What Differentiates a Fluent Reader from a Non-Fluent Reader and How Should We Assess It: Implications for the Classroom

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Dedication

This dissertation is dedicated to my Aunt, Ms. Lois Alt, who told me I must go back to school and finish my degree and gave me the financial support I needed to begin this wonderful journey. Little did she know it would go this far!

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Abstract

There were three questions being asked: 1) Does an adjusted words per minute score measure reading fluency, 2) Is an adjusted words per minute score predictive of reading fluency, and 3) What characteristics distinguish a fluent reader from a non-fluent reader?

There were two studies conducted to address these concerns. Study 1 consisted of sixty college students and Study 2 consisted of twenty-three second graders, twenty-five fourth graders, and twenty-one sixth graders.

It was found that an adjusted word per minute score on the oral reading assessment was neither correlated with nor predictive of reading fluency, for either study. With regard to distinguishing characteristics, there were no consistently significant findings other than accuracy between fluent and non-fluent second graders on the open-maze sentence and paragraph delivered sentence-by-sentence assessments.

The fact that the results were mixed with regard to reading speed and accuracy being distinguishing factors between fluent and non-fluent readers on the oral reading assessment, and the fact that, the results were also mixed with regard to the Lexical Decision Task should make one wonder if perhaps reading speed and accuracy are actually natural by-products of maturation and not necessarily secondary characteristics of reading fluency.

Assessing Reading Fluency

These findings lend credence to the theory that current intervention practices in the schools may be teaching our students to “bark” at text. They also lend credence to the idea that there may be a third pathway for processing words/text, a pathway that contains a semantic module that isn’t quite fully developed and is in fact in the learning process. Finally, the findings also support the idea that development of gist in the phonological store may depend on a student’s ability to metacognitively monitor their reading to the point of being able to retain more appropriate gist of sentences rather than trying to rehearse a complete replication of the whole sentence. To this end, it was proposed that a longitudinal (mixed methods) study be performed to assess these qualities.

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Chapter I

Introduction

The Beginning

It could be said that the birth of reading fluency occurred with the 1908 publication of Edmund Huey's book, "The Psychology and Pedagogy of Reading", a book so instrumental in the study of reading fluency that it was re-issued sixty years later. A reason for the book's continuing popularity may be due to the timing of its publications (republished in 1968). The first occurred before the emergence of behaviorism and the second occurred when there was a paradigm shift away from behaviorism towards cognitivism. This shift brought with it a renewed desire to study the cognitive aspects of reading, one such aspect being the importance of comprehension in reading. Therefore, the reason for the book's importance to the concept of reading fluency has to do with Huey's naissance of automaticity theory and this theory's crucial link to the definition of reading fluency. Huey's automaticity theory states that *"Perceiving being an act, it is, like all other things that we do, performed more easily with each repetition of the act. To perceive an entirely new word or other combination of strokes requires considerable time, close attention, and is likely to be imperfectly done, just as when we attempt some new combination of movements, some new trick in the gymnasium or new serve in tennis. In* *either case, repetition progressively frees the mind from attention to details, makes facile the total act, shortens the time, and reduces the extent to which consciousness must concern itself with the process."* The birth of this theory was influential to the findings of Samuels, LaBerge, and Bremer (1978) that beginning readers become fluent readers in stages: first reading by letters, then by groups of letters or syllables, then by whole words, and eventually whole sentences.

With the re-emerging interest in reading fluency (Allington, 1983), reading curriculums came under attack (Goodman & Goodman, 1979; Smith, 1973), and reading wars between whole language groups, skills based groups, and advocates of a balanced approach ensued. During this time, The Human Learning Center of the University of Minnesota began research in reading and LaBerge and Samuels (1974) developed a theory of reading -- a theory which applied Huey's automatic theory to the development of word recognition. Their theory stated, *"If a participant was not automatic at word recognition then the important job of reading for meaning had to be done in two stages. During the first stage the participant's attention is on the task of decoding the words in the text and because the word recognition task is not automatic all of the available cognitive resources are being used for this task. During the second stage the participant switches his or her attention and* *cognitive resources to comprehension. This two-step process is slow and places a heavy demand on the memory systems. However, over a period of time and with a lot of practice reading books in the participant's zone of reading ability or Zone of Proximal Development (ZPD) (Vygotsky, 1978, 1986), the participant becomes automatic at the decoding task. With the decoding task now being automatic, the two tasks of decoding and comprehension could be done together."* While LaBerge and Samuels, 1974 focused on how the automatic decoding of words facilitated comprehension, Schreiber (1980, 1987) took a linguistic approach and reasoned that the route to fluency was brought about by participants learning to parse text (automatically) into its linguistic units; i.e., noun and verb phrases. Accordingly, fluent readers were able to use punctuation to rapidly determine where to place emphasis and separate text into grammatical units. For example, when we see a question mark at the end of a sentence our voices change in tone and emphasis to indicate we are asking a question and not making a statement. When breaking a text into linguistic units occurs effortlessly, it frees up cognitive resources for comprehension. Others (i.e., Thurlow & van den Broek, 1997) have extrapolated this theory -- as reading skill increases, more and more of the sub-skills become automatic -- and this has lead to the recent re-conceptualization of what can be automatic in reading that goes beyond word identification to include components of the comprehension process. The progression of automaticity being that we first learn letters to an automatic level and then words to the point of being able to “comprehend” sentences, until we are finally able to carry the “gist” of one sentence to the next such that the comprehension of paragraphs of text becomes much easier.

Now in the twenty-first century, according to Reading Today, reading fluency has once again become a hot topic (Cassidy & Cassidy, 2003/2004). Though reading fluency has experienced fluctuating periods of high and low status over the years, it is currently experiencing a place of prominence in the classroom. This may be attributed to the appalling finding published by the NAEP (2005) that nearly half of the fourth grade participants studied were not fluent in reading grade-level materials. Since the publication of these findings, two prestigious reports (NRC, 1998 and National Reading Panel [NRP], 2000) have emphasized the need for reading fluency to become an important goal of reading curriculums and have supported the method of repeated reading as an effective method for improving word recognition, fluency and comprehension across grade levels. The effect of these publications has been that reading fluency has gained new recognition as an essential element of reading programs, especially for participants who struggle with reading (Hudson, Lane, & Pullen, 2005).

The Dilemma

As an extension of reading fluency's new found notoriety, its definition and measurement have fallen under intense scrutiny. Now that reading fluency has been added to most, if not all, reading programs, a plethora of developmental methods and interventions have flooded school systems, along with a surfeit of mass marketers of testing products claiming to have assessments that measure reading fluency. At issue here then is the question of whether or not these interventions and assessments really facilitate and assess reading fluency. But, before we can begin answering these questions we must first address the issue of a definition, "What is reading fluency?"

Why must we first address the issue of a definition? If there is no clear definition of the construct how can we know if the tools we are using to measure it are really measuring reading fluency? It follows too that there will also be implications for the classroom with regard to effective methods for developing and improving a participant's reading fluency. Reading fluency as a hot topic today has brought to light some critical issues: What is it? What are the best ways of developing it? How do we assess it?

Chapter II

Literature Review

The Role of Automaticity Theory

Why is automaticity theory crucial in the study of reading fluency? It is because reading is a complex skill that requires the coordination of many sub-processes within a very short period of time. Therefore, if each sub-process requires attention to get it done, performance of the complex skill will be impossible because the capacity of attention will be exceeded. However, if enough of the processing component sub-skills become automatic then the load on attention will be within tolerable limits and the skill can be successfully performed. Therefore getting participants to decode at an automatic level permits allocation of attention to comprehension so the two processes can occur at the same time.

There are numerous empirical research findings that support the idea that people are capable of doing two things at the same time (Allport, Antonis, and Reynolds, 1972; Spelke, Hirst, and Neisser, 1976). Intuitively we know this to be true as well. How else would we be able to drive a car, talk, and change the radio station all at the same time? How is it that we can walk and talk at the same time? Perhaps the answer for it lies in the fact that these actions require the use of different cognitive sub-skills and therefore, there is no conflict between the resources required to carry them out. Or, you might argue that not everyone can drive a car, talk and change the radio station at the same time, and you'd be correct. For example, novice drivers cannot do these things as well as seasoned drivers. So, what is the difference between the novice driver and the seasoned driver? Automaticity! The seasoned driver has developed automaticity in the skills needed to drive and therefore has no interference between the automatic process (driving) and other concurrent activities (talking and changing the radio station).

What does this mean in terms of a definition for reading fluency? It has a great deal to do with definitions that posit decoding is occurring at the automatic level. This is because with little effort or attention being spent on decoding words the bulk of attention can be focused on comprehension. An example can be seen in a study by Daneman and Carpenter (1983) where children were read stories that contained inconsistencies. The inconsistencies were either explained right away (at the time the inconsistencies occurred in the story) or the explanation was delayed and occurred after a number of intervening sentences. When clarification occurred immediately (at the time of the inconsistency), there was no difference between the poor comprehenders and good comprehenders groups. However, if there were several sentences interposed between the inconsistencies and the clarification, poor comprehenders were much less likely to understand the text. Therefore, Daneman and Carpenter concluded that the crucial difference between the two groups was in their working memory capacity – one group (good comprehenders) had developed to the automatic level freeing up working memory for comprehension and the other group (poor comprehenders) had not.

Regardless of whether the definition incorporates the simultaneous decoding and comprehension of text or simply addresses its secondary characteristics (speed, accuracy, and prosody); it still relies on the assumption that attentional capacity is limited. Therefore, quick and effortless word identification is important (National Institute of Child Health and Human Development [NICHD] Pub. No. 00-4769 as reported in the National Reading Panel [NRP], 2000). The 'multi-task functioning' of the fluent reader is made possible by the reduced cognitive demands needed for word recognition and other reading processes, thus freeing cognitive resources for other functions, such as drawing inferences (NRP, 2000). Automaticity theory lends credence to the NICHD and the NRP because, according to automaticity theory, a behavior or skill is automatic when two or more complex activities can be done at the same time. In other words, when a given stimulus is repeatedly paired with the same response, it progressively appears to take less and less attentional resources, and to interfere less and less with other concurrent tasks (Baddeley, 1990).

One of the most famous examples of automaticity can be seen in the Stroop task (Stroop, 1935; Cohen, Dunbar, & McClelland, 1990). In this task, words that name colors (e.g., red, green) are printed in different colors. For example, the word red printed in green ink or the word green printed in red ink. The task then is for the participant to name the color that the word is printed in, while ignoring the actual word. John Ridley Stroop found that it took longer for a fluent reader to name the color that the word was printed in, than a non-fluent reader. This was because a fluent reader's automatic reading processes identify the word almost immediately, and the interference of time and effort causes a delay in naming the color in which the word was printed.

Since the mid -1970's when LaBerge and Samuels (1974) presented their general theory of automatic information processing in reading, cognitive skills have remained the central focus of automaticity research. According to LaBerge and Samuels (1974), the visual processing of words could take a variety of routes. Their model of visual memory shows that the following units could be used to recognize a word: distinctive features, letters, letter groups or spelling patterns, and the word itself. For skilled readers, the micro-level sub-skills (e.g., knowing letter-sound rules, letter combinations, and the meanings of words and their connections) became automatic. These units of recognition could be processed either with the services of attention, as the beginning reader might use, or automatically, as a skilled reader might do. Logan (1988, 1991), in discussing the LaBerge and Samuels' model states that in addition to the shift in the size of the unit used in word recognition, there is also a strengthening of the connections between the visual code and the phonological code.

While LaBerge and Samuels have traced the developmental route from beginning to fluent reading in their model, that is, from letter-by-letter identification leading to word recognition as a holistic process, they did not attempt to explain the process whereby a word could be identified automatically. It took other researchers like Logan (1997) and Stanovich (1990) to explain the mechanism whereby words could be identified with little attention and effort, bringing to the fore a memory phenomenon in which disparate separate actions are chunked and stored into a single unit. The phonological loop provides some clues into this phenomenon. Its association with comprehension has been shown by the deficits in comprehension that have occurred when heavy loads have been placed on the phonological store (Baddeley, 1990). For example, the process of overt or covert articulation involves setting up and running speech motor programs, if this sub-process has the function of maintaining items in the phonological store by refreshing (rehearsing) their fading traces, then the faster it can run, the more items it will maintain and the longer the memory span. This is critical to comprehension in reading text. Much of the activity that goes on during comprehension of a written text by a fluent reader depends only minimally on the sound characteristics of the material being read and is much more dependent on its meaning. Therefore, it would appear that participants maintain something approaching a verbatim representation of much of a given sentence while dumping that representation as they move from one sentence to the next. Since this involves carrying information over from one sentence to the next, there must be some form of representation that is other than a verbatim record. The quality of comprehension that occurs will then heavily depend on the accuracy of these representations.

The Process – Two Models. The model (Figure 1) provided by Ellis & Young (1988) can further enhance our understanding. This model depicts two possible routes for reading: the grapheme to phoneme conversion route and the visual lexicon through semantic route. The existence of these two routes can explain why a participants' reading speed and accuracy can surpass their comprehension in reading text. For example, by training participants to say words as quickly and accurately as possible (to the level of automaticity) does not necessarily mean the participant is going to comprehend what they have said. This is because by focusing on speed and accuracy we may be forcing the use of the grapheme to phoneme conversion route which by-passes the semantic system and phonological output lexicon where comprehension takes place. Therefore, by focusing solely on the development and assessment of speed and accuracy we may be implementing developmental practices and assessments that merely measure the participant's ability to "bark at text" (Samuels, 2007). Consequently, though automaticity is a good thing for freeing up working memory capacity so comprehension can occur, caution must be taken not to assume the visual lexicon through semantic route is being taken without explicitly testing for comprehension.

The theory of automaticity and its relationship to beginning and fluent readers can be further explained by the use of fMRI to map reading sub-processes. In the complex mapping of mental sub-processes, researchers (Pihlajamaki, Tanila, Hanninen, Kononen, Laakso, Partanen, Soininen, & Aronen, 2000, Shaywitz, Mody, & Shaywitz, 2006) argue for the capacity of parallel processing. Marsolek's (2004) model (Figure 2) is comprised of a set of five subsystems (primary visual – where decoding takes place, auditory, somatosensory, gustatory, and olfactory) which are connected to the Conceptual/Associative subsystem (where the phonological loop resides and comprehension takes place), which in turn is connected to the two motor output subsystems (manual and vocal). These subsystems are interconnected to four additional subsystems (hippocampal, basal ganglia, cerebellar, and amygdale). *It is the interconnectedness of these subsystems that permits the possibility of attaining automaticity and the by-passing of some subsystems*. In theory, when something is learned to automaticity it could conceivably enter the primary visual subsystem, go directly to the hippocampus or amygdala (by-passing semantic operations in the Conceptual/Associative subsystem altogether) and exit directly to the motor output subsystem. Further, this model lends credence and support to the earlier model offered by LaBerge and Samuels (1974) in that it does not contain a unified “thinker” as such, but has instead a set of sub-processes that when taken together (chunked as one unit) give the appearance of a central executive.

Cognitive psychologists (Ackerman, 1987; Logan, 1988/1991; Posner and Snyder, 1975; Posner, 1978; and Shiffrin and Schneider, 1977) describe the characteristics of reading fluency to be highly skilled and complex, and they agree that the seemingly effortless automatic text processing skills required for reading are acquired gradually and as a result of extended practice. This is because automatic processes are fast and effortless (from the standpoint of allocation of cognitive resources), unitized (proceduralized) such that they may not be easily altered by a subject's conscious control, and may allow for parallel operation with other information processing within and between tasks. Note that when a person is automatic at decoding it allows for parallel processing and the person is able to perform several tasks at the same time such as; decode words in a text, break words into proper grammatical units, and comprehend. This concept of parallel processing is essential to the definition of fluency and to its valid measurement.

Critical Issue – A Definition

Three different camps. Reading fluency is a complex psychological construct comprised of numerous sub-processes, and because it is, it can mean different things to different people. The conundrum is that there are currently three camps, each positing a different definition for reading fluency.

Two of the camps fracture reading fluency into its secondary characteristics of speed, accuracy, and prosody. The first of these two camps consist of those who define reading fluency as the ability to read a passage of text with speed and accuracy - where accuracy translates to words skipped or mispronounced (National Assessment of Educational Progress [NAEP], 2002 as reported in Daane, M.C., Campbell, J.R., Grigg, W.S., Goodman, M.J., and Oranje, A. (2005); Armbruster, Lehr, & Osborn, 2001), a process that occurs in two stages with word recognition or decoding occurring at stage one and comprehension occurring at stage two. This two stage process is what beginning readers do, not what fluent readers do.

The second of these two camps consists of those who define reading fluency as the ability to read with speed, accuracy and expression or prosody (Hudson, Lane & Pullen, 2005; Rasinski, 2007; Denton, Bryan, Wexler, Reed & Vaughn, 2007). This camp believes that if a participant spends most of their effort focused on word recognition or reading one word at a time without phrasing, then their ability to comprehend is compromised. They suggest prosody coupled with speed and accuracy is evidence of comprehension. Therefore, if a person reads with accuracy and prosody, but slowly then no comprehension has taken place. Implicit in their definition is that the articulation or enunciation of a word is directly related to knowing its meaning. For instance, if a person can't pronounce a word, then they don't understand it and if a person can pronounce a word then they do understand it. A problem with this definition is that there are examples where this is not true. For example, there are individuals who know the meaning of words they may not pronounce correctly (maybe they haven't had a chance to use it or hear it in conversation), and there are individuals who do not know the meaning of words they can pronounce (have heard it used).

The third camp is different from the first two camps in that it consists of those who define reading fluency as the ability to simultaneously decode and comprehend text (LaBerge & Samuels, 1974; NICHD, 2000; NRP, 2003; Samuels, 1976, 2002, 2006, 2007; Wolf and Katzir-Cohen, 2001). This approach relies on reading fluency being a one-step process, something fluent readers do. It relies on automaticity theory and the belief that decoding can occur at an automatic level (fast and accurate), thereby leaving working memory resources available for comprehension to occur at the same time.

Though at first blush the three camp's connotations may appear equivalent in that they contain secondary characteristics of reading fluency, they are not. The reason they are not the same has to do with how they deal with the issue of comprehension. The definitions offered by the first two camps do not explicitly include a comprehension component. One assumes speed and accuracy provide a bridge to comprehension (Armbruster, Lehr, & Osborn, 2001). For example, if a listener is able to understand what the reader is reading then the reader must be able to comprehend it as well – comprehension is implicit. The other includes a third characteristic – prosody, believing that if all three characteristics are done well then comprehension is a given – comprehension is explicit in the form of prosody. There are two problems with these two camps' definitions. The first problem is that they misapply automaticity theory's role in reading fluency by assuming if a person exhibits these secondary characteristics well then the person will automatically use the freed up attentional resources for comprehension. However, these camps do not explicitly check (measure) to see if the person really does comprehend what they've just read. A second problem is the misconception that the complex cognitive processes necessary for comprehension can be measured behaviorally and that all individuals will display the same behavioral affects (expression) for comprehension. This is further confounded by the effect of grammar, dialectical, and idiom rules for expression in reading that can be mimicked without comprehension of the involved text. For example, these definitions do not explain why a person can read a passage of text either in a foreign language (be it an English as a Second Language participant reading a passage in English or an English speaking individual reading a passage in French) or in the form of Jabberwocky (Carroll, 1872) with great speed, accuracy and prosody and yet when tested for comprehension shows none. For example, Alice of Alice in Wonderland reads the following poem -

'Twas brillig, and the slithy toves
Did gyre and gimble in the wabe:
All mimsy were the borogoves,
And the mome raths outgrabe.

> *"Beware the Jabberwock, my son!*
> *The jaws that bite, the claws that catch!*
> *Beware the Jubjub bird, and shun*
> *The frumious Bandersnatch!". . . .*

and then comments, “it seems very pretty, but it's rather hard to understand!” So, though Alice is perfectly capable of reading the poem with speed, accuracy and prosody, she admits to having difficulty understanding it.

Consequently, while the secondary characteristics (speed, accuracy and prosody) are necessary for reading fluency, they are not sufficient. In view of this fact, the first two camp’s definitions of reading fluency are specious because they define the two-stage process of what beginning readers do, decode at time one and then comprehend at time two, not what a fluent reader does, decode and comprehend simultaneously. It is only the third camp’s definition that definitively defines the one-stage process of fluent readers, simultaneous decoding and comprehending.

Further support for the third camp’s definition comes from the neuropsychological research of Ellis and Young (1988), Pihlajamaki, Tanila, Hanninen, Kononen, Laakso, Partanen, Soininen, and Aronen (2000), Miller and Cohen (2001), Marsolek (2004), and Shaywitz, Mody, & Shaywitz (2006) that show multiple pathways for seeing, processing and saying written words. For example, the Ellis and Young model (Figure 1) depicts two possible routes for the pronunciation of a written word. These routes are – the grapheme to phoneme conversion route and the visual lexicon through semantic route. Support for these two routes (Ellis & Young, 1988) has been found from having participants read real words and non-words – non-words take longer to pronounce and cause more error. This error is presumed to occur due to the conflict between the two different routes it could have taken.

The definitive definition of reading fluency is represented by the visual lexicon through semantic route: seen written word goes to the visual analysis system and then to the visual input lexicon, once recognized as a word it travels to the semantic system and then to the phonological output lexicon to the phonemic level buffer and finally comes out as speech. This route includes the semantic system whereby meaning is attached to the word or sentence, facilitating comprehension. The specious definitions of fluency are represented by: the grapheme phoneme conversion route -- seen written word, visual analysis system, grapheme phoneme conversion, phonemic level buffer and speech. This route does not include the semantic system and phonological output lexicon that are necessary for word meaning attachment, and hence no comprehension is taking place. Therefore the only true definition of reading fluency is the one posited by the third camp – the ability to simultaneously decode and comprehend text. This definition sets the ground rules for how reading fluency should be developed and measured.

Even so, we must be cautious and recognize that fluency is not a dichotomous variable where a person is considered to be either fluent or not fluent, but one that occurs on a continuum (Logan, 1991). For example, a participant can be very fluent when reading material they are very interested in and enjoy and less fluent when reading material they have had no previous exposure or interest. For this reason, a fluent reader should not be thought of as a stage of development in which all words can be processed quickly, for even highly skilled readers can encounter uncommon, low frequency words that they are unable to recognize automatically (Shiffrin and Schneider, 1977).

Development

To address the question of “What is the best way to develop reading fluency?” we must first address the question of, whether or not reading fluency is developmental. Automaticity theory explains how individuals become highly skilled at tasks they once found difficult; tasks such as learning to type, driving a car, playing a sport, or reading a book. In terms of reading fluency, the theory is that the transformation from a beginning reader (when decoding occurs at time one and comprehension occurs at time two) to an advanced reader (when decoding and comprehension occurs simultaneously) will take place over time and after a lot of practice. However, researchers seem to differ in their explanation of the *psychological mechanism* that facilitates this transformation.

Learning theory tells us breaking down a complex skill into smaller developmental stages or sub-skills and then giving instructions on how to perform each of the sub-skills in a sequential fashion facilitates learning (Gagne, 1985). For example, beginning typist find that when they are typing a page of text they need to concentrate very hard on looking at the letter on the page and thinking about where that letter is on the typewriter and which finger to use to hit the appropriate typewriter key. However, with practice the typist eventually finds that they are typing much faster because they are able to look at and type whole words, and with even more practice they are eventually able to read and type whole sentences.

When this theory is applied to reading we find that there are five stages involved in the development of fluency (Samuels, Ediger, & Fatsch-Patridge, 2005; Samuels, Ediger, Willcutt & Palumbo, 2005). During stage one, beginning readers learn the words people say orally can be represented in print form, that books contain words and that words combine to create stories. They begin this process by first focusing on individual letters, learning how to pronounce each letter individually, understanding the relationship between common letter combinations (Chall, 1983; Ehri, 1994), successfully combining letters to form words, and reading individual words or two word phrases. During this beginning stage, decoding simply means “seeing a word and saying it;” there is no expectation of comprehension. It is during Stage 2 that decoding begins to become automatic and attention begins to shift to understand words within a connected text. The shift from learning to read to reading to learn occurs at Stage 3 where reading becomes a tool for gaining new information. During Stage 4 there is an increase in ability evidenced by an increase in accuracy, speed, expression and comprehension. The final stage, Stage 5, incorporates metacognition or the monitoring of comprehension of the passage being read. Fluent readers decode words automatically and place their attention on comprehension and the monitoring of that comprehension.

The Samuels, Miller, and Eisenberg (1979) study of practice effects on the unit of word recognition was updated in 2005 by Samuels, Ediger, Willcutt and Palumbo (Figure 3) to reflect the metacognitive processes that become automatic in reading. At first, there is a non-accurate stage where the beginning reader has trouble identifying words. This is followed by an accuracy stage where reading is accurate but slow, halting, expressionless, and effortful, and word identification still requires mental effort. It is during the third stage that automaticity occurs. At this stage the reader automatically reads with ease and expression permitting attention to be fully applied to comprehension.

The following figures (Figures 3a, 3b, and 3c) depict the model and describe how the beginning reader proceeds to read a text. Figure 3a shows that because decoding is difficult all of the available attention is directed at decoding. When the decoding task is done, the reader switches attention to comprehension, as seen in Figure 3b. This switch in attention occurs because comprehension is usually a demanding task (even for fluent readers) that requires meaning to be constructed from information provided in the text and knowledge that is in the reader's own mind. Having completed the comprehension task, attention is now switched and focused on the metacognitive task, as seen in Figure 3c. It is at this point that the beginning reader must decide if the level of comprehension is satisfactory. If it is, the participant advances to the next text segment and repeats the process. However, if it is not, the participant must know what to do to correct the problem.

Figure 4 shows fluent reading. There are two dotted lines in the figure. These dotted lines indicate that decoding and metacognition are done automatically. In other words, these two tasks, as a result of years of practice, can be performed with little attention or effort and leaves enough cognitive resources available for the participant to be able to perform the comprehension task at the same time. As seen in Figure 4, the critical characteristic of fluent reading is that fluent readers can perform all the reading tasks at the same time.

The same mechanisms that explain how decoding becomes automatic are used to explain how metacognition becomes automatic. Usually, teachers help participants become aware of the need to self-monitor their own comprehension. If there is a breakdown in comprehension, the participant has to learn several strategies that can restore comprehension to satisfactory levels. At first, the metacognitive strategies are done with accuracy, but considerable attention and effort are required for their execution. With considerable practice, comprehension and fix-up strategies become automatic. Fluent readers automatically monitor their reading and engage in corrective procedures when there is a comprehension problem. In summary, this model of beginning and fluent reading has extended the concept of automaticity so as to include metacognition, which is an essential component of successful reading.

Development for reading disabled – phonics. Frith (1985) explains that fluent reading requires the development of strong orthographic representations, which allows fast and automatic identification of whole words made up of specific letter patterns. This has been found to be especially true for dyslexic children. For instance, Juel & Minden-Cupp (2000) found that when they focused primarily on phonics first, dyslexic children made tremendous gains in reading fluency – though they did not catch up to non-dyslexic children's performance. The NRP (2000) also suggests there is a natural progression of skill development on the path to acquiring reading fluency and recommends initial emphasis in reading instruction be on phonics instruction since word identification is aided by the application of phonic word attack strategies (letter-sound association). These word attack strategies are in turn based on the development of phonemic awareness, which is necessary to learn how to map speech to print (Fries, 1962).

Instructional Techniques

Based on these suggestions there are now a number of instructional techniques available and that claim to facilitate reading fluency. The basic tenet of these techniques is that "if they don't read much, how they ever gonna get good?" (Allington, 1983), and "the more time spent reading facilitates improved reading fluency" (Fink, 2006). Some of the techniques being used to develop reading fluency are; Repeated Reading (Armbruster & Osborn, 2007; Chomsky, 1976; Dowhower, 1987; O'Shea & Sindelar, 1983; Samuels, 1979 & 1997; Wolf & Katzir-Cohen, 2001), Guided Reading (Anderson, Wilkinson, &

Mason, 1991), Independent Reading (Samuels & Wu, 2003; Renaissance, 2003), Partner Reading, Guided Pairs, and Reader's Theater (Denton, Bryan, Wexler, Reed, & Vaughn, 2007; Rasinski, 1990 & 2003), Interest-Based Model of Reading (Fink, 2006), and computer programs such as the Renaissance Learning® Fluent Reader (2003) and Read Naturally® (2005).

