Seeing Stars®

by

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The letters of language are like the stars in the Universe—parts of a whole.

Symbol Imagery for Phonological and Orthographic Processing in Reading and Spelling

SECOND EDITION

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2 Symbol Imagery: One of Three Sensory-Cognitive Functions

I have been fortunate and honored to have extensive one-to-one instructional interaction with individuals of all ages and levels of language processing skill. There were moments when looking into the eyes of a child or an adult struggling to read and spell words that I thought about the T-O-M-O-double-R-O-W experience, and I realized that I was seeing letters in my mind. I also realized that the students who were reaching automaticity in phonemic awareness were also *seeing* the corresponding letters in their minds. I noted a relationship between how automatically and rapidly the students perceived phonological relationships and their ability to see the letters. If they could easily see letters, they could rapidly note their errors and self-correct. I also noted that those same students began to acquire sight words more readily, and they naturally could read in context more fluently.

However, many students did not picture letters in their minds, and they continued to be slow at phonological processing and self-correction. Eventually, I realized that symbol imagery—the ability to create mental representations for the sounds and letters within words—is a critical aspect of reading and spelling, supplanting phonemic awareness in terms of relevancy to fully developed literacy skills. Phonemic awareness, thanks largely to the efforts of Pat Lindamood, is now well-researched and recognized as an important function for reading and spelling. However, it is not the only sensory-cognitive function.

Over the course of our instructional experience, three sensory-cognitive functions emerged as necessary to competency and automaticity in language and literacy skills—phonemic awareness, symbol imagery, and concept imagery—and there are individual differences in acquisition and facility in each of these. Each function underlies the component parts of reading, and each can be identified, stimulated, and applied to language and literacy development.

Phonemic Awareness

Phonemic awareness is the ability to auditorily perceive the identity, number, and sequence of sounds in words.

In the 1960s, Pat Lindamood, a speech pathologist, was one of the first educators to conduct research regarding the role of phonemic awareness in reading, spelling, and speech. She often told the story of how she first became aware of phonemic awareness. While working with children and adults, she realized she could judge when a phoneme was added, omitted, or substituted in a word (for example, 'book' for *brook*). But her students could not make those same judgments and therefore they could not monitor and correct their errors. At the time, she labeled her discovery "auditory conceptualization," later renamed "phonemic awareness" by other professionals. Pat determined that although her students could accurately identify each letter in a word, they could not auditorily judge if what they *said* matched what they *saw*. The cause of the reading/spelling problem was at the sensory level, and more importantly, the sensory function of phonemic awareness could be measured, developed, and applied to literacy skills.

Pat's discovery of phonemic awareness in the early 1960s was a breakthrough in the field of reading. Indeed, by the late 1990s and early 2000s, phonemic awareness and word attack skills had become widely recognized as important to reading and spelling (Castles & Coltheart, 2004; Cirino, Israelian, Morris & Morris, 2005; Eden et al., 2004; Torgesen et al., 2001). By the turn of the century, reading and spelling programs that promoted the development of phonemic awareness had popped up everywhere, many of which were only phonics programs with no specific methodology to develop phonemic awareness.

The *Lindamood Phoneme Sequencing* (LiPS®) *Program*®, was the primary instructional methodology in our Lindamood-Bell® Learning Centers. Our students made exceptional gains in word attack, but too often they didn't make the same level of gains in word recognition and contextual reading. It was frustrating to note that our students were better at sounding out words in isolation, but still not able to read fluently on the page.

I became aware that while phonological processing was an important component of the reading process, it was not sufficient to develop global readers. Global readers do not read word by word, stopping or slowing to phonetically process each word. Instead, global readers primarily focus on orthographic and contextual information and only use phonological information as a back-up.

Symbol Imagery

Symbol imagery is the ability to create mental representations for the sounds and letters within words, *encompassing the ability to visualize the identity and sequence of letters in words.*

As discussed earlier, we noted that phonemic awareness could be quite easily developed and applied to word attack skills for our students at Lindamood-Bell Learning Centers. But it was not enough. Unfortunately, despite intensified practice, individuals often experienced difficulty memorizing sight words, and their reading in context was slow, word by word. We were creating analytical readers rather than global readers. Analytical readers primarily focus on the phonological processing of words, and reading becomes a word-by-word process that may cause contextual guessing and potential interference with reading comprehension. Our goal was to create global readers, but we didn't know how. Again, global readers primarily use their intact orthographic processing (quick and accurate word recognition) and contextual information, and they use phonological processing only when needed.

