at this time. However, the use of phonics at this time defeats the purpose of the exercises. As explained in *The Gift of Dyslexia*, if the student starts using phonetic strategies, the helper should say:

> *"You don't need to sound out the word. Only say the name of the letters one at a time. All we want is for you to name the alphabet letters in the order they are written. Then you say the word after I say it."*

The problem with adding phonics to the mix is that it sends the brain down the wrong path. We are training the brain to use the vital short-cut that is the hallmark of all good readers – the ability to recognize a string of letters and match them almost instantaneously to a known word, a skill sometimes referred to as "orthographic knowledge".

Every time the brain takes a detour to another path, we reinforce the pre-existing mental habits, and fail to build the short cut for visual word form recognition. This is the reason why dyslexic children schooled heavily in phonics have such difficulty transitioning to fluent reading: their phonic knowledge is strengthened and reinforced again and again, undermining the opportunity to develop the neural shortcut that ordinary readers have access to at age eight.

The Importance of Timing

It is not enough for the brain to merely "see" the series of letters that form a word – the brain must have a means of sorting and recording the order of the

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letters. FORM is not the same as FROM; TEA is not the same as EAT. When we look at brain scans taken with an fMRI, we are looking at images taken at one second intervals; whereas much of the work of the brain occurs in a time frames measured in tiny fractions of a second. To understand the process of word recognition, we need to do more than look at a picture of the brain; we also need to correlate the activity with the passage of time. This can be seen with the use of an EEG; which measures the rate of electric impulses generated by brain cells, which are in turn charted as oscillating waves showing the patterns generated by various areas of the brain.

Ordinarily when a person is awake and alert, the brain produces beta waves with a frequency of about 13-30 HZ. When attention is engaged for learning or retaining new information, brain activity increases to the gamma range, producing brain waves of about 40 HZ.

When the eyes fixate on an object, information is transmitted to the visual cortex of the brain, where different types of information are registered and evoke a response from different specialized sets of neurons. Information about shape, color, or position of an object is processed in different parts of the visual cortex. The process by which the brain reassembles the information is called *binding*. Scientists think that binding takes place when all neurons associated with the perceived object begin firing simultaneously, in a synchronized gamma wave pattern.

Thus, when looking at a word, the separate neurons associated with recognizing each individual letter will be firing simultaneously, in a uniform, synchronous wave pattern. In order for the letters in the string to be seen and remembered as a word, the brain must also have an efficient means of retaining information about letter order. Dr. Carol Whitney of the University of Maryland has proposed a specific scheme for encoding of letter order that she calls SERIOL: "sequential encoding regulated by inputs to oscillations within letter units".[4]

Dr. Whitney suggests the letter-order, word recognition skill is a matter of the timing of neural firing within short brain wave cycles, combined with a invocation of a mental grid which assigns a priority value to each letter based on its relative position. The grid is established through the ingrained habit of reading words from left-to-right, or from right-to-left in languages like Hebrew and Arabic.

Although the neurons for recognizing each letter are all firing, the brain's internal prioritizing system will register the first letter in any series slightly before the second letter, the second slightly before the third, and so on. This process takes place very rapidly; each letter position is registered within successive subcycles of about 25 milliseconds for each letter, within an oscillatory period of 200 msec. This is long enough for the brain to process about 7 or 8 letters within a string, and will allow a person to read at a rate of about 5 words per

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second, or 300 words per minute, which is about average for skilled readers.
Because timing is so important, the ability to recognize letter order is impaired if perception of individual letters is delayed. For example, experiments have shown that as time intervals between display of letters are extended, the subject's ability to remember letter order diminishes. These experiments are usually done with skilled adult readers; when the timing is off, the test subjects start making the same kind of mistakes that are typical for dyslexia: letters are perceived out of order, and the subjects are unable to form a mental picture of the whole word.

When exposure to letters is extended to 50 msec between letters, performance falls to 70% accuracy; at 125 msec., it falls to 50%. However, test subjects do just about as well at an interval of 250 msec. as at 50 msec; this shows the importance of the 200 msec. brain wave cycle. A 250 msec. delay results in recognition taking place at the 50 msec. point in a second cycle.

In practice, someone scanning a word slowly enough to restore accuracy -- a delay of 200 msec. per letter - would also be forced to read at a painfully slow rate. This, of course, is what is often seen with dyslexic readers who read accurately but much more slowly than their non-dyslexic counterparts.

Davis Tools and the SERIOL Model

It is very possible that the Davis tools of Orientation, Alphabet Mastery, Punctuation Mastery, Spell-Reading, and Sweep-Sweep-Spell, work by their combined effect on the brain's timing system and through training of the visual system to apply the priority gradient proposed by the SERIOL model.

With Alphabet Mastery and Punctuation Mastery we insure that the brain is able to accurately recognize each letter and punctuation mark. With Davis Orientation, we probably reset the brain's internal clock so as to enable the simultaneous gamma wave pattern that is required for the binding process. This primes the neurons associated with letter recognition to fire in synch.

With Spell-Reading and Sweep-Sweep-Spell, we are exercising the letter-recognition neurons together with developing a habit of registering the letters in their appropriate sequential order, creating the internalized grid needed to assign a priority tag to each individual letter.

Given this goal, it is imperative for Sweep-Sweep-Spell to be done quickly, because the brain must be trained to be able to recognize a short letter string within the 200 msec. cycle required for accurate encoding. However, the exercise should not be so fast as to rush or pressure the reader; this would be counterproductive. Frustration would cause disorientation, which would probably disrupt the synchronization of neural firing needed for binding.

The oral spelling that is part of Spell-Reading would not be fast enough to

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match the speed required for mental recognition in the SERIOL model, but it helps build the habit. The speed of mental letter encoding is increased when the student moves on to Sweep-Sweep-Spell, where he is instructed to let his eyes sweep through the word, and then say the word, repeating the sweep a second time and spelling out loud only if the word is not immediately recognized.

It can readily be seen why this process is so important for recognition of the small trigger words such as *the*, *for*, and *its*. Dr. Whitney points out that the time frame for recognition of a 3-letter word is the same as for a 6-letter word – both occur within a single oscillatory subcycle. It is easy to see how disorientation disrupts this process and causes students to stumble over the small words, with frequent transpositions and reversals of letter order. Sounding-out strategies also lead to the same confusion: the slowing of the input of individual letters causes the mind to lose track of letter order. That is why the dyslexic student may be able to successfully sound out a word repeatedly, but be unable to recognize the same word when seen only a short time later, or may frequently confuse words with similar letters, such as confusing *on/no*, *form/from*, etc. The word simply has not been processed in the brain in a way that can possibly be encoded for retention of information about letter order.

Because Spell-Reading and Sweep-Sweep-Spell are primarily strategies for training the brain and building the capacity for visual word form recognition, we do not use it for study of word lists or as a vehicle for learning sight words beyond those encountered in the course of practice. Rather, we use Davis Symbol Mastery for its benefits in linking the way a word sounds and what it means to the way the word looks. This makes sense, as the mental processes for relating words to their sounds and meanings takes place in the brain after the VWFA has done its work.

References:

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