Repeated reading. Samuels (1979) and Chomsky (1976) developed the methods of Repeated Reading and Modeled Repeated Reading, respectively, nearly three decades ago, and they have remained two of the very few techniques still used for fluency improvement (Armbruster & Osborn, 2007; Dowhower 1987, O'Shea, Sindelar, & O'Shea 1985 & 1987; Wolf & Katzir-Cohen, 2001). The Repeated Reading technique developed by Samuels has children read and then re-read a short passage of text several times until a satisfactory level of word recognition, accuracy, speed and comprehension is achieved. Samuels looked at the way reading was taught and determined that teachers often rushed though an entire basal workbook in one school year. For the slower readers this was difficult because the pace was too fast. Each day posed another day of frustration for these participants because it meant they would fall even further behind. Since then, research by O'Shea, Sindelar, and O'Shea (1985) has shown that most of the gains in reading speed such as word recognition error reduction and expression in oral reading are acquired by the fourth reading. They concluded that, "Four readings appear to be optimal since after four readings 83% of fluency is achieved" (p.138).

Guided repeated and partner reading. Both guided repeated oral reading and partner reading are similar to repeated reading. The unique aspect of “guided” being that a more skilled reader such as a teacher, parent or older peer, reads the passage once and then the pair read it aloud in unison a number of times until the participant feels ready to read it solo (comprehension questions should follow the solo performance). Similarly, partner reading has each child read a passage aloud to their partner a number of times with participants receiving simple feedback from their partner along with comprehension questions.

These methods of Repeated Reading are being used successfully by many children across the country and are being enhanced by computer programs such as Renaissance Learning® Fluent Reader and Read Naturally® to deliver the modeled and repeated reading opportunities that did not previously exist. Aspects of these programs that help to increase reading fluency include: listening to modeled reading, repeated oral reading, self-monitoring, and information feedback.

Reader's theatre. It is a spin-off of repeated reading and involves having the participants receive extensive practice and rehearsal of the scripted material before performing it in front of a group. This method can provide struggling readers with an opportunity to be successful at reading because it involves a lot of practice. The script is first modeled by the instructor and has a criteria chart containing expectations the reader must meet – reader speaks clearly, uses appropriate volume, reads the text accurately and with expression. This method has been especially successful in motivating participants to read (Rasinski, 2007).

When using these methods to develop fluency there are a number of important things researchers (Anderson, Wilkinson, & Mason, 1991; Chomsky, 1976; Dowhower, 1987; Fink, 2006; O'Shea & Sindelar, 1983; Rasinski, 1990 & 2003; Samuels, 1979 & 1997; Samuels & Wu, 2003; Wolf, 2001; Samuels, Ediger & Fautsch-Partridge, 2005) feel should to be kept in mind: to choose a text for the participant to read based on the individual characteristics of the participant (reading level, interests, and prior knowledge); to keep the text at a level that is not too difficult or too easy (facilitates fluency by helping participants to recognize high frequency common words as holistic units); to integrate motivational strategies for reading (letting the participants choose the text and praising them for their efforts); to model reading fluency (call attention to the components of your performance such as speed, articulation, and expression); to give feedback for miscues when they affect the meaning of the text and after giving the participant time to self-correct; and finally, to remember that the goal of fluency has little to do with speed, but a lot to do with the time it provides for comprehension to occur – which is the ultimate goal. So, an important caveat to keep in mind:

> "*the most important outcome for participants is that they can understand and learn from the text they read, and if participants have below-average reading speed, but demonstrate average or above average comprehension, it may not be appropriate to spend considerable time on improving their rate of reading" (Deno, Mirkin, and Chiang, 1982).*

Interest-based model of reading. This model is based on a study conducted by Rosalie Fink (2006) in which she compared three groups of readers – a control group (readers who experienced no difficulty with reading), a fully compensated dyslexic group of readers (able to read unfamiliar words nearly as accurately as other skilled readers), and a partially compensated dyslexic group of readers (had problems with word recognition, oral reading accuracy and spelling). Through extensive interviews and assessment she discovered that these particular dyslexic readers became fluent readers because they had these five essential elements in common: 1) a passionate, personal interest that spurs sustained reading; 2) avid, topic-specific reading; 3) deep schema knowledge; 4) contextual reading strategies; and 5) mentoring support. A common thread of these successful striving readers was that *they read a lot* and *they read to learn about a topic in which they were deeply interested*. Through their persistent reading on a specific topic they were able to develop deep schema knowledge in that particular domain. This deep schema knowledge further helped them to develop contextual reading strategies, and because of their familiarity with a particular domain they were able to anticipate the structure and format of the construct being presented, which in turn permitted them to correctly guess at unfamiliar words based on context. It must be said too that her striving readers were *resilient*, a trait necessary if learners are going to *persist* in doing things they have difficulty doing and find minimal success when first attempting. The resiliency and success found in Rosalie Fink's striving readers can also be attributed to the mentors in their lives who believed in their ability to succeed. Based on these findings, Rosalie Fink (2006) suggests that a balanced approach (with ongoing formal and informal assessments) is necessary and anything less will leave struggling participants behind and talented striving readers overlooked. Her approach includes the following five elements:

Assessing Reading Fluency

1) Discover each participant's personal interests and select motivating materials accordingly: create content area libraries.
2) Look for underlying abilities and talents in each participant: consider multiple intelligences and content area-dependent fluency.
3) Encourage hands-on activities at every age and stage of development.
4) Balance the reading program by giving equal time to; motivational activities with high interest-materials, eliciting skills instruction, and open-ended thought-provoking discussions and activities.
5) Use identifying rich materials to enhance cultural pride and literacy growth in all participants.

Computer programs. The Renaissance Learning® Fluent Reader (2003) and Read Naturally® (2005) are two computer software programs that use modeled repeated oral reading to increase reading fluency. The programs include the following components: modeled reading where participants listen to a passage read in speeds of slow, medium and normal with good expression. The participants determine the reading speed of their passage, and then, the participants are tape-recorded as they read the passage aloud until they have achieved fluency of this passage. Participants listen to their own reading and assess these recordings noting where their reading needs improvement. The computer provides data that tracks participants' progress. When the participant has read the passage at the desired rate *and answered questions about the story at a satisfactory level* they can proceed on to the next readability level. These programs have been shown to produce significant gains in reading fluency compared to traditional methods of fluency instruction (Palumbo, 2004), and according to Torgesen (1986) this is because computers have the capacity to deliver motivated, carefully monitored, individualized, and speed-oriented practice in concentrations far beyond those available in traditional methods of instruction.

Independent reading. There have been mixed findings on the effects of independent reading on reading ability development (NRP, 2000; Renaissance, 2003). Even so, teacher-education and reading-education literature (Anderson, Wilson & Fielding, 1988; Paul, 2003; Fink, 2006) often recommend in-class procedures for encouraging participants to read on their own, programs such as Silent Sustained Reading (SSR) or Drop Everything and Read (DEAR). Renaissance Learning, Inc. (2003) conducted the Guided Independent Reading (GIR) study to fill in what they thought was a gap in the NRP's study (the NRP did not include guided independent reading) and found that having successful independent reading requires the active guidance and instruction of teachers along with the allocation of up to 60 minutes a day of classroom time devoted to guided independent reading. Palumbo (2005) offers four steps to a good independent reading program:

Step 1: Assign a Readability Level to Each Book

Participants should have easy access to many books, articles, and stories that have easily identifiable readability levels.

Step 2: Determine Readability Level of Each Reader

Participants should read within their zone of proximal development (or ZPD range). If reading level is too easy, the child encounters no new material and if the reading level is too challenging this causes frustration for the participant (Torgesen, 2004). A readability level for participants in grades 1 through 12 can be obtained by using a computer adaptive-assessment or from a paper-based nationally normed reading test.

Step 3: Independent Reading at the Proper Readability Level

Participants should read many books at their independent readability level. An independent reading level is where participants are reading 90% to 95% of the words correctly. Reading at the independent level is important because new words are encountered and practiced systematically. In addition, participants do not get frustrated by reading at a level that is beyond their capabilities.

Step 4: Measure Participant's Reading Fluency Level

A reading fluency measure that includes a comprehension component would have participants read a passage, take the passage away, and then immediately have them either retell the story or answer comprehension questions about the story.

Assessment

Progress Monitors or Measures of Reading Fluency. Are the assessments being used as part of a school's curriculum merely monitoring a participant's progress or are they actually measuring reading fluency as defined by the third camp?

Curriculum Based Measurement. Curriculum Based Measurement (CBM) was developed by Dr. Stanley Deno (1985), for the purpose of helping teachers evaluate a participant's weekly *growth rate* while learning to read. This method required participants to read for one minute from a text typically used in the participant's regular instruction. The number of words read correctly in that one minute period of time was the participants score. Often the participant is tested over three passages and the median score is the score used for an evaluation. A week later the participant would be tested again on a similar passage and scored. If the participant is making progress then the score should increase from week to week. Dr. Deno's intent was for CBM to be used as a tool for measuring weekly progress in reading speed, not as a measure of fluency. CBM was developed as a means to assess participants' progress on their current curriculum and provided a formative assessment for the teacher to use in diagnosis and curriculum planning. CBM was also created in order to provide an alternative to mastery measurement which measured short-term accomplishments that often did not accumulate into broad competence (Fuchs, 2004). Placement and monitoring decisions require continuous measurement over time of a participant's performance of a skill and then comparing results of prior efforts to current performance. "Other decisions such as screening, determining program eligibility, and setting instructional goals and objectives require peer-referenced information involving comparisons with comparable peers" (Deno, 1985). CBM norms, words read correctly in one minute (WCPM), were established by Hasbrouck and Tindal (1992), and the median scores for various grades were set: Grade 2 - 53 WCPM, Grade 3 - 79 WCPM, Grade 4 – 99 WCPM, and Grade 5 – 105 WCPM.

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Because misuse of the tool has led to the misperception that the development of efficient word recognition skills leads to improved comprehension (Calfee and Piontkowski, 1981), CBM has been widely used around the country to determine if a participant is a fluent reader. In fact, McGlinchey and Hixson (2004) assessed the correlation between CBM and standardized reading scores and found supporting evidence for concurrent validity. However, Cramer and Rosenfield (2008) found *no correlations* between reading speed and reading fluency. What's more, Pressley, Hilden and Shankland (2005) not only found no correlation, but found reading speed to be a *poor predictor* of reading fluency.

DIBELS. DIBELS is an acronym for Dynamic Indicators of Basic Early Literacy Skills and is made up of multiple measures, all of which have the term fluency attached to them – fluency in these cases translating to speed. The measures are; initial sound fluency, letter naming fluency, phoneme segmentation fluency, nonsense word fluency, oral reading fluency (ORF), and retell fluency (RF). Typically the initial sound, letter naming, and phoneme segmentation fluency are given in kindergarten; the nonsense word and oral reading fluency are given in first grade, and the oral reading fluency in the second grade. Their definition of reading fluency is "the effortless, automatic ability to read words in connected text – the ability to translate letters to sounds fluently and effortlessly." Based on their form of assessment they are deconstructing reading fluency into the participant reciting "the specific form of a particular passage in a text" and "effortless, flowing smoothly and easily" as opposed to a more appropriate assessment of "to comprehend or take in the meaning of some written or printed text."

The developers of DIBELS (Good, Kaminski and Dill, 2002) state that it is designed to assess a participant's development of phonological awareness, alphabet understanding, and automaticity and fluency. They also claim that the tests are indicators of a participant's early literacy development and *predictive* of later reading proficiency. They are intended to identify participants who are not progressing as expected.

For the ORF part of the test participants are required to read out loud a passage from a grade appropriate list of passages. During the reading the instructor/tester listens to the participant reading and marks down missed words. These words are then subtracted from the total read and a score is assigned to the participant. Errors are considered to be words that the participant stumbles over, skips over, or does not self correct within a three-second time period (very similar to CBM which is a progress assessment not a predictive assessment). For the RF part, if it is given at all, is given after the participant has read the passage. Once the passage is read, the instructor/tester again records the number of words the participant uses to retell the story. This is how comprehension is measured. The quality of the words, how well they actually retell the story, is of no consequence. It is the number of words used that is important.

The test does have a number of strengths. For instance, the test only takes between five and ten minutes of the instructor's time. This is essential for teachers who are pressed to test upwards of 100 participants three times a year. The test can be repeated either in one sitting or throughout the school year, a quality the creators emphasize with their recommendation of at least three times a year. The tests are free to download and are accessible to anyone who wants them. So, not only can teachers download the test but so can parents. Parents who want their children to get a "head-start" on the test can download them and practice with their children. The tests also provide information on what parents, teachers, and participants themselves can do to improve their reading skills. For instance, participants who are found to read at an excessively slow rate may need to engage in repeated and assisted readings. Participants whose decoding accuracy is poor may need additional word study and phonics instruction, and participants who do poorly on the fluency rubric (prosody) may need additional coaching and support in reading with expression and meaning (a position taken by the second camp that prosody equals comprehension). Therefore, the test not only supposedly identifies specific areas that are giving participants trouble; it also provides quick and easy solutions for those problems.

However, the tests also have weaknesses. According to Goodman (2006) one of the worst issues is that it reduces reading to discrete skills that have, at best, minimal connection to actual reading. As a consequence, participants are required to do drilling of nonsense words and focus on narrow slices of what is being read, He further states that the creators obviously believe the whole is clearly the sum of the parts and that somehow comprehension emerges from the fragments being tested. However, the tests have been shown to mispredict reading performance, measuring reading speed and not comprehension (Pressley, et al., 2005). The retell fluency component is said to be a measure of comprehension, yet though this test may be reliable it is not valid. It may be reliable in that it is possible to obtain consistent scores on the retelling; however, these retellings are not valid measures of comprehension. They are not valid because they are measuring the number of words uttered regardless of whether or not those words make sense and actually relate to the story just read.

This issue of reliability and validity also occur with the ORF task. For instance, the method in which errors are recorded vary from tester to tester.

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According to the instructions an error would be any word that is stumbled over, skipped over, and not self-corrected within a three-second time frame. However, some teachers tell participants to skip over words they don't know so they can get a better score on the speed of their reading (Goodman, 2006). This raises the question of inter-rater reliability and if they are not reliable they cannot be valid. The test lacks validity in another area as well. The speed and accuracy of the ORF is expected to be measuring fluency, but how can it measure fluency when there is no comprehension component. Therefore it does not test the construct of reading fluency because it only tests two of the secondary characteristics – speed and accuracy. Unfortunately, participants catch on very quickly that this is a test of speed and not comprehension. This has led to a finding that 15% of the participants who took the ORF were misidentified as good readers when in actuality they had poor comprehension (Riedel, 2007). This is because most of the validation studies use a procedure that mimics what beginning readers do when they read a text not what fluent readers do. At time one the researcher tests oral reading speed, at time two (a later time) comprehension is tested using a completely different test than what was used to test reading speed. This separation of the decoding from comprehension would naturally provide significant correlations with speed and comprehension like those found using the CBM. In fact, Cramer and Rosenfield, 2008 found that using a comprehension task coupled with a speed of reading task that there was no correlation between reading speed and comprehension.

With the widespread use of the DIBELS tests (used to assess more than 1,800,000 participants from kindergarten to grade six), a number of scholars in the field of reading have evaluated them (i.e., Cramer & Rosenfield, 2008; Goodman, 2006; Pressley, 2005; Samuels, 2007). For example, Pearson (2006) stated, “DIBELS is the worst thing to happen to the teaching of reading since the development of flash cards” (p. 5). Goodman (2006) is concerned that despite warnings to the contrary the tests have become a de-facto curriculum in which the emphasis on speed convinces participants that the goal in reading is to be able to read fast and that understanding is of secondary importance. There is certainly enough concern by these leading scholars to warrant further review.

Automaticity theory provides the foundation necessary for defining the construct of reading fluency (the simultaneous decoding and comprehension of text) and identifies the resulting secondary characteristics (speed, accuracy and expression). These characteristics further provide concrete areas for the instruction and development of reading fluency, and are, in turn, necessary for the assessment of that fluency. More than ever, in these times of high-stakes testing, valid reading fluency assessments are imperative. To this end, reading fluency assessments must not only measure the secondary characteristics of speed, accuracy and prosody, but must also *explicitly* assess comprehension. However, not all assessments professing to measure reading fluency actually do (DIBELS) and even some assessments that are not claiming to measure reading fluency are being misused (CBM) to falsely report reading fluency scores. For these reasons, reading fluency assessment tools are in need of extensive review.

Snow, Burns, & Griffin (1998) state, "because the ability to obtain meaning from print depends so strongly on the development of word recognition accuracy and reading fluency, both should be regularly assessed in the classroom" (p.7). However, we must first develop a valid measure and to do so we must be steadfast in our definition of the construct being measured. In this case, the main characteristic of reading fluency is the ability to do at least two tasks simultaneously; i.e., decode and comprehend. Therefore, only measurement tasks that include a comprehension component can hope to be valid measures of reading fluency.

Eye Fixations. One method used in the 1990's involved eye movements (saccades) and fixations to measure reading speed and comprehension. Underwood, Hubbard, and Wilkinson (1990) found eye fixation duration was a successful predictor of reading comprehension. Though they *did not find a correlation between reading speed and comprehension* they did find a relationship between fixation durations and comprehension. Nevertheless, they caution that decreasing fixations may not lead to better comprehension because it could be that better comprehension leads to shorter fixations. Subsequently, Everatt & Underwood (1994) and Everatt, Bradshaw and Hibbard (1998) found increased information seeking behavior is related to reading speed and comprehension, *but reading speed had no relationship with comprehension*.

When it comes to the implementation of classroom assessment tools for reading fluency the goal is to find out if participants are simultaneously decoding and comprehending. A common method of doing this is to inform the participant at the time of testing that they will be asked to first read a passage of text orally and then be tested on comprehension by either retelling as much of the story as they can or answering questions about the text they just read. This method is a good match for measuring reading fluency because it requires the reader to decode and comprehend simultaneously. However, this is not always what happens when assessing reading fluency in the classroom as some tools assess what beginning readers do, decode at time one and comprehend at time two (DIBELS), or merely serve as progress monitors that assess change in growth (CBM).

An appropriate measure of reading fluency must include a measure of comprehension. It must mimic reading fluency by measuring the simultaneous decoding and comprehension of text. An appropriate method proposed by Samuels (2002), requires determining the participant's reading ability level first and then choosing a passage of text within that level. However, before the participant begins reading the text orally, (s)he is given the following instructions, "Read this passage orally and when you are done I will take the passage away. You will then have to recall the content of the passage by either retelling the story to me or by answering some questions about what you have just read." This method mimics reading fluency because it explicitly requires the participant to 1) decode the text, 2) understand the text material while decoding, and 3) hold the material in memory until the text is completed.

This is a process very similar to the Reading Fluency Indicator (RFI) used by the American Guidance Services (AGS) for measuring reading fluency. Its main strength is that it actually measures reading fluency – whether or not the participant is decoding and comprehending at the same time.

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American Guidance Services Reading Fluency Indicator. Created by Kathleen Williams of AGS it is contained in the companion assessment to GRADE (Group Reading Assessment and Diagnostic Evaluation). This program provides a concise, criterion-referenced measure of oral reading fluency; including rate, accuracy, and comprehension.

This assessment is designed to be given individually, can be taken in five to ten minutes, and provides a systematic approach to rating prosody, the ability to read with proper expression, should you choose to use it. The RFI measures phonological awareness, phoneme-grapheme, word reading, and vocabulary prior to first grade and comprehension beginning in the first grade.

The assessment begins by first establishing a participant's readability level by having the participant pronounce a list of words in increasing difficulty until the participant is able to correctly pronounce at least 9 out of 10 words. Once the readability level is established, passages of text are then selected at that readability level for the participant to read out loud. There is then a script/directions told to the participant prior to their reading the passage – "You are going to be reading a passage of text out loud, when you are finished I will ask you some questions about what you have read." Words read correctly in one minute are recorded and the comprehension questions are presented. Therefore the RFI tests fluency in terms of three components – reading time, miscues, and comprehension. Comprehension is tested on two levels: For sentence comprehension the participants must select missing target words (from a list of possible choices) from a sentence based on the context clues or sentence meaning – an open maze test. For passage comprehension the participants are given multiple choice questions with varying levels of understanding – questioning and clarifying ability, predicting and summarizing ability, and metacognitive strategies such as questioning, predicting, clarifying and summarizing.

The test has strengths. It has the flexibility to view the participant or the classroom as a whole for strengths and weaknesses in reading skills. It provides information on individual and/or group performance for parents that are easy to read and understand. It provides the software for scoring and reporting the findings or they will score it for you. It also allows for comparison from year to year in growth scale values (GSV) in readiness skills so that growth can be shown in readiness even though the performance level of the participant may still be below average.

A weakness of the test is that it does not give interpretive information of what it means when a participant gets three questions wrong out of the four questions given compared to a participant who gets two questions wrong out of the four questions given. However, if the difficulty of the questions is taken into account then this will give an interpretive element to the assessment. For instance, if a participant is able to answer the "knowing" level of questions but not the "inferential" level of questions, this will tell us something about the participants' comprehension level of the passage of text.

Rapid Naming and Double-Deficit Hypothesis. Wolf, M. & Bowers, P. (2000) discovered that "there was this one very odd phenomenon that children who were going to become dyslexic were always exhibiting, whether they were five, six or seven years of age, and that was a failure to be able to name things they saw at the same speed that other children could." Naming seems very simple but it's actually a very difficult set of underlying processes. There are many issues beyond the phoneme, which includes the visual system, the retrieval system, and the speed with which the brain puts its' systems together. Naming speed and the speed with which you read are important not for speed as speed, but for the brain's ability to do those easy processes fast enough to allocate time for comprehension.

The rapid naming test or *Rapid Automatized Naming (RAN),* measures continuous, serial naming-speed performance on common visual stimuli and opened up a world of understanding about how important the individual processes to reading are to reading fluency, and her double-deficit hypothesis shows that there are children who have single deficits in phoneme awareness, children who have single deficits in naming speed, and then there are children who have both or a double-deficit. Therefore, children who have both reading fluency and comprehension issues have different reasons for reading failure than children who have only phoneme awareness issues.

Research Questions

There are three questions being asked. One question has to do with whether or not certain reading fluency assessments actually measure reading fluency as put forward by the third camp. The second question has to do with whether or not reading speed and accuracy is predictive of reading fluency. The third question has to do with the characteristics of fluent readers. More specifically, what characteristics distinguish a fluent reader from a non-fluent reader?

It is being hypothesized that:

1) Reading speed and accuracy is not correlated with reading fluency.
2) Reading speed and accuracy is not predictive of reading fluency.
3) Fluent and non-fluent readers exhibit the same characteristics with regard to speed, accuracy, and ability to retain the gist of a sentence.

Chapter III

Method

Participants

Study 1. Study 1 consisted of 60 college participants (11 male and 49 female) enrolled in an EPsy 3119: Learning, Cognition, and Assessment course at the University of Minnesota. They were offered ten extra credit points for their participation. Three of the participants were English as a Second Language (ESL) students; one male who has Korean as his native language, one female who had Hmong as her native language, and one female who began learning English at the age of nine. Thirty-three of the participants wore either glasses or contacts to correct their vision, twenty-six of whom were female and seven of whom were male. Five of the participants were left-handed; four of whom were female and one of whom was male. Seven participants were eliminated from the study (one male and six females) because the computer software program failed to record either some or all of their data.

Study 2. Study 2 consisted of 69 elementary school participants (37 male and 32 female); twenty-three second graders (13 males and 10 females), twenty-five fourth graders (15 males and 10 females), and twenty-one sixth graders (9 males and 12 females) from a private urban elementary school in Saint Paul, Minnesota.

One second grader, a female, was adopted from Russia at the age of four but according to her parent she did not retain any of her Russian vocabulary. One second grader wore glasses to correct his vision. Two second graders, both males, were left-handed.

All fourth graders were native speakers of English. Three fourth graders, all of them male, wore glasses or contacts to correct their vision. Two of the fourth graders, one male and one female, were left-handed.

There was one sixth grader who had Spanish as her native language. Both of her parents are from Mexico and speak Spanish at home. Seven of the sixth graders, two males and five females, wore either glasses or contacts to correct their vision. Two of the sixth graders were left-handed.

There were four participants from the second grade, one male and three female; five participants from the fourth grade, three male and two female; and four participants from the sixth grade, three male and one female were eliminated due to the computer software program failing to record either some or all of their data.

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Materials

Both Studies. The materials used for both studies consisted of a quiet room in which to run the study (the Reading lab at the University of Minnesota for the college students and an unused classroom at the elementary school for the elementary students), a Hewlett-Packer laptop computer loaded with the silent reading assessments portion of the study which were made possible by the SuperLab® 4.0 computer software program of Cedrus Corporation, an egg timer, a consent form (Appendix A), a questionnaire (Appendix B), instructions and/or notes for the assessor (Appendix C), the Woodcock Johnson word identification assessment; (Appendix D), oral reading passages (Appendix E), a set of instructions for the silent reading assessments on the computer (Appendix F), a Lexical Decision Task (Appendix G), an open maze assessment (Appendix H), a reading paragraph assessment (Appendix I), and a sentence by sentence reading paragraph assessment (Appendix J). There were also debriefing forms (Appendix K) and sign-up sheets (Appendix L) provided for the participants.

Excel spreadsheets and SPSS statistical software were used to store the data and run the analyses. The Woodcock Johnson word list and the oral reading passages were typed double-spaced in Franklin Gothic, black, 12 point font, and the computer assessments and instructions were typed double-spaced in Tahoma, black, 12 or 14 point font and centered both vertically and horizontally on a 15 inch computer screen.

Design and Procedure

Design. Each student was given the Woodcock Johnson Word List assessment first so as to determine their reading grade level. Following the Woodcock Johnson assessment, each student took each of the five remaining assessments; oral reading paragraph, lexical decision task, open maze sentence, paragraphs, and paragraphs delivered sentence by sentence. Of these five assessments, one consisted of oral reading and the other four consisted of silent reading on a laptop computer. The order of the oral reading assessment and the silent reading assessments were randomized such that some students took the oral reading portion first and some took the silent reading portion first.

Within the silent reading assessments on the laptop computer there were the lexical decision task, the open maze sentence followed by multiple choice word options, the paragraphs followed by knowledge and inferential level multiple choice questions and the paragraphs delivered sentence by sentence followed by knowledge and inferential level multiple choice questions. Each of these assessments contained a “comprehension” component such that the lexical decision task required the participant to identify whether or not a string of letters was a word and the paragraphs required the participant to answer multiple choice questions about the paragraphs of text they had just read. The silent reading assessments were delivered in the order listed above so that the participants progressed from assessments dealing specifically with words to assessments dealing specifically with sentences, and then finally to assessments dealing specifically with paragraphs of text.

The lexical decision task was designed so that the order of frequency (high and low), the order of words (second, fourth, sixth, or college grade level) versus non-words, and the order of letter string length (three, four, five, and six letters) were all randomized in their delivery and the participant had to determine whether or not the string of letters they were seeing on the computer screen was a word. The frequencies of the words used in the lexical decision task were determined by the American Heritage Word Frequency Book (1971) by Carroll, J. B., Davies, P., & Richman, B.. Low frequency words ranged from 17.0 SFI to 33.3 SFI and high frequency words ranged from 45.9 SFI to 67.7 SFI, where SFI stands for standard frequency index. The high frequency words consisted of second, fourth and sixth grade level words. The grade level of words was determined by “A List of Essential Words by Grade Level” (2005) by Marzano, R. J., Kendall, J. S., & Paynter, D. E..

The task was balanced by having equal numbers of high frequency and low frequency words as well as equal numbers of letter string lengths. In other words, there were 60 high frequency words consisting of 20 words each for the second, fourth and sixth grade; 60 low frequency words which were not contained in the “List of Essential Words by Grade Level” and therefore considered to be college level. The 20 words each for the second, fourth and sixth grade levels were further balanced to contain five each at the three, four, five and six letter lengths while the 60 low frequency words were balanced to contain 15 each at the three, four, five and six letter lengths. The task was further counterbalanced with an equal number of non-words to words (120 each). The non-words were created by changing one letter in a word (e.g., Weeks, S., 1997; Masson, M. E., & Isaak, M. I., 1999; Perea, M., Rosa, E., & Gomez, C., 2002) such that ven became vev and nim became nym.

Following the word assessment was the sentence assessment in the form of an open maze. The participant was presented with a sentence that had a missing word and then had to make a choice of which word was missing. The open maze sentence assessment was followed by the paragraph and paragraph delivered sentence by sentence assessments. Each of these paragraphs was followed by a comprehension component represented by two levels of multiple choice questions, knowledge level and inferential level.