My experience working with hundreds of students, ranging in potential, age, and reading and spelling challenges, led me to question whether there might be another sensory input, beyond phonemic awareness, that was needed to reach our goal of creating global readers. Johnny, a ten-year-old boy, was representative of those students who caused me to think we could do better. Johnny had a good oral vocabulary and adequate language comprehension, but his decoding was very weak. He had been labeled "dyslexic" when he was very young and his mother had fought a valiant fight to get him help. In her search, she enrolled him in one of our Lindamood-Bell Learning Centers, and we focused on developing his phonemic awareness and word attack skills. Naturally, as his phonological processing base began to stabilize, we overlapped to instruction in word recognition and contextual reading. But we hit an instructional wall. While Johnny could process single and multisyllable words slowly but accurately, he had extreme difficulty memorizing an extensive list of sight words. His phonemic awareness seemed good, but it took him time to monitor and self-correct. His reading was analytical, and we just couldn't move it. Consequently, reading was a tedious word-by-word process for this bright young boy.

At the completion of our intervention with Johnny, he had improved several grade levels in word attack, and his phonemic awareness was stable (though his responses were still slow). His gains in word attack were an astounding breakthrough for him.

However, after returning to his classroom, his teacher commented that Johnny could now sound out words really well, but he still couldn't read. She was right.

Months later, Johnny returned to us, still struggling and frustrated, and hating to read. We administered a retest. Johnny had maintained his gains in word attack (performing at the 80th percentile) and phonemic awareness (a score of 100/100). However, his word recognition was only at the 37th percentile (a substantial discrepancy from his word attack skills), his paragraph reading accuracy was only at the 25th percentile, and his reading rate was at the 10th percentile. It is important to note that Johnny's reading comprehension was at the 37th percentile, still surpassing his paragraph reading skill, but far below his potential.

Johnny's retest performance was too familiar. Had we overlooked or assumed a sensory-cognitive function that we had not directly stimulated and applied to reading?

Here were my questions about and observations of our students still struggling in some areas of literacy:

- With our focus on establishing phonemic awareness, ***our students improved significantly on a retest of phonemic awareness, but very often their responses were slow and not automatic.*** This was especially apparent when they were attempting to process complex single-syllable patterns and multisyllable patterns. This slowness in processing sounds/letters in words (while not reflected in the score on an untimed phonemic awareness test) appeared to be a critical factor in the overall challenges our students continued to experience while reading.

- ***Our students improved significantly in word attack, but often their decoding was slow and tedious.*** They slowly processed sound by sound in a word and then attempted to synthesize the sounds, sometimes missing a phoneme and starting over again. This was similar to their slow, non-automatic, response on measures of phonemic awareness. In reading, they had difficulty *quickly* judging if what they said matched what they saw in print.

- ***Our students did not demonstrate the same level of gains in word recognition and contextual reading as they did in word attack.*** Repeatedly, our students gained numerous years in word attack, sometimes as many

as six or eight years after weeks of instruction, but they gained only a year or more in word recognition and much less in contextual reading. Despite increased focus on word recognition and contextual reading, their progress in those skills was not comparable to their progress in word attack skills.

- ***Our students had difficulty memorizing sight words.*** Even after repeated practice attempting to memorize sight words, our students continued to read words slowly and phonetically, both in lists and in context. The words just did not stick. As would be expected, this impacted their reading rate and reading accuracy when they read in context. There seemed to be something missing, and it wasn't phonemic awareness. It appeared to be related to the speed with which they could judge sounds and letters within words and the speed with which they could process and memorize orthographic patterns.

- ***Our students often read word by word when reading paragraphs.*** Without an extensive sight word base, their contextual reading was slow, and often they resorted to contextual guessing in an effort to increase their reading rate. Their slow phonological processing and slow self-correction of a miscue contributed to inefficient and ineffective contextual reading, often interfering with their reading comprehension and their overall comfort with, and love of, reading.

- ***Our students often spelled phonologically rather than orthographically.*** They had difficulty retaining the orthographic patterns needed to spell accurately ('hav' for *have*, 'reech' for *reach*, 'opertunity' for *opportunity*, etc.). Again, despite increased attention to orthographic spelling, as with sight words, our students seemed challenged with more than the sensory-cognitive function of phonemic awareness.

