

BrainWare[®] Safari: Cognitive Skills Development and Learning to Read

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SUMMARY

Learning to read well requires that the basic processes of decoding and comprehending become automatic so that they do not have to be thought about consciously. Readers who must decode letters and words consciously are distracted by the process and are thus unable to concentrate on the meaning of what they are reading.

The cognitive skills that support decoding, such as attention, visual discrimination, visual sequential processing, immediate memory and working memory, must be automatic for successful reading. Many struggling readers are deficient in these skills. But despite the necessity of these skills, they are not generally taught in schools. In fact, the primary challenge in improving the teaching of reading is to close the gap between what the research tells us is needed for struggling readers and what is actually provided in our schools.¹ The fact that cognitive skills are not explicitly taught in schools does not mean that they can not be taught. For over half a century, techniques to develop basic cognitive skills have been known and used in various clinical therapies but haven't been practical to deliver in the classroom. Today, digital game-based learning is making the delivery of cognitive training programs viable in a classroom setting.

BrainWare Safari is a comprehensive cognitive skills development program presented in a video-game format. Students have experienced dramatic increases in their cognitive skills after using the program for 11 weeks. This paper discusses how reading skills can be improved in struggling readers, as well as normal and gifted students by improving their underlying cognitive skills. Cognitive skill improvement can help any child learning to read. Even older students who are having trouble reading will be able to rapidly make significant improvements in their literacy.

IMPORTANT READING FACTS

- 85% of children diagnosed with learning difficulties have primary problems with reading and related language skills.
- Reading difficulties are neuro-developmental in nature.
- Neuro-developmental problems do not go away, but a student or adult can still learn or progress in school nonetheless.
- Most children can be taught reading and explicit strategies for success in school.
- More than 8 million students in grades 4-12 are struggling readers.
- Many older students can read, but cannot understand what they read.
(US DOE, 2003)

¹ Wolfe, Patricia & Nevills, Pamela. *Building the Reading Brain*, Corwin Press, 2004.

BACKGROUND

Most people do not remember learning to read. They may remember learning letters but do not typically recall how and when they made sense out of written symbols. This is because the process of decoding letters and recognizing the patterns of letters that form familiar words has become automatic and no longer requires conscious thought.

Whenever a person first learns a skill, every aspect of the learning experience requires conscious attention. If we think about what is involved in learning to drive a car, ride a bike, or spell the word “catch,” we notice that the brain internalizes the procedures only after a great deal of practice. Once internalized through practice, we refer to skills as residing in unconscious or implicit memory². Implicit memory allows the brain to carry out processes at an automatic level, without conscious thought. Thus, these processes are considered neuro-developmental. Once the mechanisms of reading have been integrated into an unconscious process, the reader’s mind is free to concentrate on developing a structure of meaning. When we refer to “unconscious” processes, we mean that the processes can be performed without thinking.

Speech and language are natural functions of the brain, and children master speech just by spending time with people who already speak. Reading, on the other hand, is not a natural function. Unfortunately, children do not learn to read simply by spending time with people who already read.

Many of the structures used in spoken language come into play in reading as well, but often for purposes other than those for which they seem to have been designed.³ Translating what one already knows about language from speech and listening into visual symbols is a highly complex process that some learn intuitively, but that the majority must be taught.⁴ For struggling readers, the learning curve is even steeper. Generally, only with that kind of specific instruction and extensive practice can struggling readers master the decoding of letters and letter combinations to create meaningful units of morphemes and words, to understand word origins, and to achieve comprehension through a core knowledge base.⁵

READING TASKS

Reading is composed of two main processes – decoding and comprehension. Decoding involves the process of recognizing letters, relating them to speech sounds, and then connecting those sounds to make words. Children are explicitly taught that letters represent the sounds of spoken words and they practice those relationships. Then they connect those sounds to make words.

Comprehension, the second of reading’s main processes, involves understanding the written word, and specifically connecting information within the context of a particular text. Students must also learn to relate what they are reading to prior knowledge. And they must learn to read fluently. The frontal lobes of the brain are called upon to coordinate thought processes in more complex ways as those processes begin to become more expansive. As a child becomes a proficient reader, he or she uses both decoding and comprehending so that both skills become

² Some researchers and authors also use the term “procedural memory.”

³ Wolfe, Op.Cit.

⁴ Ibid.