Reading Fluency. The paragraph assessment was used to determine reading fluency. Specifically, whether or not a participant was considered to be fluent or non-fluent was determined by how well they performed on the multiple choice questions regarding the paragraph of text they had just read. For example, getting either none of the knowledge or inferential questions correct resulted in a fluency score of 0; getting half of the knowledge questions and none of the inferential questions correct resulted in a fluency score of .25; getting none of the knowledge and half of the inferential questions correct results in a fluency score of .50; getting half of the knowledge and half of the inferential questions correct resulted in a fluency score of .75; getting all of the knowledge and none of the inferential questions correct resulted in a fluency score of 1.00; getting all of the inferential and none of the knowledge questions correct resulted in a fluency score of 1.25; getting all of the knowledge and half of the inferential questions correct resulted in a fluency score of 1.50; getting all of the inferential and half of the knowledge questions correct resulted in a fluency score of 1.75; and getting all of the knowledge and all of the inferential questions correct resulted in a fluency score of 2.00. Based on these scores, anyone with a score of .00 to.25 was considered to be non-fluent and anyone with a score of 1.75 to 2.00 was considered to be fluent (See Table 4.1 and Figures 5 and 6).

For both studies, it could be said that there was one major factor with two levels. The major factor being the paragraph's multiple choice questions, the levels being knowledge and inferential. It was a repeated, within subjects design in that each participant received each level of multiple choice question for the paragraph. Also for each study, the dependent variable was reading fluency based on percent correct on the two levels of multiple choice questions.

Valid and Predictive. Adjusted reading speed in terms of total words read per minute (wpm) minus total words missed (errors) on the oral reading assessment was assessed in terms of whether or not it was correlated with reading fluency (valid assessments of fluency) as well as whether or not it was predictive of reading fluency.

The reading speeds and accuracies of the oral reading assessment assessed for validity by looking at their correlation coefficients with regard to the reading fluency assessment (fluency). Reading speeds and accuracies on the oral reading assessments was also assessed with regard to whether or not it was predictive of reading fluency by looking at their R-squared values from their ANOVAs. This addressed the DIBELS debate of whether or not the

Assessing Reading Fluency

DIBELS Oral Reading Fluency assessment is a valid reading fluency assessment as well as whether or not it is able to predict reading fluency based on the speed and accuracy of an oral reading task.

For the college, second, fourth, and sixth grade groups, their oral reading scores on a passage was used to check the validity and predictiveness of this type of an assessment with regard to reading fluency. This was a within person factor because it looked at the speed and accuracy scores received on the assessment for each student in the group.

In both Study 1 and Study 2, the dependent variable was reading speed and accuracy scores in the form of adjusted wpm on the assessment.

Characteristics. What distinguishes a fluent reader from a non-fluent reader was determined by each participant's performance on the oral reading passage assessment and the lexical decision task (frequency and letter string length) in terms of their speed and accuracy as well as their performance on the open maze sentence and the paragraph delivered sentence by sentence in terms of how well they were able to retain the gist of a sentence when there was only one sentence versus when there was a whole paragraph of text. Specific characteristics being looked at were; reading speed, reading accuracy, ability to carry the gist of a sentence for one sentence versus many sentences, and their ability to answer the inferential level multiple choice questions following a paragraph of text .

Procedure

Procedure Study 1. For the college students, an announcement was made during their EPsy 3119 class that there would be an extra credit opportunity made available to them, that if they were willing to participate in a Reading Fluency research study they would be awarded ten extra credit points toward their final grade in the course and that a sign-up sheet (see Appendix L) would be made available to them on which they could pick a date and time they'd like to participate. The sign-up sheets were collected by the researcher at the end of each EPsy 3119 class and the participants were e-mailed with a confirmation of the date and time they chose to participate along with directions and a map to the research room. If a conflict occurred with the date and time they originally chose, they were asked to contact the researcher (e-mail address was provided) with a notice of cancellation and an alternative possible date to participate.

Procedure Study 2. For the pilot study with elementary school age participants a consent form was sent home with the participants for their parents to sign. If the participant's parent consented for them to participate they signed the form and returned it to the school with the participants. The researcher collected the consent forms and filled out the sign-up sheet. The sign-up sheet was then e-mailed to each participant's teacher. The teachers then sent the participants to a room in the school where the research was to take place on the date and time agreed upon (for the second graders the researcher would meet the participant at their classroom and walk with them to the research room).

Procedure Both Studies. On a date and time a participant was expected to appear for the study, the researcher booted up the computer, started the experiment by typing in the participant's code name and the name of the study. This brought up the first set of instructions onto the computer screen. The participant's code name had the following form: date and time the participant participates in the study (i.e., 03/11/10 at 9:00 AM) followed by the order the assessments were to be presented such as oral readings first (OF) and computer readings last or computer readings first and oral readings last (OL). An example: 0311100900 OL would mean that the participant participated on March 11, 2010 at 9:00 AM and the oral reading was done last. These codes were assigned in order to maintain each participant's confidentiality. Once codes were assigned, the sign-up sheets with the participants' names on them were shredded. All consent forms were kept in a locked drawer of the locked research room. Randomization of the order of oral reading versus computer reading was done by flipping a coin.

When a participant arrived at the research room they were greeted by the researcher, reassured that they themselves were not being assessed on their reading ability but that the reading assessments were being evaluated. (Study 1: College participants were then asked to read the consent form and to please sign it if they were willing to continue with the study.) Participants were then informed of how the study was to proceed.

Beginning with the Woodcock Johnson word list assessment the participants were informed that they were going to read some words from a list, that they would hear a buzzer go off during their reading, but that they were to ignore it and to keep reading the words until told to stop by the researcher. The researcher then started the timer, told the participant to begin reading the words, made an “X” on any words the participant misread and didn’t self-correct within three seconds or skipped over entirely, circled the word and word number of the last word said when the timer beeped, and told the participant to stop reading the words when they failed to correctly say six consecutive words in a category. If this occurred before the timer beeped, the participant was to continue reading words until told to stop by the researcher (usually five words after the timer beeped so they hopefully wouldn’t jump to the conclusion that these were timed assessments). The category where the six consecutive errors occurred was considered by Woodcock Johnson to be the ceiling. This ceiling score was later converted to a grade level value by the Woodcock Johnson conversion scale. The Woodcock Johnson assessment was followed by either the computer portion of the study or the oral reading passage of the study (determined randomly).

If it was followed by the oral reading passage, the researcher reset the timer to one-minute, started the timer and had the participant begin reading the passage. The participant was reminded that they would be hearing a buzzer but that they were to ignore it and keep reading until told to stop. The researcher started the timer and had the participant begin reading the passage. As the participant read the passage the researcher circled the words that were misread and not self-corrected within three seconds or skipped over entirely and marked a slash (/) in the passage where the timer beeped – later this was used to determine the number of words read per minute and the adjusted words read per minute was obtained by subtracting the number of misread words from the total number of words read per minute.

After the oral reading portion of the study was finished, the participant either then proceeded to the computer portion of the study or was finished with the study. If they proceeded on to the computer portion of the study, they were told that they would be beginning with a practice lexical decision task assessment. For the practice set they would be seeing a string of letters appear in the center of the screen and they would need to make a decision as to whether or not this set of letters was a word. When they've made their decision they would need to press a key ("L" to indicate it was a word and "A" to indicate it was not a word) on the keyboard to indicate their choice. Once they've made their choice the letter string would disappear and a "+" would appear and then disappear from the middle of the screen before the next set of letters appeared. Finally, they were told that this practice assessment would be followed by four other assessments; the actual lexical decision assessment, an open maze sentence with multiple-choice word options for the missing word, and some paragraphs of text followed by multiple-choice questions concerning the passage just read. The participant was then directed to read the first set of instructions and to let the researcher know if they had any question with regard to what they would need to do for the first assessment as well as at any time during the study. If there were no questions after the first set of instructions, the participant began the computer portion of the study. The computer was programmed to deliver the lexical decision task randomly by frequency (high and low) and letter string length (three, four, five and six letters). Once the participant finished the practice set they received a reminder screen that they were to use their right index finger to press the “L” key on the keyboard to indicate that the letter string was a word and to use their left index finger to press the “A” key on the keyboard to indicate that the letter string was *not* a word before proceeding on to the actual lexical decision assessment.

Following the lexical decision assessment the participant received an instruction screen letting them know that they would be reading a sentence and that the sentence would have a word missing, that once they’ve read the sentence the sentence would disappear and a list of multiple-choice words would appear for them and they would need to choose which word best fit the sentence -- by pressing either the letter a, b, c, or d on the keyboard. The open maze sentence assessment was followed by an instruction screen for the paragraph assessment portion of the study. The participants were told that they would be reading a paragraph of text and that when they were finished, they would press a key and the paragraph would disappear and some multiple-choice questions would appear (one at a time on the screen) regarding the passage they’ve just read. They would then need to press the appropriate key to indicate their choice of an answer (either a, b, c, or d) until all of the questions had been answered. The next set of instructions then appeared informing them that they would be reading another passage of text which would be followed by some multiple-choice questions concerning the text they just read, but that there would be a difference in this assessment - the difference being that only one sentence would be visible at a time. They would press a key (any key) and a sentence would appear, they would then press another key (any key) and that sentence would disappear and be replaced with another sentence, and so on, until all of the sentences had appeared and disappeared and the multiple-choice questions began appearing one at a time. After the last of the multiple-choice questions had been answered the participant received a screen letting them know they had finished the computer portion of the assessment.

Once all assessments had been taken, the participants were presented with the debriefing form, verbally thanked for their time, asked not to discuss the research study with any of their fellow classmates as doing so may taint the study. They were then asked if they had any questions concerning the study. If they had any questions, they were answered, if not, the participant left the research room, the consent form was filed away into a locked drawer in the research room, and the next participant was welcomed (or in the case of the elementary participants the consent forms were filed and locked in the research room before going to the elementary school to conduct the study).

Assessing Reading Fluency

If the computer portion of the study was predetermined to occur first, then the participant took the Woodcock Johnson word list, the computer portion of the study and then the oral reading portion of the study. All followed up with the debriefing form.

The participants were run one at a time and thirty minutes was allotted for each of the participants to participate in this study. There was no problem adhering to this time constraint.

The computer software program SuperLab®4 stored the data as individual text files for each participant and these text files were converted into Excel spreadsheets. The Excel spreadsheets were then copied and pasted into SPSS files. The SPSS files were used to run the data analyses and obtain the results for the studies.

Chapter IV

Results

There were two studies, one conducted with college students and one (a pilot study) conducted with elementary students. The assessments used consisted of the Woodcock Johnson Word List, an oral paragraph reading, a Lexical Decision Task (LDT), a sentence followed by a multiple choice question, paragraphs followed by multiple choice questions, and paragraphs delivered sentence-by-sentence followed by multiple choice questions. The Woodcock Johnson Word List was used to determine a student's reading grade level and the oral reading assessment was used to address claims that speed and accuracy measure and predict reading fluency. The LDT (high and low frequency words), the sentence, and the paragraphs contained comprehension components; the LDT required students to decide whether or not a string of letters was a word (high and low frequency words) and the sentence and paragraphs were followed by multiple choice questions.

To answer questions regarding what distinguishes a fluent reader from a non-fluent reader, students were divided into two groups -- these groups were determined by a student's performance on reading paragraphs and then answering multiple choice questions about the paragraphs.

Assessing Reading Fluency

The validity and predictiveness of speed and accuracy were addressed first, and then these secondary characteristics were used to determine what characteristics might distinguish a fluent reader from a non-fluent reader.

The study progressed from assessing a participant's automaticity with words, to assessing their automaticity with a sentence, and then to assessing their automaticity with multiple sentences.

Reading Fluency

Reading fluency was determined by how well students performed on knowledge and inferential level multiple choice questions. Their performance on these questions was fit into the following criteria (see Table 4.1) and resulted in the following distributions (see Figures 5 and 6).

Table 4.1

Reading Fluency Criteria

Reading Fluency Score	Knowledge Level Criteria		Inferential Level Criteria
.00	0% Correct	and	0% Correct
.25	1% to 50% Correct	and	0% Correct
.50	0% Correct	and	1% to 50% Correct
.75	1% to 50% Correct	and	1% to 50% Correct
1.00	51% to 100% Correct	and	0% Correct
1.25	0% Correct	and	51% to 100% Correct
1.50	100% Correct	and	1% to 50% Correct
1.75	1% to 50% Correct	and	100% Correct
2.00	51% to 100% Correct	and	51% to 100% Correct

Figure 5. Distribution of Reading Fluency Scores – College

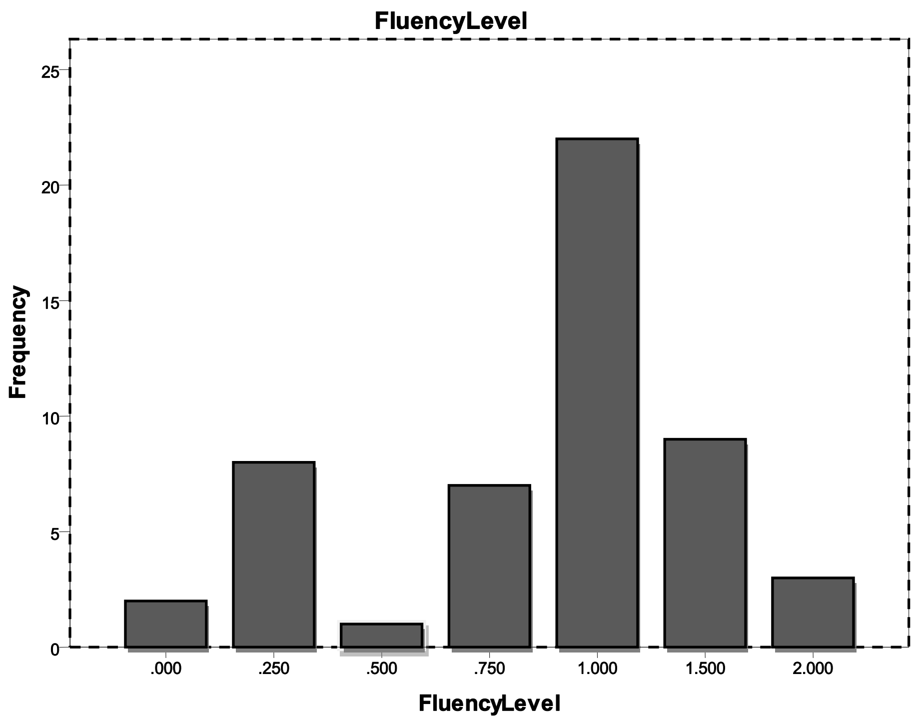
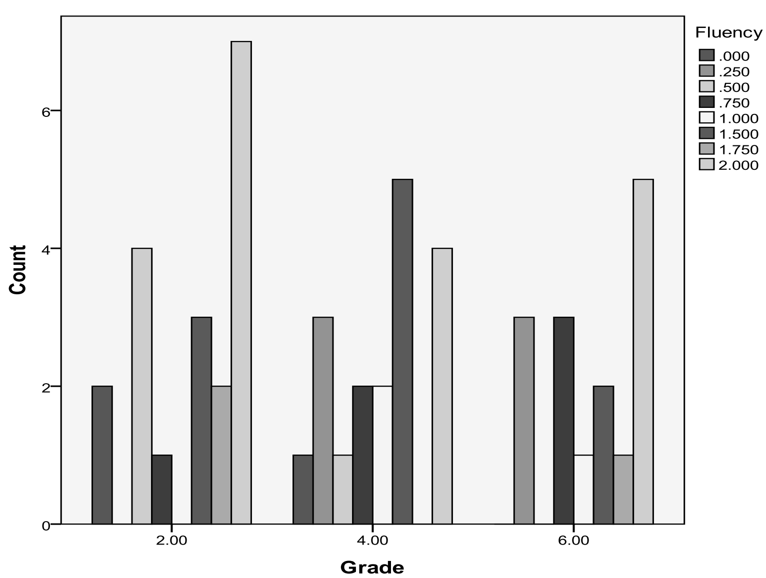


Figure 6. Distribution of Reading Fluency Scores – Elementary.



The distribution of fluency scores was further categorized into fluent and non-fluent readers. For instance, students receiving a reading fluency score of .00 to .50 were considered to be non-fluent and students receiving a reading fluency score of 1.25 to 2.00 were considered to be fluent. Students receiving a reading fluency score of .51 to` 1.24 were considered to be in-between being non-fluent and fluent and their data was not included in the results.

Study 1. Based on their performance on the multiple choice questions and the set criteria, there were 11 (20.80 percent) non-fluent and 12 (22.60 percent) fluent college students (see Figure 5). The remaining 29 (56.60 percent) college students were considered to be somewhere in the middle of non-fluent and fluent. This grouping of students occurred regardless of the fact that all 52 college students scored a reading grade level of 16.00 on the Woodcock Johnson Word Identification assessment. Though assumed to be fluent readers because they were in college, based on the definition of reading fluency posited in this paper, a continuum of reading fluency levels resulted within the group of college students.

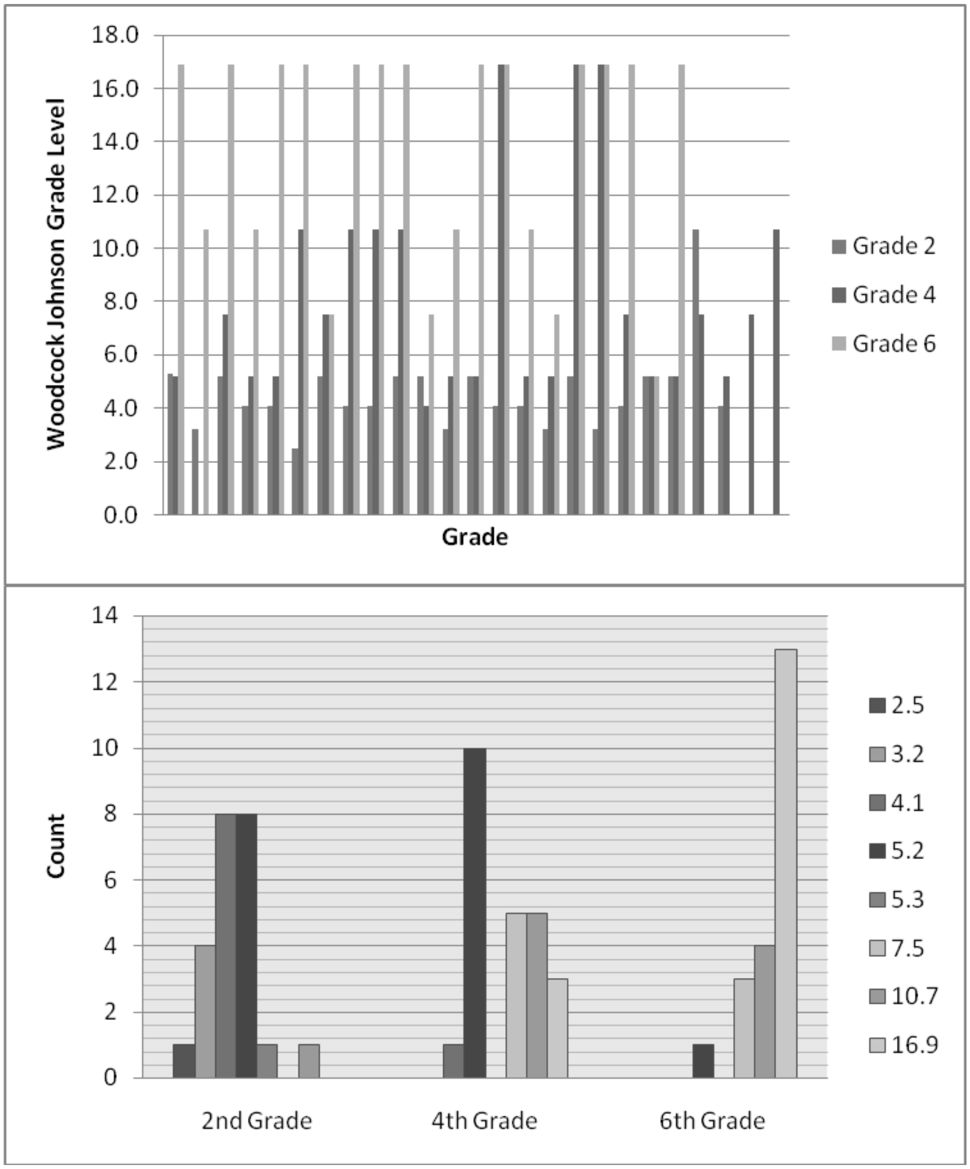
Study 2. There were six (31.60 percent) non-fluent and 12 (63.20 percent) fluent second grade readers (See Figure 6). There was only one (4.20 percent) participant considered in-between fluent and non-fluent. It was not surprising to have two-thirds of the second graders considered fluent readers when their average reading grade level was 4.56 on the Woodcock Johnson Word Identification assessment (See Figure 7).

There were five (28 percent) non-fluent and 11 (61 percent) fluent fourth grade readers (See Figure 6). There were two (11 percent) considered in-between fluent and non-fluent. A little more than one-fourth of the students were considered non-fluent while just over three-fifths were considered fluent. This was not surprising given the average grade level for the fourth graders was 8.24 on the Woodcock Johnson Word Identification assessment (See Figure 7).

There were three (20 percent) non-fluent and eight (53.30 percent) fluent sixth grade readers (See Figure 6). There were four (26.70 percent) considered in-between fluent and non-fluent. This was not surprising considering their average grade level score on the Woodcock Johnson Word Identification assessment was 13.82 (See Figure 7).

Not all second, fourth, or sixth graders were fluent. Overall, there was a continuum of scores on the reading fluency assessment within each of the grade levels (See Figures 6 and 7).

Figure 7. Woodcock Johnson Grade Level Scores – Elementary.



Validity

Because assessments claiming to measure reading fluency use an adjusted word per minute (wpm) for their scoring, this variable was used to assess the validity of their claim that reading fluency can be measured by these two secondary characteristics (speed and accuracy) alone. The adjusted wpm variable represents the speed and accuracy variables together. It was calculated by subtracting the errors made by the student while reading the text from their total number of wpm.

Study 1. There was no significant (p = .71) correlation between reading fluency and adjusted wpm on the oral reading passage (See Table 4.2) for college students.

Table 4.2.

Correlation between Reading Fluency and Adjusted WPM (Speed and Accuracy) for College Students

		Reading Fluency	ORadjwpm
Reading Fluency	Pearson Correlation	1	.053
	Sig. (2-tailed)		.710
	N	52	52
ORadjwpm	Pearson Correlation	.053	1
	Sig. (2-tailed)	.710	
	N	52	52

ORadjwpm represents the adjusted reading words per minute on the oral reading passage.

Study 2. There was no significant correlation for second (p = .28), fourth (p = .06), or sixth grades (p = .52) between reading fluency and adjusted wpm on the oral reading passage (See Tables 4.2a, b, c, respectively). Therefore, using an adjusted reading speed based on subtracting students' errors from their total reading speeds is not a valid method for measuring reading fluency.

Table 4.2a.

Correlation between Reading Fluency and Adjusted WPM (Speed and Accuracy) for Second Grade

		Reading Fluency	ORadjwpm
Reading Fluency	Pearson Correlation	1	.262
	Sig. (2-tailed)		.279
	N	19	19
ORadjwpm	Pearson Correlation	.262	1
	Sig. (2-tailed)	.279	
	N	19	23

ORadjwpm represents the adjusted reading words per minute on the oral reading passage

Table 4.2b.

Correlation between Reading Fluency and Adjusted WPM (Speed and Accuracy) for Fourth Grade

		Reading Fluency	ORadjwpm
Reading Fluency	Pearson Correlation	1	.456
	Sig. (2-tailed)		.057
	N	18	18
ORadjwpm	Pearson Correlation	.456	1
	Sig. (2-tailed)	.057	
	N	18	24

**ORadjwpm represented the adjusted reading words per minute on the oral reading passage*

Table 4.2c.

Correlation between Reading Fluency and Adjusted WPM (Speed and Accuracy) for Sixth Grade

		Reading Fluency	ORadjwpm
Reading Fluency	Pearson Correlation	1	.179
	Sig. (2-tailed)		.522
	N	15	15
ORadjwpm	Pearson Correlation	.179	1
	Sig. (2-tailed)	.522	
	N	15	21

**ORadjwpm represented the adjusted reading words per minute on the oral reading passage*

Predictors

Because reading speed and accuracy in the form of adjusted reading speed (total reading time minus total errors) have also been said to be predictive of reading fluency, the veracity of this claim was also examined.

Study 1. Adjusted reading speed (ORadjwpm) accounted for .30 percent of the variability in reading fluency. Adjusted reading speed was not a predictor of reading fluency for college students with $F(1, 51) = .14$, $p > .05$ (see Table 4.3).

Table 4.3.

Speed and Accuracy as a Predictor of Reading Fluency for College Students

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.053[a]	.003	-.017	.631345

a. Predictors: (Constant), ORadjwpm

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.056	1	.056	.140	.710[a]
	Residual	19.930	50	.399		
	Total	19.986	51			

a. Predictors: (Constant), ORadjwpm

b. Dependent Variable: Reading Fluency

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.778	.373		2.088	.042
	ORadjwpm	.001	.003	.053	.374	.710

a. Dependent Variable: Reading Fluency

Study 2. For second graders (see Table 4.3a) adjusted reading speed (ORAdjwpm) accounted for 6.80 percent of the variability in reading fluency. Adjusted reading speed was not a predictor of reading fluency for second grade students with $F(1, 17) = 1.25$, $p>.05$.

Table 4.3a.

Speed and Accuracy as a Predictor of Reading Fluency for Second Grade

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.262[a]	.068	.014	.839544

a. Predictors: (Constant), ORAdjwpm

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.880	1	.880	1.248	.279[a]
	Residual	11.982	17	.705		
	Total	12.862	18			

a. Predictors: (Constant), ORAdjwpm

b. Dependent Variable: Reading Fluency

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.641	.600		1.069	.300
	ORAdjwpm	.005	.005	.262	1.117	.279

a. Dependent Variable: Reading Fluency

For fourth graders (see Table 4.3b) adjusted reading speed (ORAdjwpm) accounted for 20.80 percent of the variability in reading fluency. However, adjusted reading speed was not a predictor of reading fluency for fourth grade students with $F(1, 16) = 4.20$, $p>.05$.

Table 4.3b.

Speed and Accuracy as a Predictor of Reading Fluency for Fourth Grade

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.456[a]	.208	.158	.759549

a. Predictors: (Constant), ORAdjwpm

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.422	1	2.422	4.198	.057[a]
	Residual	9.231	16	.577		
	Total	11.653	17			

a. Predictors: (Constant), ORAdjwpm

b. Dependent Variable: Reading Fluency

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.689	.896		-.768	.454
	ORAdjwpm	.012	.006	.456	2.049	.057

a. Dependent Variable: Reading Fluency

For sixth graders (see Table 4.3c) adjusted reading speed (ORAdjwpm) accounted for 3.2 percent of the variability in reading fluency. Adjusted reading speed was not a predictor of reading fluency for sixth grade students with $F(1,13) = .43$, $p>.05$.

Table 4.3c.

Speed and Accuracy as a Predictor of Reading Fluency for Sixth Grade

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.179[a]	.032	-.042	.859958

a. Predictors: (Constant), ORAdjwpm

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.319	1	.319	.432	.522[a]
	Residual	9.614	13	.740		
	Total	9.933	14			

a. Predictors: (Constant), ORAdjwpm

b. Dependent Variable: Reading Fluency

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.532	1.016		.524	.609
	ORAdjwpm	.004	.006	.179	.657	.522

a. Dependent Variable: Reading Fluency

Therefore, speed and accuracy in the form of adjusted wpm was not a predictor of reading fluency for any of the groups in this study.

Distinguishing Characteristics

Based on the definition of reading fluency put forth in this paper, valid methods of measuring a student's reading fluency must contain a comprehension component; such as, having a student read a paragraph and then answer multiple choice questions about the paragraph (s)he just read. This method was applied to the groups of students participating in these studies, and depending on how well they performed on the comprehension component (knowledge and inferential questions); they were divided into fluent and non-fluent reader groups. The two groups were then examined to determine what characteristics (i.e., speed, accuracy, and gist with gist meaning the general idea, substance or essence of a sentence) might distinguish a non-fluent reader from a fluent reader. The assessments progressed from word in the form of the lexical decision task using high and low frequency words, to sentence, to multiple sentence formats. It is important to note that only tables and/or figures containing significant results are presented in this section of the paper. All other tables and figures can be found in the Appendix M.