As I questioned the above processing behaviors, I also began to observe key behaviors in the students who were beginning to show substantial improvement in their literacy skills. The observations described below centered around a type of sensory-cognitive processing that enabled accurate and rapid processing of sounds and letters in words:

- ***Students who demonstrated rapid responses on a phonemic awareness test didn't appear to need to verify sounds with articulatory feedback.*** Their responses were quick and accurate, and they didn't need to feel sounds in their mouth to verify their responses. When questioned, they indicated they could mentally see the letters in the words and simply made their responses based on seeing the sounds converted to letters. The imaged sensory-cognitive information facilitated their rapid responses on the test. "T-O-M-O-double-R-O-W."

- ***Students who indicated they could visualize letters within words also began to experience success developing a sight word base.*** Their orthographic memory skills appeared to be substantially improved. Suddenly they didn't struggle to hold words in memory. Their word recognition skills improved substantially. They could also more readily hold words in memory for orthographic spelling features, remembering to double letters, add silent letters, use the correct suffix (e.g., 'tial' instead of 'cial'), etc.

- ***However, students still struggling to process sounds and letters seemed confused when I asked them if they could see letters in words.*** One college student on academic probation, previously labeled "dyslexic," smiled her charming smile and said, "It's just dark up there."

- ***Students who reported visualizing letters within words and who were also developing an extensive sight word base moved from analytical reading to global reading.*** Their cognitive tool kit seemed filled with another sensory-cognitive function that enabled them to move away from reading word by word in context. They began to rely primarily on orthographic processing, word recognition, and contextual information. Perhaps just as important, when they did need to use phonological processing, their processing and self-correction were fast and accurate.

Many years of instructional experience, and now research, have verified that there was another sensory-cognitive function—symbol imagery—underlying both phonological and orthographic processing and also, consequently, fluent, self-correcting reading behaviors. Phonemic awareness wasn't the only sensory

information needed for literacy. *There was a new sensory-cognitive function that we could explicitly develop and apply to literacy.* Global readers were within our reach.

Concept Imagery

Concept imagery is the ability to create an imaged gestalt (whole) for language and thought.

A gestalt is an organized whole that is more than the sum of its parts. Individuals with well-established concept imagery rapidly and efficiently bring parts to whole and "get the big picture." Language comprehension and thinking require the sensory-cognitive function of concept imagery, which underlies both oral and written language comprehension, creative and logical thinking, language expression, following directions, and memory.

Yet there are many individuals who experience weakness in creating an imaged gestalt (whole). Their weakness in concept imagery interferes with connection to and interpretation of language, especially higher order thinking skills. Unfortunately, when individuals cannot easily or rapidly create an imaged gestalt, they primarily process *parts* of what they read or hear. A main idea is discerned from the whole and not easily grasped if only a few random parts have been processed. An inference or a conclusion cannot be accurately drawn from a few parts or a few isolated facts. As I wrote in *Visualizing and Verbalizing for Language Comprehension and Thinking*®:

> Imagery is the sensory base of language and thought, connecting us to incoming language and linking us to and from prior knowledge, accessing background experiences for us, establishing vocabulary, and creating and storing information in both short-term and long-term memory. (Bell, 2007)

Weak concept imagery may be a primary cause or contributing factor in the following symptoms:

- ***Difficulty with written language (reading) comprehension***

  Though decoding skills and oral vocabulary may be sufficiently developed, individuals may only get a few facts, details, from what they read—and they experience frustration and difficulty answering higher order thinking questions. They may need to read material

repeatedly in order to process it, and often are unable to get the big picture. It appears that language goes in one ear and out the other and only a few parts/facts/details are processed.

- *Difficulty with oral language (listening) comprehension*

  Again, as with written language comprehension, oral language appears to go in one ear and out the other. Whether listening to conversation, stories, or lectures, some random details or facts may be processed but not the big picture (whole). They may seem unable to pay attention or not interested in listening. They often appear to process irrelevant and incidental parts of what they hear, and often ask and re-ask the same question. Sadly, they may be considered poor listeners, inattentive, or intellectually challenged, but in reality the source of their difficulty is at the sensory-cognitive level.

- *Difficulty with critical, logical, and abstract thinking and problem solving*

  With only parts processed, and not the whole, individuals are challenged by critical thinking and logic. They may appear to have less ability in critical thinking because at the sensory level they are only processing specifics (part-images).

- *Difficulty following directions*

  With parts of language being processed, individuals have difficulty holding oral language in memory long enough to execute multiple directions. If the weakness is severe enough, they may even experience difficulty holding and completing a single direction. The directions may seem to go in one ear and out the other. Again, though the weakness is at a sensory-cognitive level, it might be interpreted that they are not paying attention or that they are not able to focus. When reading directions, they may have to read language multiple times in order to follow and execute the instructions.