⁵ Moats, L.C., Furry, A.R., & Brownness, N. Learning to Read: Components of beginning reading instruction. Sacramento, CA. Comprehensive Reading Leadership Center, 1998

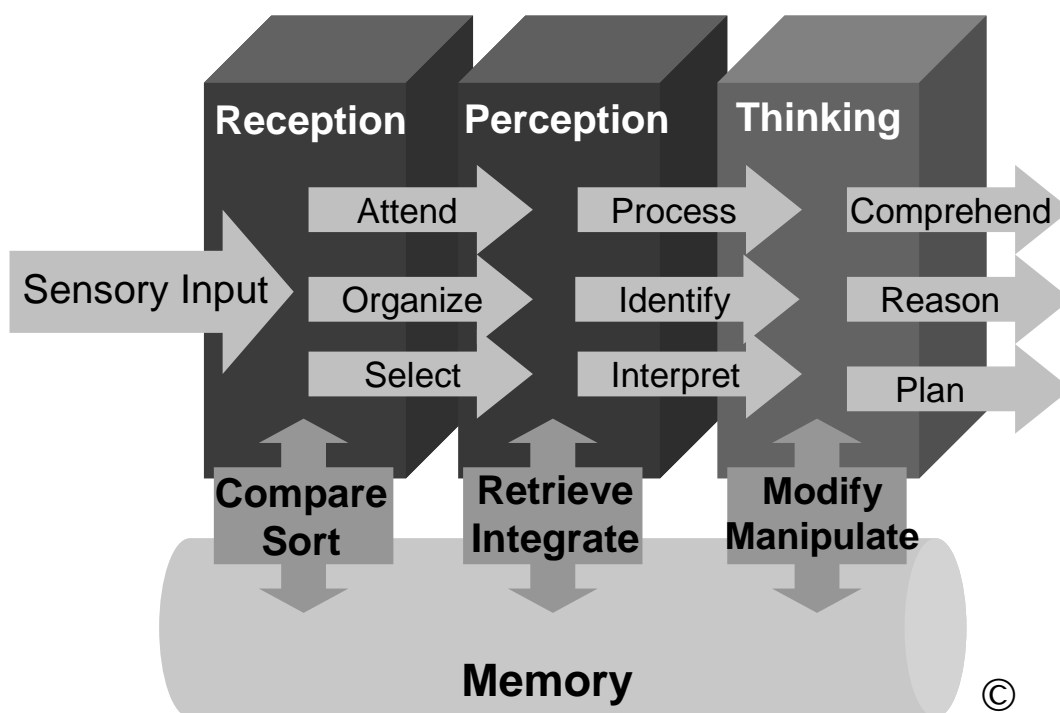
more interdependent upon each other. That is, the context and meaning of the text aid in the decoding process, as the child predicts what words will appear, just as the decoding process gives rise to additional meaning.

There is one final task involved in learning to read, and that is remembering what one has read. Children must be able to organize and summarize the content and to make connections to previously learned material. They must also store the information in long-term memory so that they can use that information in the future.

COGNITIVE SKILLS

Underpinning the tasks required in reading are basic cognitive skills that allow the brain to take in and process information. Children who struggle with reading tend to have difficulty with some of these basic skills, such as memory, paying attention, organizing information and following instructions. It is important to note that these cognitive skills are not uniquely critical in reading – they underlie the ability to learn any skill.

Below is a model of mental processing⁶ that illustrates these functions as a general model of learning and cognitive processing. As this model shows, external and internal stimuli must be attended to, the most important or relevant ones selected (ignore the dog barking outside, listen to the teacher), and then they must be organized (for example letters and words perceived in sequential order left to right in the case of reading). The activities just described can be grouped into a category called “Reception.”



The process of “Perception” takes the selected and organized data that has been derived from sensory input and begins to associate it with meaning. Letters are identified and distinguished

⁶ © Learning Enhancement Corporation

one from another, patterns of letters are compared to “sight” words and other patterns of words in memory, and the sounds of unknown words are connected to create something familiar. Perceiving also includes the process of integrating new information into existing memory.

The next step, “Thinking,” is the point at which conscious and focused activity takes place. If the various mental processes associated with receiving and perceiving written information are still carried out consciously, then an individual’s ability to comprehend, interpret, reason, plan and act on that information will be severely limited or non-existent.