Words – Oral Reading Speed

Study 1. Non-fluent readers had a mean of 130.12 wpm and fluent readers had a mean of 130.08 wpm on the oral reading passage. On average, non-fluent readers read .04 wpm faster than fluent readers. Non-fluent readers had a standard deviation of 27.12 wpm while fluent readers had a standard deviation of 29.49 wpm. Non-fluent and fluent readers had approximately the same amount of variability in their mean reading speed. The difference in reading speed between fluent and non-fluent readers was not significant with $t(21) = .00$, $p > .05$ (see Table 4.4). Both groups read the passage at similar rates of speed; therefore, oral reading speed was not a distinguishing characteristic between fluent and non-fluent readers of college students. This finding tends to support the theory posited in this paper for a new definition of reading fluency which states speed alone cannot be used as a defining characteristic or measuring tool to identify non-fluent readers from fluent readers.

Study 2. Second grade non-fluent readers had a mean reading speed of 106.71 wpm with a standard deviation of 18.07 wpm while fluent readers had a mean reading speed of 125.15 wpm with a standard deviation of 44.95. Fluent readers read, on average, 18.44 wpm faster than non-fluent readers and had more variability in their mean reading speed than non-fluent readers. However, the mean reading speed between the two groups was not significantly different with $t(16) = -.96$, $p>.05$ (see Table 4.4a). Both fluent and non-fluent readers read at similar speeds; therefore, reading speed was not a distinguishing characteristic between fluent and non-fluent readers of second graders. This finding tends to support the theory posited in this paper for a new definition of reading fluency which states speed alone cannot be used as a defining characteristic or measuring tool to identify non-fluent readers from fluent readers.

Fourth grade non-fluent readers had a mean of 128.55 wpm with a standard deviation of 8.54 wpm while fluent readers had a mean of 160.09 wpm with a standard deviation of 26.27 wpm. Fluent readers read, on average, 31.54 wpm faster than non-fluent readers, but fluent readers had more variability in their mean wpm. The mean difference between the two groups was significant with $t(12) = -2.57$, $p<.05$ (see Table 4.4b). Reading speed is a distinguishing characteristic between fluent and non-fluent readers of the fourth graders. This finding appears to support theories that state reading speed alone can depict a non-fluent reader from a fluent reader for fourth graders as the non-fluent readers did indeed read at a significantly slower rate of speed.

Table 4.4b

Oral Reading Speed for Fourth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
ORwpm	1.00	5	128.55480	8.535367	3.817132
	2.00	9	160.09378	26.271757	8.757252

ORwpm represents words read per minute on the oral reading assessment

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ORwpm	assumed	1.256	.284	-2.569	12	.025	-31.538	12.27634	-58.286	-4.791
	not assumed			-3.301	10.566	.007	-31.538	9.55300	-52.670	-10.407

ORwpm represents words read per minute on the oral reading assessment

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Sixth grade non-fluent readers had a mean of 162.14 wpm with a standard deviation of 67.34 wpm while fluent readers had a mean of 169.89 wpm with a standard deviation of 24.78. Fluent readers read, on average, 7.75 wpm faster than non-fluent readers while non-fluent readers had more variability in their mean reading speeds than fluent readers. The mean difference between the two groups was not significant with $t(2.207) = -.20$, $p>.05$ (see Table 4.4c). Though both groups did not read at exactly the same rate of speed, the difference in their reading speeds was not significant. Therefore, reading speed was not a distinguishing characteristic for sixth graders. This finding tends to support the theory posited in this paper for a new definition of reading fluency which states speed alone cannot be used as a defining characteristic or measuring tool to identify non-fluent readers from fluent readers.

Summary. There were conflicting findings with regard to reading speed being a distinguishing characteristic between fluent and non-fluent readers in that reading speed was only found to be significant between fluent and non-fluent readers of the fourth grade group. Non-fluent fourth grade readers read significantly fewer wpm than fluent fourth grade readers – a finding that supports early theories which state non-fluent readers read at a significantly slower rate than fluent readers.

Assessing Reading Fluency

Words – Oral Reading Accuracy

Study 1. Non-fluent readers had a mean percentage error rate of .02 with a standard deviation of .02 percent while fluent readers had a mean percentage error rate of .02 with a standard deviation of .01 percent. On average, non-fluent readers made almost the same mean percentage of errors as fluent readers (.005 percent more errors) but had more variability in their average percentage of errors. The difference in performance in terms of mean percentage of errors was not significant with $t(21) = .57$, $p>.05$ (see Table 4.5). Both fluent and non-fluent readers made approximately the same mean percentage of errors on the passage; therefore, reading accuracy is not a distinguishing characteristic between fluent and non-fluent readers of college students. This finding tends to support the theory posited in this paper for a new definition of reading fluency which states accuracy alone cannot be used as a defining characteristic or measuring tool to identify non-fluent readers from fluent readers.

Study 2. Second grade non-fluent readers had a mean error of 2.41 percent with a standard deviation of 1.35 percent while fluent readers had a mean error rate of 2.00 percent with a standard deviation of 2.71 percent. Non-Fluent readers had, on average, .41 percent more errors than fluent readers, and they had less variability in their mean percentage of error. The difference in their mean percentage of error was not significant with t(15) = .31, p>.05 (See Table 4.5a). Therefore, reading accuracy is not a distinguishing characteristic between fluent and non-fluent readers for second graders. This finding tends to support the theory posited in this paper for a new definition of reading fluency which states accuracy alone cannot be used as a defining characteristic or measuring tool to identify non-fluent readers from fluent readers.

Fourth grade non-fluent readers had a mean error rate of 1.63 percent with a standard deviation of 1.18 percent while fluent readers had a mean error rate of .75 percent with a standard deviation of .69 percent. Non-fluent readers made, on average, .88 percent more errors than fluent readers. Non-fluent readers also had less variability in their mean error rates than fluent readers. The difference in mean error rate was not significant with t(14) = 1.88, p>.05 (See Table 4.5b). Therefore, reading accuracy is not a distinguishing characteristic between fluent and non-fluent readers of fourth graders. This finding tends to support the theory posited in this paper for a new definition of reading fluency which states accuracy alone cannot be used as a defining characteristic or measuring tool to identify non-fluent readers from fluent readers.

Sixth grade non-fluent readers had a mean error rate of 1.91 percent with a standard deviation of .97 percent while fluent readers had a mean error rate of .42 percent with a standard deviation of .47 percent. Non-fluent readers had, on average, 1.49 percent more errors and more variability in their mean error rate than fluent readers. The difference in mean error rate was significant with $t(9) = 3.36$, $p<.05$ (See Table 4.5c) between these two groups of sixth graders. Therefore, reading accuracy is a distinguishing characteristic between fluent and non-fluent readers of sixth graders. This finding supports early theories of reading fluency that state non-fluent readers make significantly more errors than fluent readers and can therefore be used to distinguish the two groups of readers.

Table 4.5c

Oral Reading Accuracy for Sixth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
ORperWrong	1.000	3	.01908	.009720	.005612
	2.000	8	.00421	.004676	.001653

ORperWrong represents the percentage of errors made on the oral reading assessment

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95 percent Confidence Interval of the Difference	
									Lower	Upper
ORPerError	assumed	4.178	.071	3.563	9	.006	.014871	.004173	.0054	.0243
	not assumed			2.542	2.357	.107	.014871	.005850	-.0069	.0367

ORPerError represents the percentage of errors made on the oral reading assessment.

Summary. Accuracy was only a distinguishing characteristic for the sixth grade group, in that, non-fluent six grade readers made significantly more errors than fluent sixth grade readers on the oral reading assessment – a finding that supports early theories stating non-fluent readers make significantly more errors than fluent readers.

Words – Lexical Decision Task Speed of High Frequency Words

Study 1. Non-fluent readers had a mean latency response time of 665.45 msec. with a standard deviation of 80.79 msec. while fluent readers had a mean latency response time of 844.17 msec. with a standard deviation of 441.93 msec. when deciding whether or not a string of letters was a word for high frequency words. Non-fluent readers made the decision that a string of letters was a word when the letter string was a high frequency word faster and with less variability in their mean latency response times than fluent readers. The mean latency difference was not significant with $t(21) = -1.32$, $p>.05$ (see Table 4.6). Deciding whether or not a string of letters was a word for high frequency words was not a distinguishing characteristic between the two groups of college students. The finding does not support early theories claiming fluent readers would have faster mean latency response times.

Study 2. Second grade non-fluent readers had a mean latency of 1751.60 msec. with a standard deviation of 774.02 msec. while fluent readers had a mean latency of 1581.40 msec. with a standard deviation of 529.29 msec. when deciding whether or not a string of letters was a word for a high frequency word. Non-fluent readers made the decision, on average, 170.20 msec. slower and with more variability in their mean decision making time than fluent readers. However, the mean difference was not significant with $t(13) = .51$, $p>.05$ (See Table 4.6a). Therefore, the time it took to make a decision of whether or not a string of letters was a word for high frequency words was not a distinguishing characteristic between fluent and non-fluent readers in the second grade, but appears to support early theories claiming fluent readers would have faster mean latency response times.

Fourth grade non-fluent readers had a mean latency of 1133.57 msec. with a standard deviation of 210.26 msec. while fluent readers had a mean latency of 1335.17 msec. with a standard deviation of 406.64 msec. when deciding whether or not a string of letters was a word for high frequency words. Non-fluent readers made the decision, on average, 201.60 msec. faster and with less variability in their mean decision time than fluent readers. However, the mean difference was not significant with $t(11) = -1.15$, $p>.05$ (See Table 4.6b). Therefore the time it took to make a decision of whether or not a string of letters was a word for high frequency words was not a distinguishing characteristic between fluent and non-fluent readers in the fourth grade, and does not support early theory claims that fluent readers would have faster mean latency response times.

Sixth grade non-fluent readers had a mean latency of 769 msec. with a standard deviation of 89.96 msec. while fluent readers had a mean latency of 1051.67 msec. with a standard deviation of 300.30 msec. when deciding whether or not a string of letters was a word for high frequency words. Non-fluent readers made the decision, on average, 282.67 msec. faster and with less variability in their mean decision time than fluent readers. However, the mean difference was not significant with $t(7) = -1.55$, $p>.05$ (see Table 4.6c). Therefore, the time it took to make a decision of whether or not a string of letters was a word for high frequency words was not a distinguishing characteristic between fluent and non-fluent readers in the sixth grade, and does not support early theory claims that fluent readers would have faster mean latency response times.

Summary. Though non-fluent readers made the decision of whether or not a string of letters was a word when it was a high frequency word faster and with less variability (except for second graders when they were slower and had more variability) than fluent readers, the difference in speed was not significant for any of the groups. Therefore, early theory claims that non-fluent readers would have slower mean latency response times have not been supported with these findings.

Words – Lexical Decision Task Speed of Low Frequency Words

Study 1. Non-fluent readers had a mean latency response time of 910 msec. with a standard deviation of 202.68 msec. while fluent readers had a mean latency response time of 1299.17 msec. with a standard deviation of 328.73 msec. when deciding whether or not a string of letters was a word when it was a low frequency word. Non-fluent readers made the decision that a low frequency word was a word faster and with less variability in their mean latency response times compared to fluent readers. The mean latency response time difference was significant with $t(21) = -3.38$, $p<.05$ (see Table

4.6). Deciding whether or not a string of letters was a word for low frequency words was a distinguishing characteristic between the two groups of college students. It would appear that early theories claiming fluent readers would be faster were not supported with the college group, since it was the non-fluent group with significantly faster mean latency response times.

Study 2. Second grade non-fluent readers had a mean latency of 2102.20 msec. with a standard deviation of 851.07 msec. while fluent readers had a mean latency of 1928.40 msec. with a standard deviation of 713.72 msec. Non-fluent readers took, on average, 173.8 msec. longer than fluent readers to decide whether or not a string of letters was a word for low frequency words. Non-fluent readers had slightly more variability in their mean decision time than fluent readers. However, the mean difference was not significant with $t(13) = .42$, $p>.05$ (see Table 4.6a). Therefore, the time it took to make the decision of whether or not a string of letters was a word for low frequency words was not a distinguishing characteristic between fluent and non-fluent readers for second graders. This finding tends to support early theory claims that non-fluent readers would have slower mean latency response times; however, non-fluent readers were not significantly slower than fluent readers.

Assessing Reading Fluency

Fourth grade non-fluent readers had a mean latency of 1446.57 msec. with a standard deviation of 260.88 msec. while fluent readers had a mean latency of 1945.50 msec. with a standard deviation of 918.76 msec. Contrary to early theory claims, fluent readers took, on average, 498.93 msec. longer than non-fluent readers to decide whether or not a string of letters was a word for low frequency words. Non-fluent readers had less variability in their mean decision time than fluent readers. The mean difference was not significant with $t(11) = -1.38$, $p > .05$ (see Table 4.6b). Therefore, the time it took to make the decision of whether or not a string of letters was a word for low frequency words was not a distinguishing characteristic between fluent and non-fluent readers for fourth graders.

Sixth grade non-fluent readers had a mean latency of 1351.67 msec. with a standard deviation of 300.65 msec. while fluent readers had a mean latency of 1620.67 msec. with a standard deviation of 840.91 msec. Contrary to early theory claims, fluent readers took, on average, 269 msec. longer than non-fluent readers to decide whether or not a string of letters was a word for low frequency words. Non-fluent readers had less variability in their mean decision time than fluent readers. The mean difference was not significant with $t(7) = -.52$, $p > .05$ (see Table 4.6c). Therefore, the time it took to make the decision of whether or not a string of letters was a word for low frequency words was not a distinguishing characteristic between fluent and non-fluent readers for sixth graders.

Table 4.6.

Lexical Decision Task Speed for Fluent and Non-Fluent College Readers

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
LFspeed	1.00	11	910.00000	202.682017	61.110927
	2.00	12	1299.16667	328.729188	94.895942

LFspeed stands for latency times for low frequency words.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
LF speed	assumed	.802	.381	-3.378	21	.003	-389.166	115.201	-628.74	-149.59
	not assumed			-3.448	18.513	.003	-389.166	112.870	-625.82	-152.50

LF speed stands for latency times for low frequency words.

Study 1 Summary. Overall, non-fluent readers responded faster when deciding whether or not a string of letters was a high or low frequency word than fluent readers. Both non-fluent and fluent readers had faster mean latency response times for high frequency words compared to low frequency words. Only mean latency response times for low frequency words were a distinguishing characteristic between fluent and non-fluent readers for college students. The findings are counter to early theory predictions that fluent readers would have faster mean latency response times.

Study 2 Summary. Though non-fluent readers made the decision that a string of letters was a word for high frequency and low frequency words faster and with less variability in their mean decision times (except for second graders who took longer to make the decision and had more variability), the mean difference in decision making time was not significant for second, fourth or sixth graders. These findings are inconsistent with early theory predictions that fluent readers would have faster mean latency response times.

Words – Lexical Decision Task Accuracy of High Frequency Words

Study 1. Non-fluent readers had a mean error rate of 4.90 percent (or missed an average of 2.90 words out of 60 words) with a standard deviation of 4.30 percent while fluent readers had a mean error rate of 2.80 percent (or missed an average of 1.60 words out of 60 words) with a standard deviation of 2.70 percent for high frequency words. Non-fluent readers had 2.10 percent more errors (or missed an average of .96 more words) and had less variability in their mean percentage of errors compared to fluent readers. However, the mean difference in error rates was not significant with t(21) = 1.46, p>.05 (See Table 4.7). Mean error rate with regard to high frequency words on the lexical decision task was not a distinguishing characteristic between fluent and non-fluent readers for college students. A finding that tends to support the new theory posited in this paper that accuracy alone cannot be used to distinguish a fluent reader from a fluent reader since the mean error differences were not significant between the two groups.

Study 2. Second grade non-fluent readers had a mean error rate of 32.02 percent (19.21 words) with a standard deviation of 17.06 percent (10.24 words) while fluent readers had a mean error rate of 20.84 percent (12.50 words) with a standard deviation of 12.94 percent (7.76 words). Non-fluent readers made, on average, 11.18 percent (6.71 words) more errors than fluent readers and had slightly less variability in their mean percentage error rate. The difference in mean error rates was not significant with t(13) = 1.42, p>.05 (See Table 4.7a). Accuracy for high frequency words in the lexical decision task was not a distinguishing characteristic between fluent and non-fluent readers for second graders: a finding that tends to support the new theory posited in this paper that accuracy alone cannot be used to distinguish a non-fluent reader from a fluent reader since the mean error differences were not significant between the two groups.

Fourth grade non-fluent readers had a mean error rate of 13.31 percent (7.99 words) with a standard deviation of 6.09 percent (3.65 words) while fluent readers had a mean error rate of 20.25 percent (12.15 words) with a standard deviation of 19.83 percent (11.9 words). Non-fluent readers made, on average, 6.94 percent (4.16 words) fewer errors than fluent readers and had less variability in their mean percentage error rate. The difference in mean error rates was not significant with $t(11) = -.88$, $p>.05$ (See Table 4.7b). Accuracy for high frequency words in the lexical decision task was not a distinguishing characteristic between fluent and non-fluent readers for fourth graders. A finding that does not support early theory predictions that non-fluent readers would make more errors.

Sixth grade non-fluent readers had a mean error rate of 2.23 percent (1.34 words) with a standard deviation of .92 percent (.55 words) while fluent readers had a mean error rate of 21.67 percent (13 words) with a standard deviation of 37.71 percent (22.63 words). Non-fluent readers made, on average, 19.43 percent (11.66 words) fewer errors than fluent readers and had less variability in their mean percentage error rate. The difference in mean error rates was not significant with $t(7) = -.86$, $p>.05$ (See Table 4.7c). Accuracy for high frequency words in the lexical decision task was not a distinguishing characteristic between fluent and non-fluent readers for sixth graders. A finding that does not support early theory predictions that non-fluent readers would make more errors.

Words – Lexical Decision Task Accuracy of Low Frequency Words

Study 1. Non-fluent readers had a mean error rate of 51.63 percent (or missed an average of 30.96 words out of 60 words) with a standard deviation of 15.49 percent while fluent readers had a mean error rate of 46.25 percent (or missed an average of 27.78 words out of 60 words) with a standard deviation of 18.69 percent on low frequency words. Non-fluent readers made 5.30 percent (or missed an average of 3.18 more words) more errors and had less variability in their mean error rates than fluent readers. Both groups missed approximately half of the low frequency words. However, the mean difference in error rate was not a distinguishing characteristic between fluent and non-fluent readers with $t(21) = .75$, $p>.05$ (See Table 4.7). A finding that tends to support the new theory posited in this paper that accuracy alone cannot be used to distinguish a non-fluent reader from a fluent reader since the mean error differences were not significant between the two groups.

Study 2. Second grade non-fluent readers had a mean error rate of 68.02 percent (40.81 words) with a standard deviation of 17.06 percent (10.24 words) while fluent readers had a mean error rate of 69.34 percent (41.60 words) with a standard deviation of 21.51 percent (12.91 words). Non-fluent readers made, on average, 1.32 percent (.79 words) fewer errors than fluent readers and had slightly less variability in their mean percentage error rate. The difference in mean error rates was not significant with $t(13) = -.12$, $p>.05$ (See Table 4.7a). Accuracy for low frequency words in the lexical decision task was not a distinguishing characteristic between fluent and non-fluent readers for second graders. A finding that does not support early theory predictions that non-fluent readers would make more errors.

Fourth grade non-fluent readers had a mean error rate of 57.37 percent (34.42 words) with a standard deviation of 16.68 percent (10.01 words) while fluent readers had a mean error rate of 75.27 percent (45.16 words) with a standard deviation of 16.39 percent (9.83 words). Non-fluent readers made, on average, 17.90 percent (10.74 words) fewer errors than fluent readers but had more variability in their mean percentage error rate. The difference in mean error rates was not significant with $t(11) = -1.94$, $p>.05$ (See Table 4.7b). Accuracy for low frequency words in the lexical decision task was not a distinguishing characteristic between fluent and non-fluent readers for fourth graders. A finding that does not support early theory predictions that non-fluent readers would make more errors.

Sixth grade non-fluent readers had a mean error rate of 59.47 percent (35.68 words) with a standard deviation of 15.75 percent (9.45 words) while fluent readers had a mean error rate of 49.43 percent (29.66 words) with a standard deviation of 20.03 percent (12.02 words). Non-fluent readers made, on average, 10.03 percent (6.02 words) more errors than fluent readers but had less variability in their mean percentage error rate. The difference in mean error rates was not significant with $t(7) = .75$, $p > .05$ (See Table 4.7c). Accuracy for low frequency words in the lexical decision task was not a distinguishing characteristic between fluent and non-fluent readers for sixth graders. A finding that tends to support the new theory posited in this paper that accuracy alone cannot be used to distinguish a non-fluent reader from a fluent reader since the mean error differences were not significant between the two groups.

Summary for High and Low Frequency Words. These findings tend to support the new theory posited in this paper that accuracy alone cannot be used to distinguish a non-fluent reader from a fluent reader since the mean error differences were not significant between the two groups in any grade level when deciding if a string of letters was a word for high or low frequency words on the lexical decision task.

Letter String Length

Looking at the difference in the time it takes a participant to make a decision of whether or not a string of six letters is a word and whether or not a string of three letters is a word will determine if fluent readers and non-fluent readers process the letter strings differently – processing the letter string as a whole word (chunking) or processing the letter string letter-by-letter (serially). If they are processing the letter string as a whole word (chunking) then the time it takes to make a decision will be the same for the two letter string lengths. However, if they are processing the letter string serially it will take them longer to process a six letter string than it will take them to process a three letter string. Letter string lengths were recorded in seconds (sec.). Since this section is only concerned with the time difference between six letter string lengths and three letter string lengths as the determinate of a fluent and non-fluent reader, there was no analysis done with regard to accuracy for this section.

Letter String Length – Speed of High Frequency Words

Study 1. Non-fluent readers had a mean latency difference of -7.69 sec. with a standard deviation of 22.47 sec. while fluent readers had a mean latency difference -.59 sec. with a standard deviation of 3.31 seconds. The mean latency difference between six and three letter strings for non-fluent readers of -7.69 sec. [$t(10) = -1.49$, $p>.05$] and fluent readers of -.59 sec. [$t(11) = -1.23$, $p>.05$] (see Table 4.8) were not significant. What this means is there was no difference in the time it took them to process a six letter string compared to a three letter string, so both non-fluent and fluent readers were processing three and six letter strings as chunks.

Both non-fluent and fluent readers took longer to decide whether or not a three letter string was a word than they took to decide whether or not a six letter string was a word for high frequency words. Non-fluent readers took, on average, 7.10 second longer to make this decision had less variability in their mean decision time than fluent readers. The difference between six and three letter strings was not significant with $t(21) = -1.08$, $p>.05$ (See Table 4.8). The mean difference in time for deciding when a six letter string and a three letter string was a high frequency word was not a distinguishing characteristic between fluent and non-fluent readers for college students. The finding is *inconsistent* with early theory, because even though it took non-fluent readers longer to make the decision, both groups took longer for three letter strings than six letter strings.

Study 2. Second grade non-fluent readers had a mean latency response difference of .09 sec. with a standard deviation of .27 sec. while fluent readers had a mean latency response difference of .42 sec. with a standard deviation of .75 sec. when deciding whether or not a string of six letters was a word versus when deciding whether or not a string of three letters was a word when they were high frequency words. The mean latency difference between six and three letter strings for non-fluent readers of .09 sec. [$t(5) = .85$, $p>.05$] and fluent readers of .42 sec. [$t(11) = 1.95$, $p>.05$] (see Table 4.8a) were not significant. What this means is there was no difference in the time it took them to process a six letter string compared to a three letter string, so both non-fluent and fluent readers were processing three and six letter strings as chunks.

Both groups had a positive mean latency response difference meaning it took them longer to decide whether a string of six letters was a word than it took them to decide whether a string of three letters was a word for high frequency words. Non-fluent readers made the decision .33 sec. faster but had more variability in their mean latency difference scores than fluent readers. The mean latency difference score was not significantly different with $t(16) = -1.03$, $p>.05$ (see Table 4.8a). The difference in time it took a participant to decide whether a string of six letters was a word and the time it took a participant to decide whether a string of three letters was a word when they were high frequency words was not a distinguishing characteristic between fluent and non-fluent readers for second grade. Contrary to early theory, both groups took longer for six letter words.

Fourth grade non-fluent readers had a mean latency response difference of -.03 sec. with a standard deviation of .23 sec. while fluent readers had a mean latency response difference of .13 sec. with a standard deviation of .31 sec. when deciding whether or not a string of six letters was a word versus when deciding whether or not a string of three letters was a word when they were high frequency words. The mean latency difference between six and three letter strings for non-fluent readers of -.03 sec. [$t(4) = .47$, $p>.05$] and fluent readers of .13 sec. [$t(8) = 1.25$, $p>.05$] (see Table 4.8b) were not significant. What this means is there was no difference in the time it took them to process a six letter string compared to a three letter string, so both non-fluent and fluent readers were processing three and six letter strings as chunks.

Non-fluent readers had a negative mean latency response difference meaning it took them longer to decide whether a string of three letters was a word than it took them to decide whether a string of six letters was a word for high frequency words. Fluent readers had a positive mean latency response difference meaning it took them longer to decide whether a string of six letters was a word than it took them to decide whether a string of three letters was a word for high frequency words. Non-fluent readers made the decision .16 sec. faster but had more variability in their mean latency difference scores than fluent readers. The mean latency difference score was not significantly different with $t(14) = -1.12$, $p>.05$ (See Table 4.8b). The difference in time it took a participant to decide whether a string of six letters was a word and the time it took a participant to decide whether a string of three letters was a word when they were high frequency words was not a distinguishing characteristic between fluent and non-fluent readers for fourth grade. Contrary to early theory, non-fluent readers took longer with three letter strings and fluent readers took longer with six letter strings.

Sixth grade non-fluent readers had a mean latency response difference of -1.87 sec. with a standard deviation of 3.32 sec. while fluent readers had a mean latency response difference of -6.03 sec. with a standard deviation of 17.97 sec. when deciding whether or not a string of six letters was a word versus when deciding whether or not a string of three letters was a word when they were high frequency words. The mean latency difference between six and three letter strings for non-fluent readers' significance could not be determined due to there being only one participant in this group. However, the mean latency difference between six and three letter strings for fluent readers of -6.04 sec. [$t(7) = -.95$, $p>.05$] (see Table 4.8c) was not significant. What this means is there was no difference in the time it took them to process a six letter string compared to a three letter string, so fluent readers were processing three and six letter strings as chunks.

Assessing Reading Fluency

Both non-fluent and fluent readers had a negative mean latency response difference meaning it took them longer to decide whether a string of three letters was a word than it took them to decide whether a string of six letters was a word for high frequency words. Non-fluent readers made the decision, on average, 4.16 sec. faster and had less variability in their mean latency difference scores than fluent readers. The mean latency difference score was not significantly different with $t(9) = .39$, $p > .05$ (see Table 4.8c). The difference in time it took a participant to decide whether a string of six letters was a word versus the time it took a participant to decide whether a string of three letters was a word when they were high frequency words was not a distinguishing characteristic between fluent and non-fluent readers for six graders. Contrary to early theories, both fluent and non-fluent readers took longer to process three letter strings than six letter strings.

Summary. The time it took a participant to decide whether or not a string of six letters was a word versus the time it took a participant to decide whether or not a string of three letters was a word when they were high frequency words was not a distinguishing characteristic between fluent and non-fluent readers for college, second, fourth, or sixth graders. The findings were *inconsistent* with early theories in that both groups took longer with six letter strings in second grade, non-fluent readers took longer with three letter strings and fluent readers took longer with six letter strings in fourth grade, both groups took longer for three letter strings in sixth grade, and both groups took longer for three letter strings in college. However, it should be noted that the time differences between six letter and three letter words were not significant for either the non-fluent or fluent groups. Indicating both non-fluent and fluent readers were processing six and three letter high frequency words as chunks.

Letter String Length – Speed of Low Frequency Words

Study 1. Non-fluent readers had a mean difference of 1.36 sec. with a standard deviation of 3.39 sec. while fluent readers had a mean difference of 1.85 sec. with a standard deviation of 4.30 sec. The mean latency difference between six and three letter strings for non-fluent readers of 1.36 sec. [$t(10) = 1.90$, $p > .05$] (see Table 4.8, page 232) was not significant. However, the mean latency difference between six and three letter strings for fluent readers of 1.85 sec. [$t(11) = 2.84$, $p < .05$] (see Table 4.8 below) was significant.

Table 4.8

Lexical Decision Task Speed of Letter String Length Differences for Low Frequency Words for Fluent College Group

One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Diff6Ltr3LtrLF	2.842	11	.016	.23383	.0527	.4149

Diff6Ltr3LtrF stands for six letter low frequency word times minus three letter low frequency word times for the fluent group

What this means is there was no difference in the time it took non-fluent readers to process a six letter string compared to a three letter string, so non-fluent readers were processing three and six letter strings as chunks. But, there was a difference in the time it took fluent readers to process a six letter string compared to a three letter string, so fluent readers were either processing three and six letter strings serially or three letter strings as chunks and six letter strings serially.