- *Difficulty expressing language orally*

  Language expression represents thought. Hence, individuals with concept imagery weakness may express language in a disjointed, unconnected array of parts. They may talk about irrelevant parts and

tell stories out of sequence. They may be very quiet and appear shy, or they may be very talkative and seem to ramble on and on, moving from one thing to the other appearing scattered, disconnected, and illogical. Whether they talk a little or a lot, the quality of their language expression seems impaired as they respond to or focus on a part that often spirals away from the main topic.

- ***Difficulty expressing language in writing***

  Individuals may demonstrate difficulty expressing their thoughts in writing. Sequencing concepts and writing with clarity is difficult. Without a gestalt to draw from, they have to rely on random parts. As a result, they have difficulty making a point, comparing and contrasting effectively, answering a question clearly and concisely, or even understanding the point of a question well enough to answer it on paper. Their writing may be disjointed or an array of disconnected facts.

- ***Difficulty grasping humor***

  Humor is often laced with an overlay of concepts. However, these individuals may not be able to process concepts easily enough to get the humor. Instead, they may take language literally. Generally, they seem to respond best to physical humor, such as slipping on a banana peel or a pie in the face, but language-based humor eludes them. They may attempt to cover their inability to grasp humor by laughing at inappropriate times. This may be interpreted as not having mastered the rules for social language known as pragmatics.

- ***Difficulty interpreting social situations***

  In social situations, they may grasp parts of interactions and not be able to interpret the whole of something expressed emotionally or verbally. Based on these isolated parts, they may make inaccurate assumptions and inaccurate responses. Their sensory-cognitive weakness in processing the whole leaves them in the unfortunate situation of responding or behaving in a manner inappropriate to the social situation.

- ***Difficulty with cause and effect***

  If individuals primarily process parts, they cannot grasp the relationship between the parts and the whole—the cause and the effect. This can impact an individual in school in terms of his or her behavior, and also in life in terms of response to situations, encounters, and conversations. For example, talking to individuals about a behavioral problem may not correct the problem if they cannot understand cause and effect. Instead, they may only be able to process the part of being talked to or punished in some fashion. Since they don't understand cause and effect, they don't understand why they are being punished, and cannot easily correct their behaviors.

- ***Difficulty with mental mapping***

  A sensory-cognitive weakness in concept imagery contributes to difficulty with mental mapping. These individuals have difficulty creating a mental map, a whole, and comparing the part of where they are with the whole of where they were or where they want or need to be. As a result, they may get lost easily.

- ***Difficulty with attention and focus***

  Because of weak concept imagery, individuals may not be able to maintain focus or attention in learning or social situations. Parts may fly in and out without making sense. Language goes in one ear and out the other and is soon not interesting or understandable. They may lose interest and begin to focus on something else, such as a video game or the television, where images come at them and the processing of parts is not an interference in their attention level. In class, these students may not enjoy story-time and may begin to fidget or do other things that are unrelated to the difficult task of processing language. Sometimes they have difficulty making sense of their surroundings or they lose interest within minutes. Their behavior may be interpreted as an attention deficit issue rather than a weakness in a sensory-cognitive function.

- ***Difficulty responding to a communicating world***

  With a concept imagery weakness, individuals may find oral and written language and social interaction a confusing mix of disconnected parts. Because the world may seem a puzzling, disconcerting, meaningless array of parts, they may isolate themselves, preferring their own company and their own tasks.

Summary

As we learned more about language and literacy processing, symbol imagery emerged as a primary sensory-cognitive domino that could be identified, stimulated, and applied to reading and spelling. Instead of hoping symbol imagery would develop with repeated instruction, we could now measure it, explicitly develop it, and apply it to literacy skills. Lucky us.

3 Symbol Imagery and Orthographic Processing

Orthographic processing involves *orthographic coding*, described as "representing a printed word in memory and accessing the whole word unit, a component letter, or a letter cluster unit" (Berninger, 1996). Orthographic sensitivity and the corresponding accuracy of orthographic coding help one to become aware of the common spelling patterns that exist in a language. This ability is needed to recall sight vocabulary for reading and spelling.