One salient feature of this model is the essential role of memory. Memory is involved through the receiving, perceiving, and thinking processes – when incoming sensory input is compared to previous patterns, when previous knowledge is retrieved to aid comprehension, and when information is held in memory to “think about,” as examples.

READING DIFFICULTIES

Persistently poor readers may read word for word or read a sentence without attending to its meaning. This means that the brain has not yet integrated a systemic approach to the reading process and experiences it only as a series of unrelated fragments that elude lasting recall. Any reader who has to stop and go back over the material in order to make basic sense of it is doing so because the mechanisms of reading have not been integrated into an unconscious process that leaves the mind free to concentrate on developing a structure of meaning.

Let’s consider the example of a third-grader named Joe. Joe learned first grade reading skills well enough not to be considered an at-risk reader. But as the text became more challenging in second grade, his reading slowed down. He usually looked only at one word at a time, which meant that he confused the meaning of most sentences. His struggle just to get the individual words right interfered with any ability to make connections and, thus, he could not summarize or retrieve related ideas.

Many children appear to slump and struggle with reading when they get to the third grade. Third grade is when schoolwork and standardized tests require them to think and perform at a more inferential level.⁷ Students who are still stuck deciphering a text word by word are not usually able to build a sense of meaning from what they are reading.

Psychologist Franklin Manis⁸ refers to a focused, complex process that occurs in the brains of successful readers as they process letter distinction fast enough to maintain the flow and fluency of text.⁹ If letter recognition is not instantaneous, or if the letters the reader identifies are not quickly connected into a familiar word, comprehension slows down. It is then up to the frontal lobes to determine whether or not the visual input is important enough to the child to motivate him or her to maintain attention.

Paying attention, focusing, and concentrating are skills that proficient readers develop in order to make meaning. If a child fails to develop these skills, then comprehending text is difficult, and

⁷ Liben, L.S. “Thinking through maps. Spatial schemas and abstract thought.” Cambridge, MA: MIT Press, 2000

⁸ Manis, Franklin. “Language Deficits in Dyslexic Children: Speech Perception, Phonology & Morphology,” *Journal of Experimental Psychology*, 2000.

⁹ Ackerman, S.J. New from the Frontier, an unfelt filter. *Brain Work, The Neuroscience Newsletter*, 13 (3), 7-8

may be impossible. The ability to pay attention underlies the accomplishment of all reading tasks.¹⁰

Unfortunately, Joe's teacher may not have been able to work with Joe as would be needed to develop his attention skills. Finding 30 to 90 minutes for reading and writing instruction on a regular basis in order to cover the necessary specific literacy standards in depth is difficult in many schools. To compound the problem, students do not come packaged alike with the same cognitive processes. Often this results in the teacher teaching to the middle of the class, while he or she wonders how and with what means learning can be differentiated so as to insure that every child is on task and properly focused.

Unfortunately, such problems are often ignored because some people believe that intelligent children learn to read easily and naturally, while less intelligent ones do not. This misperception derives from a prevailing impression among many educators that learning to read is a natural process that results from immersion in a literacy-rich environment and rich text experiences. In fact, reading is one of the most unnatural acts we humans perform and current reading programs do not directly address the building of basic cognitive skills.¹¹

HOW COGNITIVE SKILL DEVELOPMENT WORKS

The human brain is designed to coordinate many different sensory inputs into a single pattern in order to create meaningful information that can be used to perform tasks or think about that information. Taking in, comprehending, remembering, and manipulating sensory inputs to accomplish a task at hand requires well developed cognitive skills. To understand how cognitive skill development works, think of a child learning to ride a bicycle.

When a child learns to ride a bike, he or she must coordinate body movement in several different ways. First, the child has to balance on the bike so that it does not fall to one side or the other. Second, the child has to pedal the bike so it will move forward. Third the child has to steer the bike using the handlebars so it will go in a particular direction. Fourth, the child has to have a means of stopping the bike. Usually this means applying the brakes, but it might also mean dropping his or her feet to the ground.

After a little practice, the child has assimilated these various tasks separately from each other well enough to integrate them into a single set of patterns that, from then on, can operate outside of conscious awareness. At that point, the child thinks of "riding" the bike, not of balancing, pedaling, steering and braking. All the different processes have integrated into a single process that the brain can repeat ad infinitum without any further conscious input.

At the same time, all of the actions can be modified at will by the conscious mind, so as to change speed, direction, and so forth. When we say that the processes have become unconscious, we do not mean that they are "no longer under conscious control." Rather we mean that the processes can be performed in absence of conscious thought.