Both fluent and non-fluent readers took longer to decide whether or not a string of six letters was a low frequency word than they took to decide whether or not a three letter string was a low frequency word. Fluent readers took longer than non-fluent readers by .49 sec. Non-fluent readers had more variability in mean latency difference times than fluent readers. The difference of .49 sec. was not significant with $t(21) = -.31$, $p>.05$ (See Table 4.8). Therefore, the time it took to decide whether or not a six letter string or a three letter string was a low frequency word was not a distinguishing characteristic between fluent and non-fluent readers for college students. The finding is *inconsistent* with early theory in that both groups took longer with six letter strings.

Study 2. Second grade non-fluent readers had a mean latency response difference of -.25 sec. with a standard deviation of .42 sec. while fluent readers had a mean latency response difference of .25 sec. with a standard deviation of .41 sec. when deciding whether or not a string of six letters was a word versus when deciding whether or not a string of three letters was a word when they were low frequency words. The mean latency difference between six and three letter strings for non-fluent readers of -.25 sec. [$t(5) = -1.46$, $p>.05$] and fluent readers of .25 sec. [$t(11) = 2.14$, $p>.05$] (see Table 4.8a) were not significant. What this means is there was no difference in the time it took them to process a six letter string compared to a three letter string, so both non-fluent and fluent readers were processing three and six letter strings as chunks.

Non-fluent readers had a negative mean latency response difference meaning it took them longer to decide whether a string of three letters was a word for low frequency words than it took them to decide whether a string of six letters was a word for low frequency words. Fluent readers had a positive mean latency response difference meaning it took them longer to decide whether a string of six letters was a word than it took them to decide whether a string of three letters was a word for low frequency words. Non-fluent readers made the decision .01 sec. faster than fluent readers, and had about the same amount of variability in their mean latency difference scores as fluent readers. The mean latency difference scores were significantly different with $t(16) = -2.43$, $p<.05$ (see Table 4.8a). The difference in time it took a participant to decide whether a string of six letters was a word and the time it took a participant to decide whether a string of three letters was a word when they were low frequency words was a distinguishing characteristic between fluent and non-fluent readers for second grade. The finding is *inconsistent* with early theory in that non-fluent readers took longer with three letter strings.

Table 4.8a

Lexical Decision Task Speed of Letter String Length for Low Frequency Words for Second Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
LFdiff6and3	1.000	6	-.2474	.41548	.16962
	2.000	12	.2534	.41019	.11841

LFdiff6and3 stands for the difference in time between a six letter string and a three letter string for low frequency words.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95 percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
LFdiff6and3	Equal assumed	.150	.704	-2.43	16	.027	-.5007	.20593	-.9373	-.0642
	Equal not assumed			-2.42	9.983	.036	-.5007	.20686	-.9617	-.0397

LFdiff6and3 stands for the difference in time between a six letter string and a three letter string for low frequency words

Fourth grade non-fluent readers had a mean latency response difference of .18 sec. with a standard deviation of .69 sec. while fluent readers had a mean latency response difference of .40 sec. with a standard deviation of .58 sec. when deciding whether or not a string of six letters was a word versus when deciding whether or not a string of three letters was a word when they were low frequency words. The mean latency difference between six and three letter strings for non-fluent readers of .18 sec. [$t(4) = -.05$, $p>.05$] and fluent readers of .40 sec. [$t(8) = 2.09$, $p>.05$] (see Table 4.8b) were not significant. What this means is there was no difference in the time it took them to process a six letter string compared to a three letter string, so both non-fluent and fluent readers were processing three and six letter strings as chunks.

Both non-fluent and fluent readers had a positive mean latency response difference meaning it took them longer to decide whether a string of six letters was a word for low frequency words than it took them to decide whether a string of three letters was a word for low frequency words. Non-fluent readers made the decision .22 sec. faster but had a more variability in their mean latency difference scores than fluent readers. The mean latency difference score was not significantly different with $t(14) = -.67$, $p>.05$ (See Table 4.8b). The difference in time it took a participant to decide whether a string of six letters was a word and the time it took a participant to decide whether a string of three letters was a word when they were low frequency words was not distinguishing characteristic between fluent and non-fluent readers for fourth grade. Again, counter to early theory prediction, non-fluent readers made the decision faster than fluent readers and both groups took longer on the six letter string length.

Sixth grade non-fluent readers had a mean latency response difference of 2.11 sec. with a standard deviation of .4.63 sec. while fluent readers had a mean latency response difference of 2.91 sec. with a standard deviation of 5.81 sec. when deciding whether or not a string of six letters was a word versus when deciding whether or not a string of three letters was a word when they were low frequency words. The mean latency difference between six and three letter strings for non-fluent readers' significance could not be determined due to there being only one participant in this group. However, the mean latency difference between six and three letter strings for fluent readers of 2.91 sec. [$t(7) = 1.42$, $p>.05$] (see Table 4.8c) was not significant. What this means is there was no difference in the time it took them to process a six letter string compared to a three letter string, so fluent readers were processing three and six letter strings as chunks.

Both non-fluent and fluent readers had a positive mean latency response difference meaning it took them longer to decide whether a string of six letters was a word for low frequency words than it took them to decide whether a string of three letters was a word for low frequency words. Non-fluent readers made the decision, on average, .80 sec. faster and had less variability in their mean latency difference scores than fluent readers. The mean latency difference score was not significantly different with $t(9) = -.21$, $p>.05$ (See Table 4.8c). The difference in time it took a participant to decide whether a string of six letters was a word and the time it took a participant to decide whether a string of three letters was a word when they were low frequency words was not a distinguishing characteristic between fluent and non-fluent readers for sixth grade. Counter to early theory prediction, non-fluent readers made the decision faster than fluent readers and both groups took longer with the six letter string length.

Summary. As expected, there was a significant difference in the time it took fluent and non-fluent second graders to decide whether a string of six letters was a word and the time it took them to decide whether a string of three letters was a word when they were low frequency words. However, the difference did not occur in the direction expected, it took non-fluent readers longer to make this decision for three letter words than six letter words, and it took fluent readers longer to make this decision for six letter words than three letter words. It should be noted that the time differences between six letter and three letter words were not significant for either the non-fluent (all groups) or fluent (second, fourth, and sixth grade) groups. Indicating both non-fluent and fluent readers were processing six and three letter high frequency words as chunks for these groups. There was only a significant difference in mean time difference between six and three letter words for the fluent college group. Indicating fluent college readers are processing six and three letter low frequency words serially or three letter words as chunks and six letter words serially.

Assessing Reading Fluency

Sentence - Speed

Study 1. Non-fluent readers had a mean reading speed of 226.72 wpm with a standard deviation of 134.04 wpm while fluent readers had a mean reading speed of 132.48 wpm with a standard deviation of 29.09 wpm on the sentence assessment. On average, non-fluent readers read 94.25 wpm faster than fluent readers. Non-fluent readers also had a lot more variability in their average reading speeds on the sentence than fluent readers. Non-fluent readers read nearly twice as fast, but they also had more than twice the variability in their average reading speeds compared to fluent readers. The difference in reading speed on the sentence was significant with t(10.86) = 2.28, p<.05 (See Table 4.9). Counter to early theory prediction, non-fluent readers read the sentence significantly faster than fluent readers. Speed of reading the sentence was a distinguishing characteristic between the two groups for college students.

Table 4.9.

Sentence Reading Speed for College Students

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
Sentwpm	1.00	11	226.7245	134.03698	40.41367
	2.00	12	132.4758	29.09252	8.39829

Sentwpm stands for words read per minute on the sentence assessment

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Sentwpm	assumed	23.832	.000	2.380	21	.027	94.24871	39.59705	11.902	176.595
	not assumed			2.283	10.864	.044	94.24871	41.27706	3.259	185.237

Sentwpm stands for words read per minute on the sentence assessment

Study 2. Second grade non-fluent readers had a mean of 122.94 wpm with a standard deviation of 31.96 wpm while fluent readers had a mean of 106.01 wpm with a standard deviation of 44.56 wpm. Counter to early theory prediction, non-fluent readers read, on average, 16.93 more wpm than fluent readers. Non-fluent readers had less variability than fluent readers. The reading speed difference was not significant with $t(15) = .82$, $p>.05$ (See Table 4.9a). Reading speed for the sentence was not a distinguishing characteristic between fluent and non-fluent reads in the second grade.

Fourth grade non-fluent readers had a mean of 169.37 wpm with a standard deviation of 52.81 wpm while fluent readers had a mean of 195.54

wpm with a standard deviation of 46.30. Consistent with early theory predictions, non-fluent readers read, on average, 26.17 fewer wpm than fluent readers. Non-fluent readers had more variability than fluent readers. The reading speed difference was not significant with $t(14) = -1.06$, $p > .05$ (See Table 4.9b). Reading speed for the sentence was not a distinguishing characteristic between fluent and non-fluent readers in the fourth grade.

Sixth grade non-fluent readers had a mean of 119.02 wpm with a standard deviation of 35.00 wpm while fluent readers had a mean of 221.27 wpm with a standard deviation of 116.34 wpm. Consistent with early theory predictions, non-fluent readers read, on average, 102.25 fewer wpm than fluent readers. Non-fluent readers had less variability than fluent readers. The reading speed difference was not significant with $t(9) = -1.45$, $p > .05$ (See Table 4.9c). Reading speed for the sentence was not a distinguishing characteristic between fluent and non-fluent readers in the sixth grade.

Summary. There was only a significant difference in reading speed between fluent and non-fluent readers on the sentence for the college group. Surprisingly and contrary to early theory predictions, non-fluent readers read the sentence significantly faster than fluent readers.

Sentence - Accuracy of Multiple Choice Question

Each sentence was followed by a multiple choice question containing four options of words the participant had to choose from that would best fit the missing words from the sentence they had just read. This exercise was used to address the issue of whether or not there is a difference in the two group's ability to carry the gist for one sentence long enough to answer the multiple choice question correctly.

Study 1. Based on their performance, 63.64 percent of the non-fluent readers were able to answer the multiple choice question correctly and 66.67 percent of the fluent readers were able to answer the multiple choice question correctly. The mean difference percent correct between the two groups was not significant with $t(21) = -.15$, $p>.05$ (See Table 4.10). Contrary to the new theory posited in this paper, both groups carried the gist of the sentence well enough to answer the multiple choice questions correctly; therefore, it was not a distinguishing characteristic between the two groups of college students.

Study 2. Second grade non-fluent readers had zero percent correct while fluent readers had 42 percent correct (See Figure 8) on the sentence multiple choice question. The difference in performance between the fluent and non-fluent readers was significant with $t(11) = -2.80$, $p<.05$ (See Table 4.10a). The ability to carry the gist of a sentence was a distinguishing characterisitc between fluent and non-fluent readers for second graders. This finding supports the new theory posited in this paper that fluent readers are better able to carry the gist of a sentence than non-fluent readers and therefore better able to answer multiple choice questions correctly.

Table 4.10a

Sentence Accuracy for Second Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
SentenceAcc	1.000	6	.00	.000	.000
	2.000	12	.42	.515	.149

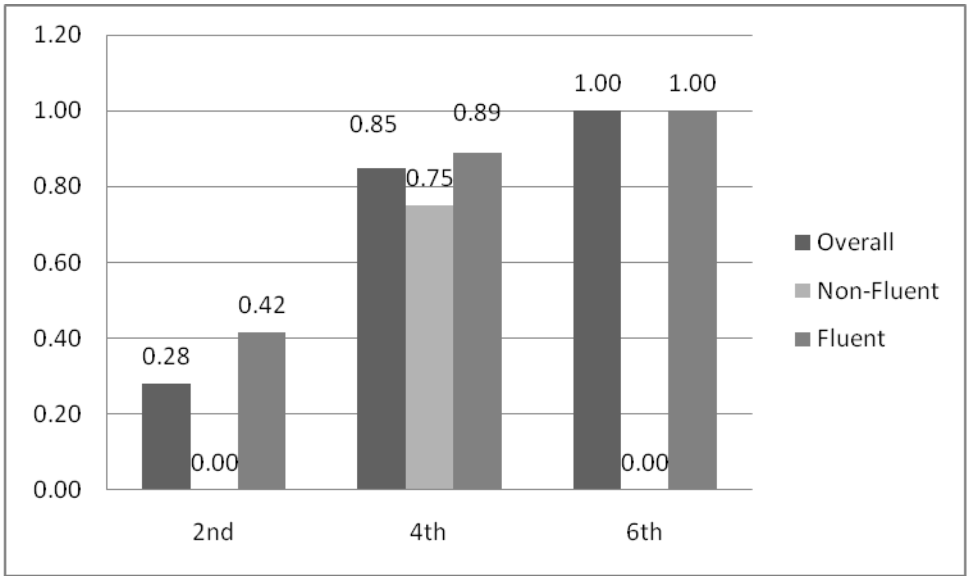
SentenceAcc stands for accuracy on multiple choice questions regarding the sentence

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Sent Acc	Equal assumed	186.667	.000	-1.95	16	.069	-.417	.213	-.869	.036
	Equal not assumed			-2.80	11.00	.017	-.417	.149	-.744	-.089

Sent Acc stands for accuracy on multiple choice questions regarding the sentence

Figure 8. Sentence Accuracy of Multiple Choice Question – Elementary



For fourth grade, there was no significant difference with t(11) = -.60, p>.05 (See Table 4.10b) between fluent and non-fluent readers with 75 percent of the non-fluent readers getting the multiple choice question correct and 89 percent of the fluent readers getting the multiple choice question correct (see Figure 8). Being able to carry the gist of a sentence long enough to answer a multiple choice question was not a distinguishing characterisitc between fluent and non-fluent readers for fourth graders even though there were more fluent readers who answered the question correctly as predicted by the new theory posited in this paper.

For sixth grade, zero percent of the non-fluent readers and 100 percent of the fluent readers answered the multiple choice question correctly (see

Table 4.10c and Figure 8). This finding supports the new theory that fluent readers will be better able to answer the mutliple choice question correctly because they will be better able to carry the gist of the sentence. Because there were no participants in the non-fluent group to compare to the fluent group, it was not possible to determine whether or not it was a distinguishing characterisitc between non-fluent and fluent readers in the sixth grade.

Summary. Though fluent readers appear to do slightly better with carrying the gist of a sentence long enough to answer the multiple choice question correctly than non-fluent readers - the ability to carry the gist of a sentence was only significantly different and a distinguishing characteristic for the second grade group.

Paragraphs Delivered Sentence-by-Sentence - Speed

Study 1. Non-fluent readers had a mean reading speed of 74.92 wpm with a standard deviation of 16.69 wpm while fluent readers had a mean reading speed of 79.12 wpm with a standard deviation of 22.20. Fluent readers read, on average, 4.19 wpm faster than non-fluent readers but had more variability in their mean reading speed than non-fluent readers. The mean reading speed difference was not significant with $t(21) = -.51$, $p>.05$ (See Table 4.11). Contrary to early theory predictions, non-fluent readers read faster than fluent readers. Even so, the mean reading speeds for a paragraph delivered sentence-by-sentence was not a distinguishing characteristic between the two groups of college students.

Study 2. Second grade non-fluent readers had a mean of 72.40 wpm with a standard deviation of 19.18 wpm while fluent readers had a mean of 72.62 wpm with a standard deviation of 24.84 wpm. Non-fluent readers read, on average, .22 wpm slower and had less variability in their mean reading speed than fluent readers. Even though non-fluent readers read slower than fluent readers – supporting early theory predictions, the mean difference was not significant with $t(15) = -.02$, $p > .05$ (See Table 4.11a). Therefore, reading speed on the paragraph delivered sentence-by-sentence was not a distinguishing characteristic between fluent and non-fluent readers in the second grade.

Fourth grade non-fluent readers had a mean of 115.59 wpm with a standard deviation of 30.18 wpm while fluent readers had a mean of 126.02 wpm with a standard deviation of 63.94 wpm. Non-fluent readers read, on average, 10.43 wpm slower and had less variability in their mean reading speed than fluent readers. Even though non-fluent readers read slower than fluent readers – supporting early theory predictions, the mean difference was not significant with $t(11) = -.31$, $p > .05$ (See Table 4.11b). Therefore, reading speed on the paragraph delivered sentence-by-sentence was not a distinguishing characteristic between fluent and non-fluent readers in the fourth grade.

Sixth grade non-fluent readers had a mean of 118.20 wpm with no standard deviation while fluent readers had a mean of 183.78 wpm with a standard deviation of 56.67 wpm. Non-fluent readers read, on average, 65.78 wpm slower than fluent readers. Even though non-fluent readers read slower than fluent readers – supporting early theory predictions, the mean difference was not significant with $t(7) = -1.09$, $p>.05$ (See Table 4.11c). Therefore, reading speed on the paragraph of text delivered sentence-by-sentence was not a distinguishing characteristic between fluent and non-fluent readers in the sixth grade.

Summary. Even though fluent readers read faster than non-fluent readers, the difference in reading speed was not significant. Reading speed on the paragraphs delivered sentence-by-sentence was not a distinguishing characteristic between fluent and non-fluent readers for any of the groups.

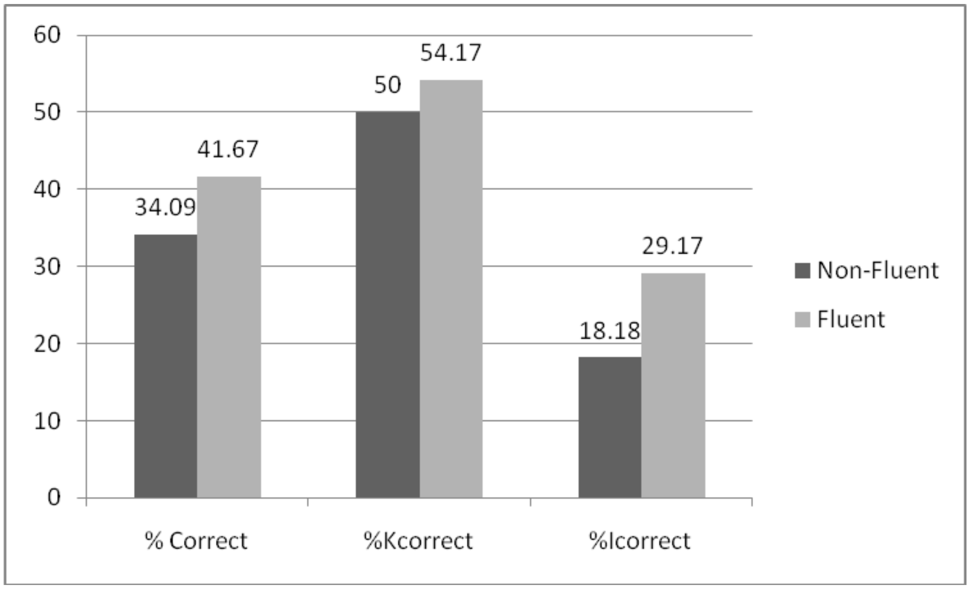
Paragraphs Delivered Sentence-by-Sentence – Accuracy of Multiple Choice Questions

Study 1. Fluent readers had a higher percentage of correct responses to the multiple choice questions. Fluent readers had a mean of 41.67 percent correct while non-fluent readers had a mean of 34.09 percent correct (See

Figure 9), but the mean difference was not significant with $t(21) = -.66$, $p > .05$ (See Table 4.12). Breaking the questions down into their two levels of difficulty, fluent readers had a mean of 54.17 percent of the knowledge level questions correct while non-fluent readers had a mean of 50 percent correct. The mean difference was not significant with $t(21) = -.28$, $p > .05$ (See Table 4.12). For the inferential questions, fluent readers had a mean of 29.17 percent correct while non-fluent readers had a mean of 18.18 percent correct. Even though the findings support the new theory posited by this paper that fluent readers will get more questions correct, the mean difference for college students was not significant with $t(21) = -.89$, $p > .05$ (See Table 4.12).

Fluent and non-fluent college readers had a decrease in their mean percentage correct when going from the knowledge (easier) questions to the inferential (more difficult) questions (See Figure 9).

Figure 9. Sentence-by-Sentence Paragraph Accuracy of Multiple Choice Questions – College.



Study 2. Second grade non-fluent readers had a mean percent correct of 60 percent with a standard deviation of 22.36 percent while fluent readers had a mean percent correct of 93.75 with a standard deviation of 11.31 percent. Supporting the new theory posited in this paper that fluent readers will get more questions correct, fluent readers had a mean percent correct of 33.75 more than non-fluent readers and had less variaiblity in their mean percent correct than non-fluent readers. The result being that the mean difference between fluent and non-fluent readers is significant for second graders with t(4.878) = -3.21, p<.05 (See Table 4.12a and Figure 10)

Table 4.12a

Accuracy of Paragraph Delivered Sentence-by-Sentence for Second Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
Psbys*PercentCorrect	1.000	5	.60000	.223607	.100000
	2.000	12	.93750	.113067	.032640
Psbys*PercentKcorrect	1.000	5	.70000	.273861	.122474
	2.000	12	1.00000	.000000	.000000
Psbys*PercentIcorrect	1.000	5	.50000	.353553	.158114
	2.000	12	.87500	.226134	.065279

**Psbys stands for paragraphs delivered sentence by sentence*

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Psbys*Per Corr	assumed	5.383	.035	-4.20	15	.001	-.33750	.0802	-.5084	-.1665
	not assumed			-3.20	4.878	.025	-.33750	.1051	-.6099	-.0650
Psbys*Per K corr	assumed	254.118	.000	-3.98	15	.001	-.30000	.0752	-.4604	-.1395
	not assumed			-2.44	4.000	.070	-.30000	.1224	-.6400	.0400
Psbys*Per I corr	assumed	.019	.893	-2.64	15	.018	-.37500	.1416	-.6769	-.0730
	not assumed			-2.19	5.423	.076	-.37500	.1710	-.8046	.0546

Psbys stands for paragraphs delivered sentence by sentence; Pe rCorr stands for percent correct; K stands for knowledge level questions; I stands for inferential level questions

This was also true when the multiple choice questions were broken down into the knowledge and inferential level questions (See Figure 10). For the knowledge questions non-fluent readers had a mean percent correct of 70 with a standard deviation of 27.39 mean percent correct while fluent readers had a mean percent correct of 100 with a standard devaition of zero. Fluent readers had, on average, 30 mean percent more correct than non-fluent readers and they had less variablity in their mean percent correct. The mean difference between the fluent and non-fluent readers was not significant with $t(4) = -2.44$, $p>.05$ (See Table 4.12a). For inferential questions non-fluent readers had a mean percent correct of 50 with a standard deviation of 35.36 mean percent correct while fluent readers had a mean percent correct of 87.5 with a standard deviation of 22.61 mean percent correct. Fluent readers had, on average, a mean percent correct of 37.50 higher than the non-fluent readers and less variabity compared to non-fluent readers. The mean difference between the second grade fluent and non-fluent readers was significant with $t(15) = -2.65$, $p<.05$ (See Table 4.12a and Figure 10).

As predicted by the new theory, the ability to answer multiple choice questions regarding a passage of text delievered sentence-by-sentence was a distinguishing characteristic between fluent and non-fluent readers in the second grade in that fluent readers had more questions correct (significantly more for inferential questions).

Fourth grade non-fluent readers had a mean percent correct of 62.50 percent with a standard deviation of 32.27 percent while fluent readers had a mean percent correct of 69.44 percent with a standard deviation of 30.05 percent (See Figure 10). Even though the mean difference between the fourth grade fluent and non-fluent readers was not significant with $t(11) = -.38$, $p>.05$ (See Table 4.12b), as predicted by the new theory posited in this paper, fluent readers had a mean percent correct of 6.94 more than non-fluent readers.

This was also true when the the multiple choice questions were broken down into the knowledge and inferential level questions. For the knowledge questions non-fluent readers had a mean percent correct of 75 with a standard deviation of 28.87 mean percent correct while fluent readers had a mean percent correct of 83.33 with a standard devaition of 25 mean percent correct (See Figure 10). Fluent readers had, on average, 8.33 more mean percent correct than non-fluent readers and they had less variablity in their mean percent correct than non-fluent readers. The mean difference between the fluent and non-fluent fourth grade readers was not significant with $t(11) = -.53$, $p>.05$ (See Table 4.12b). For inferential questions non-fluent readers had a mean percent correct of 50 with a standard deviation of 40.82 mean percent correct while fluent readers had a mean percent correct of 55.56 with a standard deviation of 39.09 mean percent correct. Fluent readers had, on average, a mean percent correct of 5.56 higher than the non-fluent readers and less variability compared to non-fluent readers. The mean difference between the fluent and non-fluent readers was not significant with $t(11) = -.23$, $p>.05$ (See Table 4.12b and Figure 10). Even though fluent readers had more questions correct, the ability to answer multiple choice questions regarding a passage of text delievered sentence-by-sentence was not a distinguishing characteristic between fluent and non-fluent readers in the fourth grade.

Sixth grade non-fluent readers had a mean percent correct of zero while fluent readers had a mean percent correct of 40.63 with a standard deviation of 26.52 percent (see Figure 10). As predicted by the new theory posited in this paper, fluent readers had a mean percent correct of 26.52 more than non-fluent readers. However, the mean difference between the fluent and non-fluent sixth grade readers was not significant with $t(7) = -1.44$, $p>.05$ (See Table 4.12c).

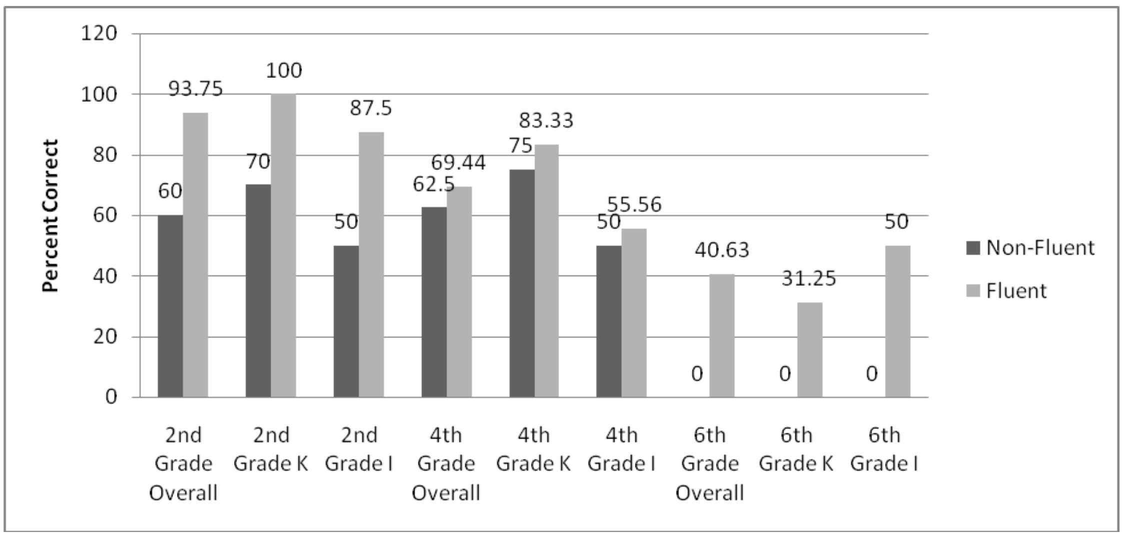
This was also true when the multiple choice questions were broken down into the knowledge and inferential level questions. For the knowledge questions non-fluent readers had a mean percent correct of zero while fluent readers had a mean percent correct of 31.25 with a standard devaition of

25.88 mean percent correct (see Figure 10). Fluent readers had, on average, 31.25 more mean percent correct than non-fluent readers but they had more variablity in their mean percent correct. The mean difference between the sixth grade fluent and non-fluent readers was not significant with $t(7) = -1.14$, $p>.05$ (See Table 4.12c). For inferential questions non-fluent readers had a mean percent correct of zero while fluent readers had a mean percent correct of 50 with a standard deviation of 37.80 mean percent correct. Fluent readers had, on average, a mean percent correct of 50 higher than the non-fluent readers. The mean difference between the fluent and non-fluent sixth grade readers was not significant with $t(7) = -1.25$, $p>.05$ (see Table 4.12c and Figure 10).

The ability to answer multiple choice questions regarding a passage of text delievered sentence-by-sentence was not a distinguishing characteristic between fluent and non-fluent readers in the sixth grade though this statement must be taken with caution since there was only one participant considered to be non-fluent in the sixth grade group.