The mental representation involved in orthographic processing is an orthographic image. Ehri (1980) noted that an orthographic image "can be scanned in memory, contains all the letters in a word's spelling, and serves as the symbols for both spoken and silent sounds." A wide array of research supports orthographic processing as strongly correlated to and predictive of literacy skills independent of phonological ability (Badian, 1997; Barker, Torgesen & Wagner, 1992; Berninger, 1986; Cunningham & Stanovich, 1990; Stanovich & West, 1989). Nancy Mather, speaking at the 17th Annual State Dyslexia Summer Institute in 2012, noted:

> Orthographic processing is the ability to rapidly and accurately form images of individual letters and the spelling patterns of our language in memory. This includes letter form and orientation, common letter combinations, and syllable types. When a typical young reader sounds out a word a few times, he notices frequently seen letter combinations (e.g., *con, er, tion, what*), which are converted into images in long-term memory along with their sounds. Subsequently, when the reader encounters one of these letter combinations again, recognition of the image and its sound is activated. A person

> who has an orthographic weakness is less likely to perceive the patterns; thus, no image is created in long-term memory or the image created is unstable. Subsequently, when he sees a word/word part (even one seen many times before), it does not register as familiar or activate its sound. Consequently, this person depends on sounding words out for recognition, acquires sight words more slowly, and reads less fluently.

While orthographic processing is requisite for well-developed word recognition skills, as we learned, not all individuals have the underlying sensory input needed to create an *orthographic image* necessary for orthographic coding and orthographic processing. Enter symbol imagery diagnosis and instruction.

Individual Differences in Symbol Imagery Ability

Given our noted relationship between symbol imagery ability and our students' literacy progress, development of the Symbol Imagery (SI) Test® was initiated in order to obtain valuable data for reading research and instructional planning. A question was whether there were individual differences in symbol imagery ability and, if so, how was that related to phonological and orthographic processing, spelling, and paragraph reading accuracy and fluency. Would a test of symbol imagery ability verify Berninger's observation of the role that weak orthographic processing could play in disabled readers? "It has been clearly shown that skilled readers code the visual information in printed words. Disabled readers may fail to code that visual information efficiently or sufficiently" (Berninger, 1990).

After years of study, the SI Test was created and the results definitively showed individual differences in symbol imagery ability and a very strong relationship to measures of literacy. Students who did well on the test (i.e., whose Standard Scores were 90 or above) had adequate word attack, word recognition, and paragraph reading skills. Students who were less successful (i.e., whose Standard Scores were 89 or below) had difficulty with phonological and orthographic processing and the subskills of reading. The results also indicated whether a particular student's symbol imagery ability deviated from his or her age expectancy.

Correlations to Measures of Literacy

The correlations between the SI Test and each measure of literacy assessment are noted below (Bell, 2010). To interpret the magnitude of these correlations, a

Likert-scale approach was adopted, as suggested by Hopkins (2002). (Correlation coefficients between .10 and .29 are Small; coefficients between .30 and .49 are Moderate; coefficients between .50 and .69 are Large; coefficients between .70 and .89 are Very Large; coefficients between .90 and .99 are Almost Perfect).

Corrected (and Uncorrected) Correlations between the SI Test and Measures of Literacy
(N = 717)

Measures of Literacy	SI Test Correlation	Magnitude
Gray Oral Reading Tests—4th Edition		
Rate	.73 (.69)	Very Large
Accuracy	.77 (.74)	Very Large
Fluency	.75 (.73)	Very Large
Comprehension	.51 (.50)	Large
Slosson Oral Reading Test—Revised	.79 (.76)	Very Large
Wide Range Achievement Test—3rd Edition		
Spelling	.78 (.75)	Very Large
Woodcock Reading Mastery Tests—R/NU		
Word Attack	.71 (.68)	Very Large

Note: All correlations are significant at the $p < .0001$ level. Magnitude of correlations is based on Hopkins's (2002) criteria.

As you can see, symbol imagery ability has a Very Large correlation to spelling, word attack, word recognition, and paragraph reading accuracy, rate, and fluency. It should be noted that the SI Test shows a Large correlation between symbol imagery ability and reading comprehension (GORT-4). While symbol imagery is not directly involved in reading comprehension, this correlation is likely to be explained by the consideration that symbol imagery facilitates accurate and fluent paragraph decoding, which are factors in written language comprehension.

Correlations to Measures of Phonological Awareness

In observing student behaviors and responses to instruction, I began to think that

symbol imagery had a phonological component. While the strong correlation of symbol imagery to word attack skills was noted, the question remained: did symbol imagery also correlate with tests of phonological processing and phonemic awareness? To answer this question, we examined the relationship between the SI Test and the Lindamood Auditory Conceptualization Test—Third Edition® (LAC-3®) and the Comprehensive Test of Phonological Processing (CTOPP). The correlation coefficients are reported both uncorrected (in parentheses) and corrected for attenuation (Bell, 2010). They are significant at the .0001 confidence level.