In similar fashion, the brain learns to do certain things that no longer have to be thought about when we are reading or exercising other related skills, such as doing math problems. The better integrated the processes are, the better a person can read.

¹⁰ Wolfe, Op. Cit.

¹¹ Shaywitz, S. *Overcoming dyslexia: A new and complete science-based program for reading problems at any level.* New York: Alfred A Knopf, 2003

In their efforts to help students integrate the processes into an unconscious routine, teachers employ a number of different strategies. They strive to select appropriate reading materials, assign appropriate tasks, guide students in practice, and adjust instructional interactions. One of the strategies teachers seek to employ is scaffolding, where the instructor provides opportunities to continue mastering phonics, vocabulary, fluency, and comprehension in a time-sensitive and intricately coordinated manner so that the student is exposed to new concepts and ideas that are at the right level – neither too easy nor too difficult.

However, two difficulties often arise. One is that individualizing instruction and scaffolding to the degree needed are time-consuming. Most teachers with classrooms of 18 to 30 students are hard-pressed to find the time to attend to individual students' needs. The other difficulty is that many of the basic cognitive skills required for reading, such as attention, visualization and memory, are not the skills that teachers have been taught to teach.

But while these skills have not been a part of the pedagogical repertoire of the classroom teacher, they have been trained, for more than half a century, by optometrists, speech pathologists, psychologists and other learning experts. Because they required highly trained therapists and one-to-one administration, these training programs were extremely expensive and consequently beyond the reach of all but a few of the students who were in the direst need.

DIGITAL GAME-BASED LEARNING – A NEW WAY TO DELIVER COGNITIVE SKILLS TRAINING

When a person has established bad reading habits, it is difficult and, at times, may even be impossible to change those habits through direct action by the learner, since they are no longer specifically conscious of those mental processes. However, that same person can do something different from reading, such as training with a video game that causes the habits to change.

Recently, digital game-based learning programs have been developed which are extremely effective at training basic cognitive skills and which are more affordable and practical for classroom use than clinical therapies. While clinical therapies are vitally important for some children, it is not feasible to devote the time and individual attention to such therapies across the board in most classrooms. Moreover, because digital game-based programs incorporate the latest video-game technologies, students find them enjoyable to use.

One of the most effective digital game-based learning programs is BrainWare Safari, created by Learning Enhancement Corporation¹². Children using the program at home have increased their cognitive skills by over four years on average, in just 11 weeks of using the program three to five times a week for one-half hour to one hour.¹³ Students using BrainWare Safari in a school setting at the same pace reportedly improved their cognitive skills by six years on average.¹⁴

BrainWare Safari provides students with game-like challenges that cause them to develop new habits of cognition so that they can read and process their reading much more effectively than before. In fact, the same students who improved their cognitive skills by over four years achieved

¹² www.MyBrainWare.com

¹³ Helms, D., and Sawtelle, S. A Study of the Effectiveness of Cognitive Skill Therapy Delivered in a Video-Game Format, *Optometry and Vision Development*, Volume 38, Number 1, 2007

¹⁴ Learning Enhancement Corporation, Study conducted in the Indianapolis Public Schools, Unpublished research, 2006.

one year and eleven months' improvement on tests of math and reading achievement (Woodcock-Johnson).

Digital game-based learning approaches have several important benefits for schools. First, students can work on them relatively independently. This means that the teacher no longer has to be the sole mediator of what level of difficulty and challenge the student is ready for. Second, because they are computer-based, inconsistent delivery of the material and potential bias are avoided. Third, computer-based programs can provide immediate feedback, letting the student know what they have done well and where they need more work – rather than waiting for a teacher to grade a test or a paper. And finally, the tedium or repetitive exercises to train these skills is eliminated for the teacher – who no longer has to control the drill – and for the student who can practice his or her skills in the context of an entertaining video game without fear of judgment or failure.

While the specific skills these games teach are not identified by many educators as specific “reading skills,” they are the mental processing skills that would support any academic or life activity. It maybe helpful to explain the relationship between the kinds of cognitive skills that are developed in BrainWare Safari and their role in reading. The chart below relates seven of the 41 cognitive skills developed in BrainWare Safari to the reading process. While all 41 cognitive skills relate to reading success, we have selected a subset to illustrate the relationships. It is important to note, however, that the other skills may also contribute to improvements in decoding and comprehension, and that the simultaneous development of multiple skills, as in BrainWare Safari, serves to drive skills more quickly to implicit memory. The goal is the unconscious operation of these processes so that the reader can focus on meaning.