Summary. The ability to carry the gist of multiple sentences from a paragraph of text delivered sentence-by-sentence and answer multiple choice questions concerning the passage of text was a distinguishing characteristic between fluent and non-fluent readers for second graders but not for college, fourth or sixth graders; even though, as predicted by the new theory, fluent readers were able to answer more questions correctly for both the knowledge and inferental level questions. However, there was only one non-fluent reader in the sixth grade group making it difficult to determine whether or not the finding is true for this group.

Figure 10. Sentence-by-Sentence Paragraph Accuracy – Elementary



Chapter V

Discussion

Reading fluency has had a wavering group of enthusiasts over the years, mainly due to discrepancies in defining it as a psychological construct. Part of the problem arose from the shifting psychological paradigms – it is very difficult to define a construct in terms of cognition when the prevailing paradigm is behaviorism. With advances in technology (i.e., fMRI) and cognitive psychology (i.e., neuro-psychology), reading fluency in terms of cognition has found new support. With the old behavioral ideology that fluency can be measured by observing an increase in reading speed, accuracy and prosody being replaced with the cognitive perspective that we must also explicitly test whether or not comprehension is simultaneously occurring with these secondary characteristics in place, we are off to a good start. As put forward in this paper, it is imperative that a new definition of reading fluency be adopted immediately, a definition which contains an explicit measure of comprehension. For instance, students must be informed that after they have read a passage of text they will have to answer some questions concerning the passage of text they just read.

To this end and to recap, the purpose of conducting this research was to answer three questions; three questions that hopefully will separate the two paradigms' roles in the measurement of reading fluency by showing that an explicit measurement of comprehension is not only important but necessary for the depiction of non-fluent and fluent readers. The first question has to do with whether or not reading speed and accuracy in the form of an adjusted words per minute (adjwpm), whereby the total number of errors made are subtracted from the total number of words read per minute on an oral reading assessment (without an explicit comprehension component in the form of questions) alone actually measures reading fluency as newly defined in this paper – is it a valid measuring tool for reading fluency? The second question has to do with whether or not reading speed and accuracy in the form of an adjwpm is predictive of reading fluency as newly defined in this paper. These two questions evolve around the use of reading speed and accuracy. It has been argued that if a person reads fast and accurately then comprehension is implicit – fast frees up cognitive load for comprehension and if a word is pronounced accurately then the meaning must be known to the reader – comprehension is automatic. Further, if a person reads slowly it places too much of a cognitive load on short-term memory and comprehension cannot occur and/or if a person mispronounces a word then they must not know the meaning of the word. However, a new argument is being offered that states freeing up cognitive load does not necessarily lead to the freed up space being used for comprehension, and just because a person can pronounce a word it doesn't necessary follow that the person knows the meaning of the word or vice versa if a person doesn't pronounce a word correctly it doesn't necessarily follow that the person doesn't know the meaning of the word. To this end two routes of processing a word were presented: the grapheme to phoneme conversion route whereby a person reads fast and without error and implies comprehension and the visual lexicon through semantic route whereby a person reads slowly and without error because they are using the semantic module where comprehension occurs. A problem with forcing someone to use the grapheme to phoneme conversion route is that it doesn't explain Jabberwocky whereby the two conditions can be met (fast and accurate) without the occurrence of comprehension. A discontent between the two arguments with regard to the visual lexicon to semantic route is that according to the old argument anyone who reads slowly cannot comprehend what they are reading while the new argument states slow reading doesn't discount the occurrence of comprehension. The third question is a little more complex and centers around what characteristics distinguish a fluent reader from a non-fluent reader. For instance, can reading speed and/or accuracy characterize what differentiates a fluent reader from a non-fluent reader? On the other hand, perhaps it is the level of automaticity -- automaticity at the word, sentence or multiple sentence level that distinguishes a fluent reader from a non-fluent reader?

There were two studies conducted to address these three specific issues (validity, predictiveness, and characteristics) with regard to speed, accuracy and unit of automaticity. The two studies consisted of college students (Study 1) who were assumed to be fluent readers and would therefore exhibit specific characteristics associated with fluent readers and second, fourth, and sixth graders (Study 2) who where part of a pilot study to determine if they would mimic those same characteristics found in Study 1 with the college students.

Because there were arguments presented for both sides of the first two questions – one side claiming an adjwpm score is both correlated with and predictiveness of reading fluency and another side claiming students were misidentified as fluent readers when they had high adjwpm scores but poor comprehension scores – and because automaticity theory allows for the *possibility* of simultaneous comprehension occurring when words are learned to an automatic level; an oral reading assessment (DIBELS) was used to evaluate these two criterion: validity and predictiveness. To assess whether or not the oral reading assessment adjwpm score is a valid measure and predictor of reading fluency, the oral reading assessment was tested against a "true" reading fluency assessment. To obtain a "true" reading fluency score participants were asked to read a passage of text and then answer some multiple choice questions concerning the passage of text. The participants' reading fluency scores were then determined by how well they were able to answer the multiple choice questions. This score was then tested against the oral reading adjwpm score to determine validity and predictiveness of the oral reading adjwpm score.

Validity and Predictiveness

There were no significant correlations found between reading speed and accuracy (adjwpm) and reading fluency for either study. Reading speed and accuracy (adjwpm) had no relationship with reading fluency and as such should not be considered a valid measure of reading fluency – a student's ability to comprehend. Nor were reading speed and accuracy (adjwpm) found to be predictive of reading fluency and as such should not be used as a predictive measure for a student's reading fluency – ability to comprehend. Instructors should be made aware that reading speed and accuracy, though secondary characteristics of reading fluency, do not measure reading fluency when used alone, as comprehension is not automatically occurring just because a student reads fast and without error. There must be a comprehension component linked with the measures to make them viable reading fluency measurement tools otherwise what is being measured is really only speed and accuracy. The implication is that even though students may be learning words to an automatic level, they do not necessarily use the freed up cognitive space for comprehension, and drills focusing solely on speed and accuracy may be forcing students to use the grapheme to phoneme conversion route instead of the visual lexicon to semantic route during an oral reading task. These drills merely teach students to focus on words in isolation instead of in the context of the rest of passage and lead students to merely "bark at text" or Jabberwocky and should be avoided. There is a tendency to compare lower grades such as second graders with sixth graders and postulate that because sixth graders read faster and with more accuracy than second graders they are fluent readers and the second graders are non-fluent readers. Argued here is the fact that this difference could simply be due to "maturation." As an individual becomes more and more use to and familiar with the task of "reading" (as they become more experienced) they naturally become faster readers and with more reading and learning develop better vocabulary skills. Also being argued here is that this experience and learning occurs differently for different students and creates a continuum of reading fluency scores. Therefore, it is not enough to compare one grade level to another; the comparison must be within each grade level. By making the comparison within grade level, the continuum of scores/ability can be addressed.

If reading speed and accuracy in the form of an adjwpm score is not a valid or predictive measuring tool, a question remains as to whether or not the secondary characteristics of speed and accuracy separately may provide some insight into what distinguishes a fluent reader from a non-fluent reader. Therefore, because it has been stated in this paper that reading fluency is not a dichotomous variable but occurs on a continuum, each group was evaluated using a true reading fluency assessment (read a passage of text and answer multiple choice questions concerning the text) and based on where they fell on this continuum (how well they answered the multiple choice questions) were divided into fluent and non-fluent readers. Once participants were divided into the two groups; the two groups where then compared to each other on various assessments to see if they were significantly different from each other with regard to speed, accuracy, and automaticity level (word, gist of sentence or gist of multiple sentences). The assessments consisted of an oral reading assessment, a Lexical Decision Task with high and low frequency words, a sentence followed by a multiple choice question, and a paragraph of text delivered sentence-by-sentence followed by multiple choice questions.

Assessing Reading Fluency

Oral Reading

There were mixed findings with regard to speed and accuracy on the oral reading task (unit of measure being the word). For the college group, non-fluent readers read faster than fluent readers but not significantly faster. This finding appears to support the possibility of non-fluent college students using the grapheme to phoneme conversion route for reading words compared to their fluent counterparts who may be using the visual lexicon to semantic route. However, since the reading times were not significantly different between the two groups, reading speed as such was not a distinguishing characteristic between fluent and non-fluent readers for the college participants and would not serve as a viable measuring tool to discriminate between the two groups. With regard to accuracy on the oral reading task, fluent and non-fluent readers had approximately the same mean percentage of errors, indicating both groups may have the same vocabulary level and familiarity of words. The implication being that reading accuracy was not a distinguishing characteristic between the two groups and as such is not a viable measuring tool to discriminate who is fluent and who is not fluent. Based on the old argument, non-fluent readers should have read slower and had more errors than fluent readers. Neither of these claims was supported in that there was no significant difference between fluent and non-fluent reading speeds and accuracy.. However, the findings do lend support to the new argument proposed here that reading fluency cannot be measured by speed and accuracy alone and that reading fluency is on a continuum where non-fluent and fluent readers can overlap on the secondary characteristics of speed and accuracy (a theory further supported by the fact that all the college students scored at the 16 grade level on the Woodcock Johnson assessment), but not on a comprehension component.

It was a different story with the elementary students. In each of the second, fourth and sixth grade groups, non-fluent readers read slower and had more errors than their fluent reader counterparts. This shows a trend possibly supporting the old argument that non-fluent readers read slower and make more errors than fluent readers. However, only the non-fluent readers of the fourth grade group read significantly slower and only the non-fluent readers of the sixth grade group made significantly more errors. It could be that the non-fluent fourth graders haven’t quite caught up with their fluent counterparts with regard to vocabulary and slowed down to pronounce newly learned words, and it could be that the non-fluent sixth graders have not learned some of the new vocabulary or where just more worried about being timed and wanted to be done as soon as possible believing speed was the most important thing. Either way, the inconsistency in findings supports the new theory that reading speed and accuracy alone cannot measure reading fluency. If they could, then the findings would have had significantly slower reading times coupled with significantly higher error rates or with all groups having either significantly slower reading rates or significantly higher error rates. The implications of these findings is that an adjwpm on an oral reading assessment does not measure reading fluency and can be misleading as to what is going on with the reader. The inconsistencies found support neither the grapheme to phoneme conversion route nor the visual lexicon to semantic route. In fact, the trend shows support for a possible third route (possibly a grapheme to phoneme to semantic route) whereby the semantic module is not quite sophisticated yet and where reading slowly and having more errors can occur or where reading fast and having more errors can occur -- making it difficult to know if comprehension is occurring. Current theories don't answer why a student may be reading slowly or why a student may be making more errors. With the current theory assessments consisting of an adjwpm measuring tool, a student who reads really fast and makes a lot of errors can end up with the same score as a slow reader who makes no errors. It relies too much on assumptions about what is going on in a student's head (fast reading and few errors implicitly leads to comprehension) during the assessment instead of explicitly finding out if the student comprehends what (s)he is reading.

Assessing Reading Fluency

It should also be noted that the findings of the pilot study with elementary students did not mimic the findings of the college students. The elementary students showed a trend for non-fluent readers having slower reading times coupled with more errors, and had significant findings for fourth graders (speed) and sixth graders (errors), while the college students showed a trend for non-fluent readers reading faster and making no more errors than fluent readers. It raises the question of whether or not the college non-fluent readers were aware that they were poor readers and over compensated on the oral reading assessment in an attempt to prove something and/or that the fluent readers were confident in their reading abilities and read at a speed natural to them – weren't worried about being timed.

Lexical Decision Task – High Frequency Words

For college students, there were no significant differences between fluent and non-fluent readers for either speed or accuracy. However, the trend was for non-fluent readers to respond quicker and make more errors. This trend shows possible support for the argument that the participants were using the new third route (grapheme to phoneme to semantic route), a route whereby comprehension may or may not be taking place as the semantic module is not yet fully developed. The fact that there were no significant differences argues for the new theory that speed and accuracy cannot be used to distinguish between fluent and non-fluent readers. Remember these are high frequency words, words college students are familiar with, so if they were using the visual lexicon to semantic route they would have made no errors. Especially since the non-fluent college students also scored a 16 grade level on the Woodcock Johnson assessment. The fact that the non-fluent readers made more errors raises the possibility that the difference is a vocabulary and/or spelling difference. Could it be that there is a component within the semantic module of the third route that deals with spelling?

For the elementary students, there were mixed findings. Though second grade non-fluent readers responded slower and with more errors (argument for the grapheme to phoneme to semantic route), the difference was not significant. Both the fourth and sixth grade non-fluent readers responded faster and with fewer errors (argument for grapheme to phoneme conversion route). However, only the fourth grade non-fluent reader response times were significantly faster, and only the sixth grade non-fluent readers made significantly fewer errors. These findings support the new theory that speed and accuracy cannot be used to distinguish fluent from non-fluent readers. It could be that the second grade readers (because they are new to learning words and reading) are using the third route (grapheme to phoneme to semantic) and because they are still unfamiliar with many words make more errors; each of which (speed and accuracy) would be slightly inflated for the non-fluent group. It could also be that by the fourth and sixth grade non-fluent readers are further along (in the process of) being trained through the use of drills focusing on speed and accuracy to focus solely on speed and accuracy; thereby, being forced to use the grapheme to phoneme conversion route. Though these are high frequency words, second graders may not be familiar with all of the words presented in this task and therefore may make more errors simply due to not knowing the words. Likewise, fourth graders would be familiar with more of the words and sixth graders would be familiar with even more of the words presented in this task.

It should be noted that only the fourth and sixth grade groups mimicked the college findings with regard to speed and only the second grade group mimicked the college findings with regard to errors. Even though this task contained a comprehension component, the findings support the argument that even though words may be learned to automaticity it doesn’t guarantee comprehension will occur and that automaticity at the word level could simply mean that words are being processed through the grapheme to phoneme conversion route or the grapheme to phoneme to semantic route, by-passing comprehension completely with the first and possibly finding a faulty semantic module with the second.

Assessing Reading Fluency

Lexical Decision Task – Low Frequency Words

For low frequency words in the lexical decision task, non-fluent college students responded faster and with more errors, but not significantly faster or significantly more errors than fluent college students. This finding supports the new argument that speed and accuracy cannot be used to distinguish fluent readers from non-fluent readers as there was no significant difference in their performance. However, the trend of non-fluent readers responding faster and making more errors argues for the use of the new third route of processing words – grapheme to phoneme to semantic route: a route where comprehension may or may not be occurring. According to the old argument non-fluent readers should have responded slower and with more errors, but they responded faster or with the same amount of speed as their fluent counterparts. It could be that the non-fluent college readers were over confident in their vocabulary knowledge and made their decisions based on whether or not the letters presented sounded like or didn't sound like a word – indicating a possible faulty or under developed semantic module, and that fluent readers used the visual lexicon to semantic route whereby they employed the fully developed semantic module making their response times slower but more accurate.

Assessing Reading Fluency

The findings were mixed for the pilot study. Second grade non-fluent readers responded slower but made fewer errors. This finding is counter to the old argument that would have the non-fluent readers responding slower and with more errors. However, it also argues for the new theory that reading slowly and making fewer errors implies the visual lexicon to semantic route was being used and comprehension was occurring. This is very surprising for the second grade non-fluent readers in that these are low frequency words and should have been outside their lexicon of knowledge. Both the fourth and sixth grade non-fluent readers responded faster. The fourth grade non-fluent readers made fewer errors but the sixth grade non-fluent readers made more errors. The fact that the fourth grade non-fluent readers responded both faster and with fewer errors implies they may be using the grapheme to phoneme conversion route where the new theory argues no comprehension is occurring. The sixth grade non-fluent readers responded faster but with more errors implying they are using the new grapheme to phoneme to semantic route where comprehension may or may not be occurring. Once again these inconsistencies support the argument that reading speed and accuracy alone cannot distinguish fluent readers from non-fluent readers as the different groups appear to be using different processing routes – some where comprehension may be occurring and some where comprehension may not be occurring. The fact that none of the differences were found to be significant supports the new theory that reading speed and accuracy alone cannot distinguish fluent readers from non-fluent readers.

Lexical Decision Task – Letter String Length of High Frequency Words

The reason for this section has to do with how different letter string lengths may be being processed differently by the two groups of readers. It has been argued that fluent readers chunk words and would therefore have no difference in their processing times of a six letter string versus a three letter string of words and that non-fluent readers process words serially and would therefore take longer with a six letter string than with a three letter string of words – resulting in a positive mean latency difference time.

For the college group, both fluent and non-fluent readers had negative mean latency difference times indicating it took them longer to respond to a three letter word than it did to respond to a six letter word. This is a surprising finding since these are high frequency words. It gives the appearance that both groups may be processing a six letter string as a chunk while processing a three letter string serially. However, the fact that the differences were not significant for either the fluent or non-fluent groups means that both groups were processing six letter strings and three letter strings as chunks. So, even though the new definition of reading fluency shows that when measured correctly reading fluency occurs on a continuum, it also shows that non-fluent and fluent readers both have the capacity to chunk words when they are high frequency words. Therefore, letter string length as it relates to chunking or serially processing is not a distinguishing factor between fluent and non-fluent readers for high frequency words. The unit of automaticity may be beyond the word level for measuring reading fluency.

For the pilot study, there were mixed results. For second graders, both fluent and non-fluent readers took longer for the six letter string than the three letter string. What this implies is that both non-fluent and fluent readers may be processing the words serially. However, the fact that the difference in time was not significant for either group argues for the fact that both groups actually processed the words as chunks. This finding is counter to the old argument that non-fluent readers will process the words serially and fluent readers will process the words as chunks and argues for the new theory that the unit of automaticity may need to be beyond the single word level.

Fourth grade fluent and non-fluent readers had different processing methods as shown by the fact that non-fluent readers took longer with three letter words (may be processing six letter words as chunks and three letter words serially) while fluent readers took longer with six letter words (may be processing words serially). This is a conundrum in that according to the old argument, it should be non-fluent readers who process words serially but who are showing instead a propensity to chunk six letter words. The fact that the time differences were not significant however, argues for the fact that both groups were actually processing the words as chunks – a finding counter to the old argument and in favor of the new that the unit of automaticity may be beyond the single word level. This finding also points out the importance of not just looking at letter string differences but finding out if those differences are significant.

The sixth grade group findings are difficult to interpret due to the fact that there was only one participant in the non-fluent group. However, the fluent reader group took longer with three letter words than six letter words meaning they may be processing three letter words serially and six letter words as chunks, but the difference in time was not significant indicating that the fluent readers were actually processing the words as chunks. The finding with this group of students is inconclusive as a comparison between fluent and non-fluent readers was not possible.

It should be noted that none of the elementary groups from the pilot study mimicked the findings from the college group with regard to initial time differences between six and three letter words. However, all of the groups in the pilot study mimicked the college group findings with regard to whether or not the time difference between the two letter strings was significant – none of them were significant indicating all groups (college, second, fourth and six graders) whether fluent or non-fluent were processing the words as chunks. Therefore, automaticity at the word level should not be used to distinguish between fluent and non-fluent readers.

Lexical Decision Task – Letter String Length of Low Frequency Words

The findings for the college students with regard to letter string lengths for low frequency words were different from the findings for high frequency words. Both fluent and non-fluent college students took longer to process six letter low frequency words than three letter low frequency words indicating they were processing the words serially. This finding is counter to the argument that fluent readers would process the words as chunks. Also interesting is the finding that the difference in processing times for six and three letters words for the non-fluent group was not significant indicating that the non-fluent group was actually processing the words as chunks – while the difference in processing times for the fluent groups was found to be significant indicating that they actually were processing the words serially. Both findings are counter to the early argument that fluent readers process holistically and non-fluent readers process serially. Again, both findings argue for the new theory that the unit of automaticity may need to go beyond the single word level in order to measure reading fluency.

The pilot study had some mixed results. Second grade non-fluent readers took longer with three letter words and second grade fluent readers took longer with six letter words. This implies non-fluent readers were processing six letter words as chunks while processing three letter words serially while fluent readers were processing words serially. However, the difference in time between the letter strings was not significant for either group indicating both groups were actually processing the words as chunks.

Both fluent and non-fluent readers in the fourth and six grades took longer with six letter words than three letter words indicating both groups in both grades were processing the low frequency words serially. However, the difference in time between the two letter strings was not significant for the fourth grade fluent and non-fluent readers or the sixth grade fluent readers indicating the words were actually being processed as chunks. There was only one person in the non-fluent sixth grade group so a comparison could not be made between the two groups for this grade making it inconclusive as to whether or not the two groups were processing words differently.

The findings of the pilot study, like the findings of the college group, are counter to the old argument that fluent readers process words as chunks and non-fluent readers process words serially. The new argument that the unit of automaticity may need to go beyond the single word in order to distinguish between fluent and non-fluent readers also appears to be supported with the findings of both studies.

The unit of automaticity at the word level did not prove to be a viable method of distinguishing fluent readers from non-fluent readers in either the oral reading assessment or the lexical decision task; the former assessment looking at words in isolation and the later assessment looking at words in context of meaning. What did appear to be possible factors were vocabulary and spelling as well as a possible third route for processing words that contains an as yet fully developed semantic module that may contain a spelling component.

Sentence

As the oral reading assessment addressed the unit of automaticity being at the word level *without* a comprehension component and the lexical decision task addressed the unit of automaticity being the word level *with* a comprehension component, the sentence assessment addressed the unit of automaticity at the single sentence level with a comprehension component.

The college group non-fluent readers read the sentence significantly faster than the fluent readers and they performed only slightly less (3%) well on the multiple choice question. If using the old argument, we would have expected fluent readers to read the sentence faster and do significantly better on the multiple choice question. However, because the non-fluent readers read the sentence significantly faster than the fluent readers and did not do significantly less well than the fluent readers on the multiple choice question, it appears as though both fluent and non-fluent readers are equally good at retaining the gist of one sentence long enough to answer the multiple choice question correctly – showing the gist of the sentence they retained was correct and they therefore comprehended what they read. This finding suggests that automaticity at the sentence level is not enough to distinguish fluent readers from non-fluent readers at the college level – both groups are equally capable of retaining the gist of one sentence in their phonological loop long enough to answer the question correctly. This could be do to the gist of one sentence not placing too much of a cognitive load on the phonological loop in that the participant could continue to repeat the sentence over and over long enough to answer the question – there was no interference from another sentence to disrupt their basic understanding of the one sentence.

The findings are mixed for the pilot study. Second grade non-fluent readers read the sentence faster (though not significantly faster) and did significantly less well on the multiple choice question. This finding implies the non-fluent readers were not able to retain the gist of the sentence and were not able to answer the multiple choice question correctly – showing they did not comprehend it, and supports the new argument that fluent readers would be better able to retain the gist of the sentence and therefore be better able to answer the multiple choice question. A finding that suggests the unit of automaticity at the single sentence level may be sufficient to distinguish a fluent reader from non-fluent reader in the second grade. It could be that second grade non-fluent readers are attempting to retain the whole sentence in their phonological loop instead of a gist of the sentence and this process placed too much of a load on their phonological loop, preventing their ability to answer the question correctly.

Both fourth and sixth grade non-fluent readers read the sentence slower than fluent readers (though not significantly slower). The fourth grade non-fluent readers also did less well with answering the multiple choice question. The non-fluent fourth graders may not have developed the ability to retain just the gist of a sentence and were attempting to rehearse the whole sentence in their phonological loop, creating too much of a load and leading to an inability to answer the multiple choice question. The fourth grade findings appear to support the new argument that fluent readers would be better able to retain the gist of a sentence and therefore be better able to answer the multiple choice question. However, since the difference between the fluent and non-fluent groups was not significant the finding actually fails to support the argument. It appears as though the unit of automaticity needs to go beyond the single sentence level in order to distinguish between fluent and non-fluent readers. Due to the fact that there was only one participant in the non-fluent sixth grade group, the findings for this group was inconclusive. However, it should be noted that the sixth grade fluent group read the sentence faster and had 100% correct on the multiple choice question – indicating that this group was very good at retaining the gist of the sentence.

It should be noted that the findings of the pilot study do not mimic the findings of the college group, indicating the groups were behaving differently with regard to speed, accuracy and gist on the sentence assessment. The introduction of the trend for non-fluent readers to do less well on the multiple choice question, raises the possibility that the non-fluent readers have not developed a good method of retaining just the gist of a sentence long enough to answer the multiple choice question. This in ability to answer the multiple choice question could be due to placing too much of a load on the phonological loop by trying to retain and rehearse the whole sentence. If this is what is occurring it leads to the possibility that the non-fluent readers have yet to develop a good metacognitive skill for monitoring what they are reading while they are reading it. They may be taking each word in the sentence at face value instead of its relationship to the other words in the sentence, a relationship which leads to a metacognitive understanding or gist of the sentence being developed.

Paragraphs Delivered Sentence-by-Sentence

The purpose of this assessment was to see if the ability to retain the gist of multiple sentences is a distinguishing characteristic between fluent and non-fluent readers. According to the theory presented in this paper, fluent readers will be better able to retain the gist of multiple sentences (retain them in the phonological loop) long enough to correctly answer multiple choice questions concerning the passage of text they had just read. The unit of automaticity being at the multiple gist level. To further make the distinction between the quality of gist being retained, two levels of questions were asked – knowledge and inferential. The theory being that there will be mixed results for each level of question – fluent and non-fluent readers doing equally as well on the knowledge level questions but non-fluent readers doing less well than fluent readers on the inferential level questions.

College non-fluent readers read slower than fluent readers and did less well on the questions – both knowledge and inferential. However, it should be noted that they did not read significantly slower or do significantly less well on the questions. The fact that they did less well on the questions suggests support for the new theory that the ability to retain the gist of multiple sentences is a distinguishing characteristic between fluent and non-fluent readers. However, the fact that these differences were not significant does not support this theory because the non-fluent group did not read significantly slower or get significantly more questions wrong. It could be the non-fluent readers didn't so much as read slower as they took longer to study each sentence before moving on to the next sentence. If this is what they were doing, it could be that they were trying to memorize the sentence instead of just trying to retain the gist of it before moving on to the next sentence.

The pilot study mimics the findings of the college group with the exception of the second grade group. Within the second grade group, the non-fluent readers got significantly more of the inferential level questions wrong. This finding provides support for the theory that the ability to carry multiple gist is a distinguishing characteristic between fluent and non-fluent readers in the second grade. It could simply be that the fourth and sixth graders along with the college students in this study have progressed to the point of being able to carry multiple gist well enough to answer the inferential multiple choice questions correctly. However, it could also be due to the fact that since the participants knew the sentence, once presented and read, would disappear before the next sentence appeared, took longer to read and study the sentence before moving on to the next sentence and so on for the rest of the passage of text; thereby, utilizing a metacognitive skill of self monitoring to enhance their chances of being able to answer the questions they knew would follow -- something that would be much easier to do with an assessment whereby only one sentence is available at a time (with no time limit on how long they could study it). It could also be true that second graders have yet to develop this metacognitive skill and could not employ it during the assessment.

Conclusions and Implications for the Classroom

There were various types of assessments presented in this study. The point of using these different assessments was to determine if speed and accuracy in the form of an adjusted words per minute (adjwpm) could be a valid measure or predictive of reading fluency and to find out if reading speed, accuracy, or unit of automaticity were distinguishing characteristics between fluent and non-fluent readers. Arguments for and against reading speed and accuracy as distinguishing characteristics were presented. As well as an argument that the unit of automaticity may be a possible distinguishing characteristic between the two groups was presented.

Assessing Reading Fluency

With regard to the first two questions being asked of whether or not an adjwpm is a valid measure or predictive of reading fluency as defined in this paper, the findings for both studies strongly lend support for the argument against. With regard to the third question of what distinguishes a fluent reader from a non-fluent reader, only the unit of automaticity at the single or multiple sentence levels was found to be significant and therefore viable measuring tools for the second grade group. However, there is evidence to suggest accuracy on multiple choice questions following either one or multiple sentences may also provide clues as to who is fluent and who is not fluent across *all* grades as non-fluent readers in each grade group *consistently* made more errors on the multiple choice questions than fluent readers across both studies. This trend only happened for the sentence and paragraph delivered sentence-by-sentence assessments. A trend supporting the theory that the unit of automaticity needs to go beyond a single word unit. The findings also support the theory that reading speed and accuracy alone are not distinguishing characteristics of fluent and non-fluent readers. It is therefore strongly suggested that these two variables stop being used as measuring tools in and of themselves. The implications of these findings being that instructors must stop using inappropriate measuring tools to tell if a student is a fluent reader and must instead start using tools that explicitly measure reading comprehension as found by the fourth and sixth grade groups in the lexical decision task where both were faster but only sixth graders had fewer errors. The speed and accuracy assessments would be better suited to measuring and developing a student's vocabulary not their reading fluency. It is also recommend that drills clearly promoting reading speed alone be stopped and drills teaching students to tap into their metacognitive skills of self-monitoring be incorporated. Teaching students to "think" about what they are reading while they are reading it may result in slower reading times but would develop better comprehension of what is being read.