Corrected (and Uncorrected) Correlations between the SI Test and Measures of Auditory Conceptualization and Phonological Processing
(*N* = 717)

Measures of Auditory Conceptualization / Phonological Processing	SI Test Correlation	Magnitude
Lindamood Auditory Conceptualization Test—3rd Edition	.74 (.72)	Very Large
Comprehensive Test of Phonological Processing (CTOPP)		
Phonological Awareness	.64 (.60)	Large
Rapid Naming Digits and Letters	.60 (.56)	Large
Phonological Memory	.54 (.49)	Large
Average	.63 (.59)	Large

Note: Sample sizes for CTOPP are 688 for Rapid Naming Digits and Letters, 689 for Phonological Awareness, and 687 for Phonological Memory. All correlations are significant at the $p < .0001$ level. Magnitude of correlations is based on Hopkins's (2002) criteria.

Rapid Automatized Naming (RAN, of which the CTOPP Rapid Naming subtest is a standardized measure) has been presented by some educators as predictive of reading difficulty. The Large correlation between symbol imagery and RAN was interesting and prompted us to look further at the data.

Predicting Reading and Spelling Skills

It was interesting to confirm that symbol imagery has a Large to Very Large correlation to measures of phonological processing and phonemic awareness, including RAN, so we conducted further analysis with stepwise regression. Was symbol imagery ability more or less predictive of reading skills than were measures of phonological processing or RAN? To answer this question, the SI Test, LAC-3, and CTOPP subtests were combined as a testing model to predict student performance in word attack, word recognition, spelling, and paragraph reading (Bell, 2010).

Predicting Reading and Spelling Skills
(*N* = 717, Age Range 6.6 to 17.8)

	Stepwise Regression Using Standard Scores					
	Dependent Variables					
Independent Variables	Word Attack[a]	Word Rec[b]	Spelling[c]	Reading Rate[d]	Reading Accuracy[d]	Reading Fluency[d]
SI Test	.47	.58	.56	.47	.55	.54
LAC-3	.04	.02	.01	<.01	<.01	<.01
CTOPP–PA	.01	-	-	-	-	-
CTOPP–RN	-	.02	.02	.05	.02	.04
CTOPP–PM	-	-	-	<.01	-	<.01
Total Model	.52	.62	.59	.54	.58	.59

Note: CTOPP–PA, CTOPP–RN, and CTOPP–PM = the Phonological Awareness, Rapid Naming Digits and Letters, and Phonological Memory subtests, respectively, of the CTOPP (Wagner et al., 1999).
[a]Measured by the Word Attack subtest of the WRMT-R/NU (Woodcock, 1998)
[b]Word recognition as measured by the SORT-R3 (Slosson & Nicholson, 2002)
[c]Measured by the WRAT-3 (Wilkinson, 1993)
[d]Measured by the GORT-4 (Wiederholt & Bryant, 2001)
Test data collected in 2004-2006.

As you can see, the stepwise regression analysis indicates that the SI Test was the strongest predictor of variance in every case. For example, for word attack the total testing model predicts 52% of the variance of student performance in word attack and the SI Test alone predicts 47% of that variance, with only 5% of the additional variance predicted by the remaining model.

Given that our goal is global reading, note the high predictability of the SI Test with word recognition (orthographic processing) and reading fluency. In word recognition, the SI Test predicts 58% of the 62% predicted by the whole model, and in reading fluency, the SI Test predicts 54% of the 59% predicted by the whole model. With an N of 717 students, ranging in age from 6 to 17 years, the stepwise regression showed *symbol imagery ability is the strongest predictor of an individual's skill in each component part of literacy.*

Summary

"Fluent access to visual word representations plays a special facilitative role in the reading of connected text," according to Barker et al. (1992). Indeed, accurate and rapid access to visual word representations, orthography, is a critical component in

global reading; however, the underlying sensory input necessary for orthographic coding cannot be assumed. There are individual differences in symbol imagery ability—the sensory input to place symbols in visual memory—and those differences are strongly related to literacy skills, especially orthographic processing.

Efficient symbol imagery enables readers to automatically code and recode phonological and orthographic information and, as such, symbol imagery is integral to independence and automaticity in word attack, word recognition, spelling, and accurate/fluent contextual reading.