Indeed, one of the reasons BrainWare Safari has been so effective in helping students increase their cognitive abilities is that the program trains them to operate multiple skills at the same time, pushing them rapidly to a level of automaticity needed for fluent reading and better comprehension. In other words, the program offers cognitive loading, but not cognitive overloading.

Cognitive Skill	How the skill relates to reading
Visual Sustained Attention	Staying focused for a period of time – even just long enough to accumulate several letters into a word or several words into a sentence.
Visual Discrimination	The ability to differentiate a “b” from a “p” and an “m” from an “n” – and to recognize them quickly without consciously having to evaluate them.
Visual Span	The amount of information you can take in at a glance – taking in several words at a time, for example, enables reading to be faster and more fluent.
Visual Processing Speed	The faster the brain can process the visual stimuli that appear on the page, the more likely the reader can combine them into meaningful groups (words and phrases).
Auditory/Visual Sequential Memory	The ability to recall a sequence of bits of information is critical in remembering and recognizing the spelling of a word.
Working Memory	Being able to hold information in your mind while you manipulate it – that is, think about it – is what enables a reader to fit words and sentences into meaning and to relate one sentence to the next.
Conceptual Thinking	One aspect of abstract or interpretive thinking is the ability to form concepts – collections of features that create a category or an idea. Ideas such as “dog” or “fairness” are examples of concepts that readers may need to form or rely on in the reading process.

IMPLICATIONS

When a student makes a jump of six years or even four years in his or her cognitive maturity, the demands that reading makes can suddenly be handled much more easily. That student has a better ability to integrate the various reading skills, to track the eyes smoothly across the page, to remember what the words mean, to integrate those meanings into sentences, to get the implications those sentences have, and so on.

The kinds of results that have been achieved with games designed to develop specific combinations of cognitive skills in an integrated manner mean that there is reason to hope that even students in advanced grades who are having trouble reading effectively will be able to make significant improvements in their reading in a short time.¹⁵

To say the same thing using the educator's terminology we were using before, a program like BrainWare Safari can provide the scaffolding, leveling off materials and opportunities for students to work on their own or in small groups on specific tasks. Very importantly, if a student has difficulty attending, visualizing, making connections, or retrieving information, those deficiencies can be rapidly remediated. Indeed, by developing the underlying cognitive skills that allow the brain to draw on implicit memory and concentrate on meaning rather than process, we should be able to develop a nation of readers all at advanced levels of achievement.

ABOUT THE AUTHORS

Peter Kline is the accomplished author of more than 20 books and numerous articles on education, literature and the arts. For the past 20 years, he has been involved with integrative-accelerative learning. Mr. Kline worked with Eastman Kodak and the New York Public Schools to develop and implement programs for teacher training and corporate culture change. He also developed an integrated whole language and phonics program that has been used with a number of schools to help students make rapid improvement in reading skills. Mr. Kline founded The Thornton Friends School in the Washington, D.C. area, and has worked with school systems in Chicago, IL; Minneapolis, and St. Paul, MN; Brooklyn, Queens, Rochester, and Utica, NY; Detroit, MI; Arlington, VA; and Washington, D.C. Mr. Kline's latest books include *Why America's Children Can't Think*; *Ten Steps to a Learning Organization*; *The Everyday Genius*; and *The Genesis Principle*.

Nancy Meyer-Brown is a veteran educator, having taught pre-school through college. She has been an administrator at the elementary and middle-school levels, as well as serving as literacy coordinator at the district level for the Perry Township, Indiana school district. She has designed literacy tools for practitioner use at the point of instruction, developed programs for beginning teachers, led multiple academic planning initiatives, and conducted literacy research projects. Ms. Meyer-Brown is the recipient of a National School of Education Excellence Award. Ms. Meyer-Brown's interest in how education can assist the disengaged and/or struggling student piqued her interest in cognitive skill development. She trained with Dr. Patricia Wolfe, author of *Mind Matters*, to be a trainer of teachers on brain-based education. She also facilitates seminars for senior citizens on the aging brain.

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¹⁵ Some anecdotal evidence is available to support this expectation.