There is much work to be done. The first step being proposed is that a longitudinal study be conducted to investigate this possible "third" processing route whereby words are processed through the grapheme to phoneme to (in early stages of development) semantic route. It may be that this isn't the specific pathway taken by those students who read fast and make a lot of errors or those students who read slow and make a lot of errors, but right now these students are falling between the cracks when using an adjusted words per minute argument that only takes speed and accuracy into consideration as the grapheme to phoneme conversion route only covers those students who read fast and make few errors and the visual lexicon to semantic route only covers those students who read slow and make few errors – where it is being argued the first requires no comprehension and the second requires comprehension. Also recommend for further study is the trend found across all grades and across both studies where fluent readers consistently answer more of the questions (inferential) correctly than their non-fluent reader counterparts. A study that incorporates a metacognitive component to determine if fluent readers are tapping into this process while non-fluent readers are not, resulting in better comprehension by the fluent readers.

As a caveat: it must be noted that because the pilot study consisted of very small sample sizes in each of the grades and each of the grades tested way above their grade level on the Woodcock Johnson assessment that these findings must be taken with caution. It should also be noted that thirty minutes of assessment time seems to be a little long for all grade groups. Fatigue could be a contributing factor to the findings and an effort should be made to develop a study that would eliminate this possibility. However, the fact that the trends hold across both studies and all grades argues strongly for conducting further studies of these questions – using longitudinal studies of students as they progress from grade to grade. Having a longitudinal study with larger samples sizes and shorter assessments would lead to the ferreting out of the specific differences between the fluent and non-fluent readers. It would also take into consideration "maturation" that occurs naturally when learning to read, including such things as vocabulary and spelling capabilities. Only in this way can it be determined if the differences occur with regard to automaticity at the word, sentence or multiple sentence level; whether it be a difference in the route the words are being processed through; whether it be a difference in ability to use their metacognitive skills sufficiently to self-monitor their comprehension during reading; or whether it be a combination of all three (automaticity, processing route, metacognitive monitoring) working together. One thing is sure, reading speed and accuracy is not a valid measure of reading fluency, nor is it a predictor of reading fluency, nor are they distinguishing characteristics between fluent and non-fluent readers of the participants in these studies.

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Appendix A

Consent Forms
(IRB# 0408S62606)

A.1 College Students'

Your have been invited to participate in a research study of "Reading Fluency" – a study of the way reading fluency is assessed. Please read this form before signing it.

This study is being conducted by: Mrs. Shirley Alt, PhD Candidate, University of Minnesota
Dr. S. Jay Samuels, Professor, University of Minnesota

Background: The purpose of this study is to assess the reliability and validity of reading fluency assessments.

Procedures: If you agree to participate in this study, you will be asked to do the following things:

1) Look at a computer screen.
2) Read a list of words, a string of letters, some sentences, and some paragraphs of text.
3) Press a specific letter on the keyboard to indicate if a string of letters is a word or not a word.
4) Press a specific letter on the keyboard to indicate your choice of answers to some multiple choice questions.

The study will take approximately 30 minutes to complete.

Risks and Benefits of Participating in the Study: This study has no known risks or benefits associated with it.

Confidentiality: The records of this study will be kept strictly confidential. Any publication of findings will not include any information to identify a participant. Even the researcher will not be able to discern what person each data set belongs to as they are only identified by a file number. Research records will be kept in a locked file in a locked office at the University of Minnesota and only the researcher will have access to the office or the file.

Voluntary Nature of the Study: Your decision to participate in this study will not affect your current or future relationship with the University of Minnesota.

Contacts and Questions: Please feel free to share with the researcher (Shirley Alt) any questions or concerns you may have.

If you would like, you may keep a copy of this consent form for your records.

Statement of Consent: I have read the above information and consent to participate in the reading fluency study.

Signature of Parent ________________________________ Date__________
Signature of Researcher____________________________ Date__________

Assessing Reading Fluency

A.2 Elementary Students'

Your son(s) and/or daughter(s) have been invited to participate in a research study of "Reading Fluency" – a study of the way reading fluency is assessed. Please read this form before signing it.

This study is being conducted by: Mrs. Shirley Alt, PhD Candidate, University of Minnesota
Dr. S. Jay Samuels, Professor, University of Minnesota

Background: The purpose of this study is to assess the reliability and validity of reading fluency assessments.

Procedures: If you agree to permit your child(ren) to participate in this study, they will be asked to do the following things:

1) Look at a computer screen.
2) Read a list of words, a string of letters, some sentences, and some paragraphs of text.
3) Press a specific letter on the keyboard to indicate if a string of letters is a word or not a word.
4) Press a specific letter on the keyboard to indicate their choice of answers to some multiple choice questions.

The study will take approximately 30 minutes per student to complete.

Risks and Benefits of Participating in the Study: This study has no known risks or benefits associated with it.

Confidentiality: The records of this study will be kept strictly confidential. Any publication of findings will not include any information to identify a participant. Even the researcher will not be able to discern what person each data set belongs to as they are only identified by a file number. Research records will be kept in a locked file in a locked office at the University of Minnesota and only the researcher will have access to the office or the file.

Voluntary Nature of the Study: Your decision to permit your child(ren) to participate in this study will not affect your or their current or future relationship with their teachers, the school, the school principle, or the University of Minnesota.

Contacts and Questions: Please feel free to share with the researcher (Shirley Alt) and/or the school principle any questions or concerns you may have.

If you would like, you may keep a copy of this consent form for your records.

Statement of Consent: I have read the above information and consent to have my child(ren) participate in the reading fluency study.

Signature____ Date__________
Signature of Researcher____________________________ Date__________

Appendix B

Participant Questionnaires
(IRB# 0408S62606)

B.1 College Students'

Please read and answer the following questions (circle the appropriate answer):

1.	Are you a boy or a girl?	Boy		Girl
3.	Are you left-handed or right-handed?	Left	Right	Both
4.	Are you a native speaker of English?	Yes		No
5.	Do you speak any other languages? If yes, what?__________________	Yes		No
6.	Is English the primary language at home?	Yes		No
7.	Do you wear glasses or contacts?	Yes		No
8.	Do you need to wear glasses or contacts to read?	Yes		No
9.	Are there any comments you'd like to make (i.e., I am dyslexic)?			

B.2 Elementary Students’ Parents

Please read and answer the following questions concerning your child (circle the appropriate answer):

1.	Your child is in which grade?	2nd	4th	6th
2.	Is your child a boy or a girl?	Boy		Girl
3.	Is your child left-handed or right-handed?	Left	Right	Both
4.	Is your child a native speaker of English?	Yes		No
5.	Does your child speak any other languages? If yes, what?__________________	Yes		No
6.	Is English the primary language at home?	Yes		No
7.	Does your child wear glasses or contacts?	Yes		No
8.	Does your child need to wear glasses or contacts to read?	Yes		No

9. Are there any comments you’d like to make (i.e., My child is dyslexic)?

Appendix C

Notes and Instructions for Assessor
(IRB# 0408S62606)

1) Set up a schedule of random order for the oral reading and computer portions of the study.
    a. Randomly assign each participant to either have the oral reading portion first or the computer portion first by tossing a coin.
        i. Heads denotes oral reading first and computer portion second.
        ii. Tails denotes computer portion first and oral reading second.
2) Welcome participant to the study
    a. For College Students - Ask participant to read the consent form and if they are willing to participant in the study to please sign it.
3) Explain that they are going to read from a list of words until told to stop.
    a. Pick up the assessor's version of the Woodcock Johnson Word List.
    b. Tell the participant that they may turn over their list of words and begin reading them..
    c. Place an "x" by any missed words on the assessor's form.
        i. Missed words are words that are mispronounced and not self-corrected within three seconds or words skipped over entirely.
    d. Stop participant when they have failed to correctly read six consecutive items in a category on the assessor's form -- this is the ceiling score or grade level value.
4) Participant will either proceed on to the oral reading passage of text or begin the computer portion of the study.
    a. The order of which was determined prior to the participants arrival as denoted in number 1.
5) If the oral reading occurs first then proceed on to sub-section a., if the computer portion of the study occurs first then skip on to number 6.
    a. Tell the participant that they may hear a buzzer during their reading, but that they are to ignore it and continue reading until told to stop.
    b. Set the timer.

c. Have the participant turn over their reading passage and begin reading.
d. Start the timer.
e. Circle any errors during the reading.
    i. Errors are words mispronounced and not self-corrected within three seconds or skipped over entirely.
f. Put a slash (/) at the spot where the timer buzzed – this is the words read per minute score.
g. Calculate their words read per minute score by subtracting the number of errors made from the total words read per minute and make a note on the sheet.

6) Before the participant begins the computer portion of the study you must enter a code (i.e., 030110 OL meaning March, 01, 2010 Oral Last) for the participants name, type in the name of the study and hit enter. This will bring you to the first instruction screen of the study.
    a. Be sure to let the participants know that they should feel free to ask questions (at any time during the study) if they don't understand the instructions or are unclear about what they need to do.
    b. Explain that the first thing they will see is an introduction screen with instructions on how to proceed.
    c. Explain that there will be a "practice" Lexical Decision Task assessment followed by a reminder screen on how to proceed with the actual Lexical Decision Task assessment.
    d. This will be followed by another instruction screen followed by a sentence they will need to read.
    e. Once they have read the sentence and answered the question, they will see an instruction screen on how to proceed for the paragraphs they will be reading and the multiple choice questions they will need to answer.
    f. This will be followed by a "thank you" screen indicating that they are finished with the computer portion of the study.
    g. If the computer portion occurred first, return to number 5) and proceed with the oral reading portion of the study.
7) Once all of the assessments have been taken, give the participants a debriefing form explaining the purpose of the study and how they can obtain a copy of the results.

Appendix D

Woodcock Johnson Word Lists
(IRB# 0408S62606)

D.1 Participant's Copy

is	chair	pedestrian
you	because	yacht
and	beautiful	mathematician
up	slowly	almanac
cat	watch	relativity
stop	early	instigator
come	heavy	prognosis
jump	already	judicious
help	laugh	causation
book	hurry	vernacular
play	largest	alkali
sun	expert	philanthropist
blue	evening	naïve
two	passage	inordinate
no	receive	carnivorous
boy	gasoline	artesian
little	calendar	quintessence
bed	human	heterogeneous
milk	twilight	cygnet
car	certain	expostulate
swim	dwarf	tableau
fast	furnace	zymolysis
down	amazement	tuberculous
rug	torpedo	surreptitious
with	vehicle	internecine
find	departure	taupe
said	yardage	quadruped
night	urgent	epistrophe
sleep	mechanic	dossier
after	wounded	picayune
woman	zenith	oenology
summer	petroleum	zeitgeist
table	stigma	
work	spectacular	
stove	cologne	
ground	miser	
airplane	hysterical	

Assessing Reading Fluency

D.2 Assessor's Copy

1. is ______
2. you______
3. and______
4. up ______
5. cat ______
6. stop______
7. come______
8. jump______
9. help______
10. book______
11. play______
12. sun______
13. blue______
14. two______
15. no ______
16. boy______
17. little______
18. bed______
19. milk______
20. car______
21. swim______
22. fast______
23. down______
24. rug______
25. with______
26. find______
27. said______
28. night______
29. sleep______
30. after______
31. woman______
32. summer ______
33. table______
34. work______
35. stove______
36. ground______
37. airplane ________
38. chair______
39. because______
40. beautiful_____
41. slowly______
42. watch______
43. early______
44. heavy______
45. already______
46. laugh______
47. hurry______
48. largest______
49. expert______
50. evening______
51. passage______
52. receive______
53. gasoline_____
54. calendar_____
55. human ______
56. twilight______
57. certain______
58. dwarf______
59. furnace______
60. amazement___
61. torpedo______
62. vehicle______
63. departure____
64. yardage______
65. urgent ______
66. mechanic____
67. wounded_____
68. zenith______
69. petroleum____
70. stigma______
71. spectacular___
72. cologne______
73. miser ______
74. hysterical_____
75. pedestrian____
76. yacht ______
77. mathematician___
78. almanac______
79. relativity______
80. instigator______
81. prognosis______
82. judicious______
83. causation______
84. vernacular_____
85. alkali_______
86. philanthropist__
87. naïve_______
88. inordinate_____
89. carnivorous____
90. artesian_______
91. quintessence___
92. heterogeneous___
93. cygnet_______
94. expostulate_____
95. tableau_______
96. zymolysis______
97. tuberculous____
98. surreptitious___
99. internecine____
100. taupe_______
101. quadruped____
102. epistrophe____
103. dossier______
104. picayune_____
105. oenology_____
106. zeitgeist______

Appendix E

Oral Reading Passages
(IRB# 0408S62606)

E.1 College
SAT 2010

Picture-taking is a technique both for annexing the objective world and for expressing the singular self. Photographs depict objective realities that already exist, though only the camera can disclose them. And they depict an individual photographer's temperament, discovering itself through the camera's cropping of reality. That is, photography has two antithetical ideals: in the first, photography is about the world, and the photographer is a mere observer who counts for little; but in the second, photography is the instrument of intrepid, questing subjectivity and the photographer is all. These conflicting ideals arise from a fundamental uneasiness on the part of both photographers and viewers of photographs toward the aggressive component in "taking" a picture. Accordingly, the ideal of a photographer as observer is attractive because it implicitly denies that picture-taking is an aggressive act. The issue, of course, is not so clear-cut. What photographers do cannot be characterized as simply predatory or as simply, and essentially, benevolent. As a consequence, one ideal of picture-taking or the other is always being rediscovered and championed. An important result of the coexistence of these two ideals is a recurrent ambivalence toward photography's means. Whatever the claims that photography might make to be a form of personal expression on a par with painting, its originality is inextricably linked to the powers of a machine. The steady growth of these powers has made possible the extraordinary informativeness and imaginative formal beauty of many photographs, like Harold Edgerton's high-speed photographs of a bullet hitting its target or of the swirls and eddies of a tennis stroke. But as cameras become more sophisticated, more automated, some photographers are tempted to disarm themselves or to suggest that they are not really armed, preferring to submit themselves to the limits imposed by pre-modern camera technology because a cruder, less high-powered machine is thought to give more interesting or emotive results, to leave more room for creative accident. For example, it has been virtually a point of honor for many photographers, including Walker Evans and Cartier-Bresson, to refuse to use modern equipment. These photographers have come to doubt the value of the camera as an instrument of "fast seeing." Cartier-Bresson, in fact, claims that the modern camera may see too fast. This ambivalence toward photographic means determines trends in taste. The cult of the future (of faster and faster seeing) alternates over time with the wish to return to a purer past — when images had a handmade quality. This nostalgia for some pristine state of the photographic enterprise is currently widespread and underlies the present-day enthusiasm for daguerreotypes and the work of forgotten nineteenth-century provincial photographers. Photographers and viewers of photographs, it seems, need periodically to resist their own knowingness.

E.2 Sixth Grade
AGS Level 6 - Form A

“Marcus, how do you suppose a scientist makes an important discovery?” Roberta asked as she peered into the microscope and examined the specimen. “My dad says it’s all luck,” replied Marcus, thumbing through his notes. “It can’t be that simple” Roberta countered. “My Aunt Natalie is a biologist. She has college degrees hanging in her office. Every day she leaves our apartment to work in her lab. Most days she doesn’t get home until after we’ve eaten supper? When I ask her what she’s working on, she always says, “I’m trying to find answers.” I have a problem,” interrupted Marcus. “I can’t find my notes, and I need them before the bell rings.” “That’s what we’re talking about, Marcus!” Roberta piped. “Problem solving – that’s what scientists do.” “Well, if you couldn’t find your notes, what would you do?” asked Marcus. I’ve observed that you’ve only looked for your notes in your notebook. I would look somewhere else. Maybe they fell out where you used them last,” Roberta replied. Marcus sat for a moment thinking quietly. Then he remembered. He got up and walked to the back of the room. “As Aunt Natalie says, ‘You have to explore and look for clues. You go down a lot of blind alleys. You fail sometimes, but you exhaust all the possibilities, and what you find may surprise you!” said Roberta. “Clues, patterns – I love playing detective and solving riddles!” Marcus exclaimed. Then Roberta heard Marcus call out, “Eureka! We found them!” Roberta turned to see Marcus crawling out from under the tables in the back of the room, a bunch of wrinkled papers in his hand. “You were right!” said Marcus. “I just needed to retrace my steps. Hey, do you suppose teamwork has something to do with great discoveries?”

E.3 Fourth Grade
AGS Level 4 - Form B

Have you ever dreamed about setting a world record? Charles Osborne set one, but not because he wanted to. Believe it or not, he had the hiccups for sixty-seven years! How and why could that happen? Doctors can tell us what takes place inside the body when a person hiccups, but nobody can say why hiccups happen. More important to most people is making those hiccups go away. There are plenty of ideas around for doing that.

Got the hiccups? Some people claim that a spoonful of sugar will help. Others promise that pinching and rubbing your earlobes works every time. Something that stops and restarts your breathing, like a cough or a sneeze, might help too.

Try a good scare – that's always fun! If there's nothing around to scare you, try holding your breath as long as you can. Still have the hiccups? Water might help. Try drinking it while holding your breath, or laughing with a mouthful of water. (Just don't sit too close to anyone!)

Did one of these cures work for you? It's a sure bet that each one worked for someone – but nothing worked for poor Mr. Osborne.

E.4 Second Grade
AGS Level 2 - Form A

The little shoemaker worked very hard all day. He made many shoes, but he did not make much money. One day, he had only enough leather to make one pair of shoes. Before he went to bed, he cut out the shoes. He set the pieces aside to make into shoes in the morning.

The next day, the shoemaker went down to his shop very early. Much to his surprise, the shoes were finished. A man came into the shop and spotted the shoes. He tried them on and liked them so much that he bought them.

Now the shoemaker had enough money to buy leather for two more pairs of shoes. He cut the leather out that night. In the morning he found two beautiful pairs of shoes. What a wonderful surprise!

Appendix F

Computer Instructions
(IRB# 0408S62606)

F.1 Introduction

"Welcome to the Reading Fluency Experiment!

Before we begin the experiment, we'd like to give you a chance to go through a "practice" set.

For this experiment you will be presented with a string of letters. This string of letters will either be a word or it will NOT be a word.

If it is a word, please press the "L" key on the keyboard with your right index finger.

If it is NOT a word, please press the "A" key on the keyboard with your left index finger.

In preparation of getting ready to start the experiment, I would now like you to place your right index finger on the "L" key of the keyboard and your left index finger on the "A" key of the keyboard.

The practice set is just like the experiment and is simply designed to give you a chance to practice pushing the "L" key for a word and the "A" key for when it is NOT a word.

Please press "any" key when you are ready to begin the practice set."

F.2 Reminder for Lexical Decision Task Assessment

“ Okay, now that you have had a chance to practice pressing the “L” key for when the string of letters is a word and pressing the “A” key when the string of letters is not a word, we are ready to begin the experiment.

Press “any” key to begin the experiment.”

F.3 Open Maze Sentence

“You will now be given a sentence to read and you must make a decision based on the sentence.

Once you have read the sentence, press “any” key to continue on to the decision making part.

Once you press this key, the sentence will disappear and a multiple choice question will appear.

When given a decision to make please press the appropriate keyboard key.

For instance:

If you choose option “a”, please be sure to press the “a” key on the keyboard.

If you choose option “b”, please be sure to press the “b” key on the keyboard.

If you choose option “c”, please be sure to press the “c” key on the keyboard.

If you choose option “d”, please be sure to press the “d” key on the keyboard.

Again, remember after reading the sentence you may press “any” key to proceed on to the question.

You may press “any” key now to begin.”

Assessing Reading Fluency

F.4 Passage of Text

"For this section of the experiment, you will be reading a passage of text and answering some questions.

Once you have read a passage of text, you may press "any" key to proceed. The passage of text will disappear and you will be asked to recall the content of the passage by answering some questions about what you have just read.

The questions are in a multiple-choice format and you will need to press a key to indicate your answer. For instance:

If you believe "a" is the correct answer then you would need to press the "a" key on the keyboard.

If you believe "b" is the correct answer then you would need to press the "b" key on the keyboard.

If you believe "c" is the correct answer then you would need to press the "c" key on the keyboard.

If you believe "d" is the correct answer then you would need to press the "d" key on the keyboard.

You may press "any" key when you are ready to begin reading the passage."

F.5 Passage of Text – Sentence by Sentence

For this section of the experiment you will be presented with a passage to read. However, this time the passage will be presented sentence by sentence.

You will be presented with a sentence and once you have read it, you will press “any key” to continue on to the next sentence. The sentence will disappear and the next sentence in the passage will appear and so on.

You will do this until the last sentence has been presented.

Once the last sentence has been presented you will be asked some questions about the passage you have just read. These questions will be in multiple-choice format, and just like the early questions you must:

Press the “a” key on the keyboard if you choose option “a.”
Press the “b” key on the keyboard if you choose option “b.”
Press the “c” key on the keyboard if you choose option “c.”
Press the “d” key on the keyboard if you choose option “d.”

Please press “any” key when you are ready to begin reading the sentences.

F.6 Closing Screen

“That is it, you are all done with the computer portion of the study!

Appendix G

Lexical Decision Task Word/Non-Word Sets
(IRB# 0408S62606)

G.1 Practice Set

Three Letter Words	Four Letter Words	Five Letter Words	Six Letter Words	Three Letter Non-Words	Four Letter Non-Words	Five Letter Non-Words	Six Letter Non-Words
dog	wind	space	ground	Zif	Clab	Snarb	Plinge
box	land	state	change	Cos	Flyn	Blorp	Bloice
man	fire	voice	school	Lin	Crat	Blomb	Thream
bag	town	horse	friend	Bof	Tove	Tromb	Geight
car	time	group	branch	Mof	Ryre	Blant	Bource
top	list	learn	spring	Zin	Wabe	Blick	Tealth
wet	ball	right	bought	Dif	Braf	Cheal	Smarch
sun	girl	three	street	Fic	Blin	Fubbe	Storst
men	blue	whole	length	Gri	Sime	Vloun	Strink
set	tree	ting	square	Gli	Bave	Strim	Blaste
bus	word	track	course	Fru	Vath	Schok	Ploste
fun	cold	night	chance	Res	Vlop	Kleek	Kridge
oil	book	light	phrase	Pos	Mabe	Satch	Bletch
leg	fish	earth	stream	Ter	Stee	Bripp	Streez
bed	door	house	breath	Faw	Truf	Fradt	Crinze
job	face	world	string	Ert	Steb	Mipth	Churmf
map	room	mouth	weight	Lol	Tect	Strus	Stilpe
sky	name	eight	speech	Keb	Shom	Plart	Sterth
ice	home	shape	church	Avs	Shid	Fough	Treast
end	lin	store	fourth	Lau	Nald	Tauge	schent

G.2 Assessment Set

THREE LETTER

Low Frequency (23.4 – 33.3 SFI*)	High Frequency (45.9 – 67.7 SFI*)	Non-Words
urn (30.6)	top (65.0)	urx
gib (30.3)	set (67.7)	gix
ace (33.3)	buy (61.8)	acx
ven (32.1)	hit (60.1)	alx
alp (32.6)	few (67.1)	sov
sop (23.9)	aid (55.2)	irx
ire (30.2)	bat (56.4)	yav
nim (23.4)	raw (54.6)	cuv
yaw (30.6)	pad (51.3)	toz
cur (29.6)	nor (60.3)	loz
tot (30.6)	bin (45.9)	kiy
lox (27.7)	ram (47.2)	loy
loo (29.5)	ore (54.0)	wav
yak (31.3)	fro (46.6)	vev
wan (30.5)	rye (46.4)	nym

FOUR LETTER

Low Frequency (22.1 – 30.7 SFI*)	High Frequency (50.3 – 67.7 SFI*)	Non-Words
hart (24.6)	wind (63.8)	hazt
rife (30.5)	face (64.6)	luzu
luau (29.9)	line (67.7)	mazl
maul (30.5)	heat (61.8)	whut
zing (22.1)	mark (61.8)	wexr
whet (30.5)	acid (52.5)	vixe
weir (30.7)	coal (57.8)	rize
vive (29.6)	fame (51.2)	wevt
dint (30.5)	gear (50.8)	fuxl
cuss (30.2)	oats (50.3)	xizn
weft (29.8)	soul (52.8)	gaxl
furl (23.7)	host (51.2)	yoxd
yond (23.3)	odor (50.8)	cuxz
xion (22.1)	mate (52.6)	dixt
gaol (23.3)	mere (51.3)	zixg

FIVE LETTERS

Low Frequency (17.0 – 29.6 SFI*)	High Frequency (46.2 – 64.6 SFI*)	Non-Words
motif (28.3)	state (63.3)	nixty
abaca (23.2)	voice (63.2)	moxif
tenon (22.5)	group (64.6)	raxel
belle (26.4)	track (57.5)	rixor
bards (23.2)	mouth (61.1)	aboca
natal (23.9)	shape (60.7)	tevon
briar (23.3)	basic (59.3)	bavds
sprit (27.2)	death (59.6)	naxal
conic (25.0)	model (57.1)	bryar
voile (18.1)	guide (57.7)	gaxes
nifty(25.2)	valve (46.2)	spryt
ravel (18.1)	trial (53.2)	wexts
rigor (28.6)	pluck (46.9)	covic
gages (17.0)	vocal (49.9)	tryss
tress (29.6)	moral (48.9)	voxle

SIX LETTERS

Low Frequency (24.6 – 31.7 SFI*)	High Frequency (47.2 – 62.1 SFI*)	Non-Words
morass (30.6)	phrase (58.0)	spynet
gneiss (31.7)	branch (61.2)	blomey
spinet (24.6)	chance (60.0)	baxque
blimey (29.6)	purple (54.4)	stycco
barque (29.6)	forest (60.6)	scolar
stucco 28.4)	center (62.1)	coveus
scalar (27.8)	spread (59.8)	bryker
coleus (26.0)	motion (58.3)	deorth
broker (28.9)	volume (56.3)	divher
dearth (30.5)	plural (54.6)	maxtis
dither (30.5)	estate (49.0)	covpus
mantis (30.7)	divine (46.8)	enogma
corpus (30.7)	fright (49.9)	dozmer
enigma (30.5)	ginger (47.2)	gnoiss
dormer (30.5)	impact (50.5)	mozass

* denotes Standard Frequency Index as defined by The American Heritage Word Frequency Book (1971).

Appendix H

Open Maze Sentence Assessment
(IRB# 0408S62606)

College:

1. Early _______ of hearing loss is _____ by the fact that the other senses are able to compensate for __moderate amounts of loss, so that people frequently do not know that their hearing is imperfect (*on-line SAT*)
   a. discovery. . . indicated
   b. development. . . prevented
   c. treatment. . . facilitated
   d. detection. . . complicated

Sixth Grade:

1. Alex’s shirt was wet with _______ after he finished playing a hard game of basketball. *(AGS Passage Comprehension – Level 6)*
   a. perspiration
   b. pores
   c. appreciation
   d. oxygen

Fourth Grade:

1. The skater _____ gracefully across the smooth, frozen lake. *(AGS Passage Comprehension – Level 4)*
   a. swam
   b. stumbled
   c. delivered
   d. glided

Second Grade:

1. Remember to _____ your friend for the surprise. (AGS Passage *Comprehension – Level 2)*
   a. give
   b. show
   c. wish
   d. thank

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Appendix I

Computer Paragraphs
(IRB# 0408S62606)

I.1 College
SAT 2010

It has been known for many decades that the appearance of sunspots is roughly periodic, with an average cycle of eleven years. Moreover, the incidence of solar flares and the flux of solar cosmic rays, ultraviolent radiation, and x-radiation all vary directly with the sunspot cycle. But, after more than a century of investigation, the relation of these and other phenomena, known collectively as the solar-activity cycle, to terrestrial weather and climate remains unclear. For example, the sunspot cycle and the allied magnetic-polarity cycle have been linked to periodicities discerned in records of such variables as rainfall, temperature, and winds. Invariably however, the relation is weak, and commonly of dubious statistical significance.

Effects of solar variability over longer terms have also been sought. The absence of recorded sunspot activity in the notes kept by European observers in the seventeenth and early eighteenth centuries has led some scholars to postulate a brief cessation of sunspot activity at that time (a period called the Maunder minimum). The Maunder minimum has been linked to a span of unusual cold in Europe extending from the sixteenth to the early nineteenth centuries. The reality of the Maunder minimum has yet to be established, however, especially since the records that Chinese naked-eye observers of solar activity made at that time appear to contradict it. Scientists have also sought evidence of long-term solar periodicities by examining indirect climatologically data, such as fossil records of the thickness of ancient tree rings. These studies, however, failed to link unequivocally terrestrial climate and the solar-activity cycle, or even the to confirm the cycle's past existence.

1. The author's primary focus is to:
    a. Present two competing scientific theories about solar activity and to evaluate supporting evidence.
    b. Give a brief overview of the most current research into solar activity.

   c. Discuss the difficulties involved in linking terrestrial phenomena with solar activity.
   d. Outline the specific reasons why a problem in solar physics has not yet been solved.

2. According to the passage, late seventeenth- and early eighteenth-century Chinese records are important because:
   a. They establish that the solar activity at the time of the Maunder minimum did not significantly vary from its present pattern.
   b. They suggest that the Maunder minimum may not have affected climate.
   c. They suggest that the Maunder minimum might be valid for Europe only.
   d. They establish the existence of a span of unusually cold weather worldwide at the time of the Maunder minimum.

3. The solar-activity cycle includes all of these phenomena except:
   a. The flux of solar cosmic rays
   b. Periodic changes in ultraviolet radiation
   c. The Northern Lights
   d. Variations in x-radiation

4. Chinese naked-eye observations of solar activity appear to contradict:
   a. European ultraviolet radiation measurements in the early nineteenth-century.
   b. Tree ring data from the former Soviet Union
   c. The cessation of sunspot activity during the seventeenth- and eighteenth-centuries.
   d. Geological data indicating magnetic polarity during the eighteenth-century.

I.2 Sixth Grade
AGS Passage 39

Towering nearly three miles above the lowlands of western Washington, snow-capped Mount Rainier is a beautiful sight. Volcanologists, scientist who study volcanoes, call Mount Rainier a "sleeping beauty." Although it looks peaceful and harmless, Mount Rainier is, in fact, a volcano that could awaken at any moment.

Even though only a small eruption would likely occur during our lifetimes, just a hiccup of lava or steam from Mount Rainier could send massive avalanches of mud, rock, and ice speeding down the mountain. Studies of the soil around Mount Rainier show that 5,600 years ago, an avalanche roared down the mountain and buried the surrounding area under hundreds of feet of debris. These days, that occurrence would be much more serious because now the very same area is thickly populated.

If Mount Rainier behaves like most volcanoes, volcanologists will observe warning signs of an eruption, such as underground fumbling, steam coming from cracks in the rocks, or a bulge in the mountainside. Once the signs appear, residents will likely have weeks, or even months, o evacuate the area.

1. Why does the author use the word awaken in the sentence "Mount Rainier is, in fact, a volcano that could awaken. . . "?
   a. to make the volcano seem less scary
   b. to describe the nature of an eruption
   c. to relate back to the term *sleeping beauty*
   d. to emphasize the peaceful scenery

2. What is the main idea of this passage?
   a. Volcanologists work hard to determine when a volcano will erupt.
   b. People living near Mount Rainier will have time to evacuate.
   c. Mount Rainier has become thickly populated.
   d. Mount Rainier is a disaster waiting to happen.

3. Why is Mount Rainier referred to as a "*sleeping beauty*?"
   a. The mountain scenery is beautiful.
   b. It is owned by Walt Disney.
   c. It looks peaceful but could erupt at any time.
   d. People like to camp on the mountain.

4. If an avalanche like the one that happened 5,600 years ago occurred today on Mount Rainier, which would most likely happen?
    a. The nearby houses would be buried under mud and rock.
    b. The nearby houses would burn down.
    c. People would rush to buy low-priced houses nearby.
    d. People who live nearby would sell their houses.

I.3 Grade 4
AGS Level 4 Form A

People have been taking baths for thousands of years. The Romans once had whole buildings for bathing, with different rooms for hot, warm, or cool baths. Hundreds of years ago, families in Finland built small wooden huts for baths called *saunas*. In the huts, people threw water on heated rocks. They sat on benches and sweated in clouds of steam. Then they cooled off by jumping in a cold stream or rolling in the snow. At one time doctors said baths would make people sick. Then many people stopped taking baths. They had to use perfume to cover up unpleasant smells.

Today we know that baths help keep us clean and healthy by washing away germs. So why would some people cover themselves with mud to feel better? Mud baths seem to warm up people's bodies and take away aches and pains. People may have gotten the idea for mud baths from watching pigs. Pigs roll around in the mud or throw dirt on themselves. The mud hardens and keeps the hot sun away, which helps the animals stay cool.

1. What would be a good name for this story?
    a. Many Kinds of Baths
    b. Roman Baths Then and Now
    c. Mud Baths Through the Ages
    d. Why Baths are Healthy

2. If you were going to have a sauna bath, what would you do?
    a. sit in a tub of warm, steam water heated by rocks
    b. take a cool, warm, or hot bath in a wooden building
    c. sweat a lot and then use perfume to cover the smell
    d. get very hot and then cool off with icy cold water

3. How are mud baths different for pigs than for people?
    a. Mud baths make pigs feel cooler but make people feel warmer.
    b. Hundreds of years ago, pigs did not take mud baths, but people did.
    c. Doctors once thought mud was good for pigs and bad for people.
    d. Mud baths make pigs clean but make people dirty.

4. Why did people stop taking baths?
    a. Water and soap became very hard to find.
    b. Doctors said baths would make people sick.
    c. There was not enough sun to heat the water.
    d. Saunas were so common that no one used bathtubs anymore

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I.4 Second Grade
AGS Level 2 Form A

The grasshopper was happy and content as he sat and sang on a leaf. He could not understand why the ants always worked so hard, even in summer. “Carrying grain in this heat! How crazy!”

Time passed and winter arrived. One day the hungry grasshopper came to the ants while they were drying their grain in the sun. “Will you give me some of your grain? You have so much!”

“But why didn’t you put some away last summer?” they replied.

“I didn’t have time,” answered the grasshopper. I had to sing.”

“If you sang in the summer, then you can dance in the winter!” said the ants, laughing.

1. What did the ants do?
    a. They sang and danced together.
    b. They worked hard carrying grain.
    c. They carried leaves in the heat.
    d. They sat on a leaf in the sun.

2. What did the grasshopper ask the ants?
    a. to show him how to work
    b. to help him sing and dance
    c. to help him search for grain
    d. to share their food with him

3. Why wouldn’t the ants help the grasshopper?
    a. They thought he should sing more.
    b. They knew he hadn’t worked
    c. They didn’t know how to help him.
    d. They wanted time to play.

4. What lesson does the story teach?
    a. If you work too hard others will not like you.
    b. You should be happy and content.
    c. It is harder to dance than it is to sing.
    d. It’s important to work and plan ahead.

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Appendix J

Computer Sentence by Sentence Paragraphs
(IRB# 0408S62606)

J.1 College
SAT 2010

Warm-blooded animals have elaborate physiological controls to maintain constant body temperature (in humans, 37 degrees C). Why then during sickness should temperature ruse, apparently increasing stress on the infected organism? It has long been known that the level of serum iron in animals falls during infection. Garibaldi first suggested a relationship between fever and iron. He found that microbial synthesis of siderophores – substances that bind iron – in bacteria of the genus *Salmonella* declined at environmental temperatures above 37 degrees C and stopped at 40.3 degrees C. Thus, fever would make it more difficult for an infecting bacterium to acquire iron and thus to multiply. Cold-blooded animals were used to test this hypothesis because their body temperature can be controlled in the laboratory. Kluger reported that of iguanas infected with the potentially lethal bacterium *A.hydrophilia*, more survived at temperatures of 42 degrees C than at 37 degrees C, even though healthy animals prefer the lower temperature. When animals at 42 degrees C were injected with an iron solution, however, mortality rates increased significantly. Research to determine whether similar phenomena occur in warm-blooded animals is sorely needed.

1. The passage is primarily concerned with attempts to determine:
    a. the role of siderophores in the synthesis of serum iron
    b. new treatments for infections that are caused by *A.hydrophilia*
    c. the function of fever in warm-blooded animals
    d. iron utilization in cold-blooded animals

2. According to the passage, Garibaldi determined which of the following?
    a. That there is a relationship between the synthesis of siderophores in bacteria of the genus *Salmonella* and environmental temperature
    b. That serum iron is produced through microbial synthesis
    c. That microbial synthesis of siderophores in warm-blooded animals is more efficient at higher temperatures
    d. That bacteria of the genus *Salmonella* require iron as a nutrient

3. Which of the following can be inferred about warm-blooded animals solely on the basis of information in the passage?
    a. Warm-blooded animals require more iron in periods of stress than they do at other times.
    b. The body temperatures of warm-blooded animals cannot be easily controlled in the laboratory
    c. In warm-blooded animals, bacteria are responsible for the production of siderophores, which, in turn, make iron available to the animal
    d. Warm-blooded animals are more comfortable at an environmental temperature of 37 degrees C than they are at a temperature of 42 degrees C.

4. If it were to be determined that “similar phenomena occur in warm-blooded animals”, which of the following, assuming each is possible, is likely to be the most effective treatment for warm-blooded animals with bacterial infections?
    a. Administering a medication that lowers the animals’ body temperature
    b. Injecting the animals with an iron solution
    c. Administering a medication that makes serum iron unavailable to bacteria
    d. Providing the animals with reduced-iron diets

.

J.2 Sixth Grade
AGS Passage Comprehension Level 6

Saturday morning had come. All the summer world was bright and fresh, and brimming with life. There was a song in every heart; and if the heart was young the music issued at the lips. There was cheer in every face and a spring in every step. The locust-trees were in bloom and the fragrance of the blossoms filled the air. Cardiff Hill, beyond the village and above it, was green with vegetation. It lay just far enough away to seem a Delectable Land, dreamy and inviting.

Tom appeared on the sidewalk with a bucket of whitewash and a long-handled brush. He surveyed the fence. All gladness left him and deep melancholy settled down upon his spirit. Thirty yards of board fence nine feet high. Life to him seemed hollow, and existence but a burden. Sighing, he dipped his brush and passed it along the topmost plank. He repeated the operation and did it again. Tom compared the insignificant whitewashed streak with the far-reaching continent of unwhitewashed fence, and sat down on a tree-box discouraged. Jim came skipping out at the gate with a tin pail, and singing “Buffalo Gals.”

1. When does the story take place?
    a. on a Saturday morning in fall
    b. on a Sunday morning in summer
    c. on a Saturday morning in summer
    d. on a Sunday evening in spring

2. What does the “far-reaching continent” refer to?
    a. the green fields of Cardiff Hill
    b. the place where Tom lived
    c. the broad lands of North America
    d. the section of fence that needed to be painted

3. Why do you think Mark Twain ended the passage with the sentence about Tom’s friend Jim?
    a. to show how much Jim and Tom were alike
    b. to contrast Tom’s work responsibilities with Jim’s carefree attitude
    c. to introduce the reader to a new song
    d. to prove how much more important work is than play

4. After Tom painted the first section of the fence, how did he feel?
    a. depressed
    b. exhausted
    c. puzzled
    d. enraged

.

Assessing Reading Fluency

J.3 Grade 4
AGS Passage Comprehension Level 4

"Gung Hay Fat Choy" means "Happy New Year" in Chinese. In late January or early February, Chinese people all over the world celebrate the Chinese New Year. For them, the New Year is a time to remember the customs of their homeland. Banners of red and gold flutter overhead. Their colors represent happiness and wealth. Glittering parades led by huge dragons bring cheers of delight. The sound of firecrackers, once believed to chase away imaginary monsters, can be heard through the streets. Even the foods are special. Each dish bears a name that wishes diners good fortune. For the children, the best part of the celebration is their little red envelopes. Tucked inside ach envelope is a gift of money that carries with it a special wish for good luck in the new year.

1. What are "banners of red and gold"?
    a. kites
    b. flags
    c. special hats
    d. bright lanterns
2. What might be the name of a food dish to celebrate the Chinese New Year?
    a. Very Lucky Steamed Pork
    b. Dragon Delight
    c. Many Sad Vegetables
    d. Beef and Noodles Fit for a Monster
3. What do people hope for in the year ahead?
    a. firecrackers and parades
    b. a trip around the world
    c. special food
    d. happiness and good fortune
4. What is the main purpose of the paragraph?
    a. To make a special wish for good luck
    b. To compare American and Chinese customs
    c. To teach about people from other lands
    d. To describe a Chinese holiday

.

J.4 Second Grade
AGS Passage Comprehension Level 2

As Ben crawled through the doorway, he growled. He was wearing a fuzzy brown hat. He had brown paper paws on both of his hands and both of his feet. His tail was a rolled-up sock. As he raised up on his knees, he roared loudly.

Little Hannah screamed with joy.

“What a great act!” said Dad. Then Dad and Hannah clapped their hands.

1. What is Ben being in the story?
   a. a horse
   b. a baby
   c. a father
   d. a bear

2. How did Hannah feel when she saw Ben?
   a. afraid
   b. happy
   c. angry
   d. sad

3. What is this story mostly about?
   a. Ben putting on a show.
   b. Ben scaring his sister.
   c. Hannah and Dad playing together.
   d. Ben getting very angry.

4. Why did Dad and Hannah clap?
   a. They were playing a clapping game.
   b. They liked watching Ben.
   c. They heard some music.
   d. They were trying to scare Ben away.

.

Appendix K

Debriefing Form
(IRB# 0408S62606)

The major goal of this study is to assess various reading fluency assessments, specifically whether or not they are valid.

As you may or may not know, reading fluency has become a very hot topic and is now a goal all teachers have for their students. It is also a controversial topic because of the different conceptual views surrounding how reading fluency should be defined and measured. Some researchers believe reading fluency is defined by three characteristics – reading speed, reading accuracy, and reading expression. Other researchers are of the opinion that these three characteristics are only secondary characteristics and as such are, by themselves, insufficient. Our position is that a true definition of reading fluency must therefore be expanded to include a “comprehension” component such that fluent readers are able to decode and comprehend at the same time.

Fidelity to this definition is critical to the appropriate assessment of reading fluency. To properly assess a student’s reading fluency, the assessment must include a measure of the student’s comprehension of a text they have just read. Most assessments available to schools do not assess reading fluency in this way; they assess reading fluency based on a faulty definition, only measuring speed of reading. This is problematic for a number of reasons, only one of which is that some students can decode with reasonable speed, accuracy and expression but fail to understand what they’ve read. This s not measuring reading fluency and results in improper interventions and placement of students. The end result of which is the failure to meet AYP (adequate yearly progress).

Though there is no issue with how teachers are “developing” reading fluency, with the “high stakes” tests now taking place as a result of the No Child Left Behind Act, the “assessment” of reading fluency has become critical. Therefore, it is our position that teachers must be given the tools to appropriately assess their student’s reading fluency if they hope to meet the school’s AYP goals.

Assessing Reading Fluency

In this study you were asked to decide if a string of letters is a word or not a word, read some sentences and make a judgment, and then finally to read some paragraphs and make choices between possible answers. The time it takes to make these decisions, read these sentences and paragraphs and choose answers tells us something about how you are processing the information. We will be looking at these factors to determine the difference between how a fluent reader and a non-fluent reader process words, sentences and paragraphs.

If you want to learn more about the theoretical and methodological background for the study you just completed, please feel free to look up the following articles:

Ackerman, P.L. (1987). Individual differences in skill reading: An integration of psychometric and information processing perspectives. Psychological Bulletin, 102, 3-27.

Allington, R. (1983). Fluency: The neglected reading goal. Reading Teacher, 36(6) 556-561.

Hudson, R. F., Lane, H. B., & Pullen, P. C. (2005). Reading fluency assessment and instruction: What, why, and how? The Reading Teacher, 58(8), 702-714.

Samuels, S. J. (2006). Reading Fluency: It's Past, Present, and Future. In T. Rasinski, C. Blachowicz, and K. Lems (Eds.) Fluency Instruction Research Based Best Practices.

Thank you!

Appendix L

Sign-up Sheet
(IRB# 0408S62606)

Monday, January 11, 2010

9:00 AM – 9:30 AM	____
9:30 AM – 10:00 AM	____
10:00 AM – 10:30 AM	____
10:30 AM – 11:00 AM	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
11:00 AM – 11:30 AM	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
11:30 AM – 12:00 PM	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
12:00 PM – 12:30 PM	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
12:30 PM – 1:00 PM	____
1:00 PM – 1:30 PM	____
1:30 PM – 2:00 PM	____
2:00 PM – 2:30 PM	____

Tuesday, January 12, 2010

9:00 AM – 9:30 AM	____
9:30 AM – 10:00 AM	____
10:00 AM – 10:30 AM	____
10:30 AM – 11:00 AM	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
11:00 AM – 11:30 AM	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
11:30 AM – 12:00 PM	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
12:00 PM – 12:30 PM	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
12:30 PM – 1:00 PM	____

Appendix M

Tables
(IRB# 0408S62606)

Table 4.1

Reading Fluency Criteria

Reading Fluency Score	Knowledge Level Criteria		Inferential Level Criteria
.00	0% Correct	and	0% Correct
.25	1% to 50% Correct	and	0% Correct
.50	0% Correct	and	1% to 50% Correct
.75	1% to 50% Correct	and	1% to 50% Correct
1.00	51% to 100% Correct	and	0% Correct
1.25	0% Correct	and	51% to 100% Correct
1.50	100% Correct	and	1% to 50% Correct
1.75	1% to 50% Correct	and	100% Correct
2.00	51% to 100% Correct	and	51% to 100% Correct

Table 4.2.

Correlation between Reading Fluency and Adjusted WPM (Speed and Accuracy) for College Students

		Reading Fluency	ORadjwpm
Reading Fluency	Pearson Correlation	1	.053
	Sig. (2-tailed)		.710
	N	52	52
ORadjwpm	Pearson Correlation	.053	1
	Sig. (2-tailed)	.710	
	N	52	52

ORadjwpm represents the adjusted reading words per minute on the oral reading passage.

Table 4.2a.

Correlation between Reading Fluency and Adjusted WPM (Speed and Accuracy) for Second Grade

		Reading Fluency	ORadjwpm
Reading Fluency	Pearson Correlation	1	.262
	Sig. (2-tailed)		.279
	N	19	19
ORadjwpm	Pearson Correlation	.262	1
	Sig. (2-tailed)	.279	
	N	19	23

ORadjwpm represents the adjusted reading words per minute on the oral reading passage

Table 4.2b.

Correlation between Reading Fluency and Adjusted WPM (Speed and Accuracy) for Fourth Grade

		Reading Fluency	ORadjwpm
Reading Fluency	Pearson Correlation	1	.456
	Sig. (2-tailed)		.057
	N	18	18
ORadjwpm	Pearson Correlation	.456	1
	Sig. (2-tailed)	.057	
	N	18	24

ORadjwpm represented the adjusted reading words per minute on the oral reading passage

Table 4.2c.

Correlation between Reading Fluency and Adjusted WPM (Speed and Accuracy) for Sixth Grade

		Reading Fluency	ORadjwpm
Reading Fluency	Pearson Correlation	1	.179
	Sig. (2-tailed)		.522
	N	15	15
ORadjwpm	Pearson Correlation	.179	1
	Sig. (2-tailed)	.522	
	N	15	21

**ORadjwpm represented the adjusted reading words per minute on the oral reading passage*

Table 4.3.

Speed and Accuracy as a Predictor of Reading Fluency for College Students

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.053[a]	.003	-.017	.631345

a. Predictors: (Constant), ORadjwpm

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.056	1	.056	.140	.710[a]
	Residual	19.930	50	.399		
	Total	19.986	51			

a. Predictors: (Constant), ORadjwpm
b. Dependent Variable: Reading Fluency

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.778	.373		2.088	.042
	ORadjwpm	.001	.003	.053	.374	.710

a. Dependent Variable: Reading Fluency

Table 4.3a.

Speed and Accuracy as a Predictor of Reading Fluency for Second Grade

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.262[a]	.068	.014	.839544

a. Predictors: (Constant), ORAdjwpm

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.880	1	.880	1.248	.279[a]
	Residual	11.982	17	.705		
	Total	12.862	18			

a. Predictors: (Constant), ORAdjwpm
b. Dependent Variable: Reading Fluency

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.641	.600		1.069	.300
	ORAdjwpm	.005	.005	.262	1.117	.279

a. Dependent Variable: Reading Fluency

Table 4.3b.

Speed and Accuracy as a Predictor of Reading Fluency for Fourth Grade

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.456[a]	.208	.158	.759549

a. Predictors: (Constant), ORAdjwpm

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.422	1	2.422	4.198	.057[a]
	Residual	9.231	16	.577		
	Total	11.653	17			

a. Predictors: (Constant), ORAdjwpm
b. Dependent Variable: Reading Fluency

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.689	.896		-.768	.454
	ORAdjwpm	.012	.006	.456	2.049	.057

a. Dependent Variable: Reading Fluency

Table 4.3c.

Speed and Accuracy as a Predictor of Reading Fluency for Sixth Grade

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.179[a]	.032	-.042	.859958

a. Predictors: (Constant), ORAdjwpm

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.319	1	.319	.432	.522[a]
	Residual	9.614	13	.740		
	Total	9.933	14			

a. Predictors: (Constant), ORAdjwpm
b. Dependent Variable: Reading Fluency

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.532	1.016		.524	.609
	ORAdjwpm	.004	.006	.179	.657	.522

a. Dependent Variable: Reading Fluency

Table 4.4.

Oral Reading Speed for College Students

Group Statistics

Fluency		N	Mean	Std. Deviation	Std. Error Mean
ORwpm	1.00	11	130.11809	27.124298	8.178284
	2.00	12	130.08367	29.486345	8.511975

ORwpm stands for words per minute read on the oral reading assessment.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ORwpm	assumed	.296	.592	.003	21	.998	.034424	11.849020	-24.606	24.675
	not assumed			.003	20.999	.998	.034424	11.804153	-24.513	24.582

ORwpm stands for words per minute read on the oral reading assessment.

Table 4.4a

Oral Reading Speed for Second Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
ORwpm	1.000	6	106.70983	18.071004	7.377456
	2.000	12	125.15367	44.947921	12.975347

ORwpm stands for words per minute read on the oral reading assessment.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95 percent Confidence Interval of the Difference Lower	Upper
ORwpm	assumed	3.067	.099	-.955	16	.354	-18.443	19.306	-59.372	22.484
	not assumed			-1.236	15.66	.235	-18.443	14.926	-50.141	13.253

ORwpm stands for words per minute read on the oral reading assessment.

Table 4.4b

Oral Reading Speed for Fourth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
ORwpm	1.00	5	128.55480	8.535367	3.817132
	2.00	9	160.09378	26.271757	8.757252

ORwpm represents words read per minute on the oral reading assessment

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ORwpm	assumed	1.256	.284	-2.569	12	.025	-31.538	12.276	-58.286	-4.791
	not assumed			-3.301	10.566	.007	-31.538	9.553	-52.670	-10.407

ORwpm represents words read per minute on the oral reading assessment

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Assessing Reading Fluency

Table 4.4c

Oral Reading Speed for Sixth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
ORwpm	1.000	3	162.13933	67.343022	38.880512
	2.000	8	169.89400	24.779039	8.760713

ORwpm stands for words per minute read on the oral reading assessment.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95 percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ORwpm	assumed	5.514	.043	-.297	9	.773	-7.754	26.091	-66.778	51.269
	not assumed			-.195	2.207	.862	-7.754	39.855	-164.733	149.22

ORwpm stands for words per minute read on the oral reading assessment.

Table 4.5.

Oral Reading Accuracy for College Students

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
ORperWrong	1.00	11	.02101	.024126	.007274
	2.00	12	.01648	.012974	.003745

ORperWrong stands for the percentage of words missed on the oral reading assessment.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ORperWrong	assumed	1.893	.183	.568	21	.576	.004529	.007979	-.012	.021
	not assumed			.553	15.043	.588	.004529	.008182	-.012	.021

ORperWrong stands for the percentage of words missed on the oral reading assessment.

Table 4.5a

Oral Reading Accuracy for Second Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
ORperWrong	1.000	5	.02406	.013450	.006015
	2.000	12	.02005	.027078	.007817

ORperWrong stands for the percentage of words missed on the oral reading assessment.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95 percent Confidence Interval of the Difference: Lower	Upper
ORperWrong	assumed	.987	.336	.311	15	.760	.004010	.012885	-.02345	.03147
	not assumed			.407	14.196	.690	.004010	.009863	-.01711	.02513

ORperWrong stands for the percentage of words missed on the oral reading assessment.

Table 4.5b

Oral Reading Accuracy for Fourth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
ORperWrong	1.000	7	.01628	.011750	.004441
	2.000	9	.00748	.006908	.002303

ORperWrong stands for the percentage of words missed on the oral reading assessment.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95 percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ORperWrong	assumed	3.631	.077	1.878	14	.081	.008800	.004686	-.001	.018
	not assumed			1.759	9.163	.112	.008800	.005003	-.002	.020

ORperWrong stands for the percentage of words missed on the oral reading assessment.

Table 4.5c

Oral Reading Accuracy for Sixth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
ORperWrong	1.000	3	.01908	.009720	.005612
	2.000	8	.00421	.004676	.001653

ORperWrong represents the percentage of errors made on the oral reading assessment

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95 percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ORPerError	assumed	4.178	.071	3.563	9	.006	.014871	.004173	.005	.024
	not assumed			2.542	2.357	.107	.014871	.005850	-.006	.036

ORPerError represents the percentage of errors made on the oral reading assessment

Table 4.6.

Lexical Decision Task Speed for Fluent and Non-Fluent Readers for College

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
HFspeed	1.00	11	665.45455	80.791539	24.359565
	2.00	12	844.16667	441.926739	127.573261
LFspeed	1.00	11	910.00000	202.682017	61.110927
	2.00	12	1299.16667	328.729188	94.895942

HF speed stands for latency times for high frequency word
LFspeed stands for latency times for low frequency word

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HFspeed	assumed	2.556	.125	-1.319	21	.201	-178.71	135.52	-460.54	103.12
	not assumed			-1.376	11.79	.194	-178.71	129.87	-462.22	104.80
LFspeed	assumed	.802	.381	-3.378	21	.003	-389.16	115.20	-628.74	-149.59
	not assumed			-3.448	18.51	.003	-389.16	112.87	-625.82	-152.50

HF speed stands for latency times for high frequency word
LFspeed stands for latency times for low frequency word

Table 4.6a

Lexical Decision Task Speed for Fluent and Non-Fluent Readers for Second Grade

Group Statistics

	Fluent	N	Mean	Std. Deviation	Std. Error Mean
HFMean	1.00	5	1751.60	774.018	346.151
	2.00	10	1581.40	529.290	167.376
LFmean	1.000	5	2102.20	851.066	380.608
	2.000	10	1928.40	713.724	225.699

HF mean stands for mean latency for high frequency words.
LF mean stands for mean latency for low frequency words.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
HFMean	Equal assumed	.523	.482	.505	13	.622	170.200	336.877	-557.58	897.980
	Equal not assumed			.443	5.945	.674	170.200	384.494	-772.74	1113.149
LFmean	Equal assumed	.030	.865	.418	13	.683	173.800	415.522	-723.88	1071.481
	Equal not assumed			.393	6.927	.706	173.800	442.496	-874.77	1222.374

HF mean stands for mean latency for high frequency words.
LF mean stands for mean latency for low frequency words.

Table 4.6b

Lexical Decision Task Speed for Fluent and Non-Fluent Readers for Fourth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
HFmean	1.000	7	1133.57	210.259	79.471
	2.000	6	1335.17	406.641	166.010
LFmean	1.000	7	1446.57	260.883	98.605
	2.000	6	1945.50	918.756	375.080

HF mean stands for mean latency for high frequency words
LF mean stands for mean latency for low frequency words

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95 percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HFmean	Equal assumed	2.489	.143	-1.150	11	.275	-201.595	175.295	-587.417	184.226
	Equal not assumed			-1.095	7.23	.308	-201.595	184.052	-633.930	230.740
LFmean	Equal assumed	3.806	.077	-1.382	11	.194	-498.929	360.903	-1293.27	295.414
	Equal not assumed			-1.286	5.69	.248	-498.929	387.825	-1460.47	462.618

HF mean stands for mean latency for high frequency words
LF mean stands for mean latency for low frequency words

Table 4.6c

Lexical Decision Task Speed for Fluent and Non-Fluent Readers for Sixth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
HFmean	1.000	3	769.00	89.956	51.936
	2.000	6	1051.67	300.304	122.599
LFmean	1.000	3	1351.67	300.650	173.580
	2.000	6	1620.67	840.908	343.299

HF mean stands for mean latency for high frequency words
LF mean stands for mean latency for low frequency words

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95 percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HFmean	Equal assumed	1.024	.345	-1.54	7	.166	-282.66	182.65	-714.55	149.25
	Equal not assumed			-2.12	6.43	.075	-282.66	133.14	-603.17	37.83
LFmean	Equal assumed	1.013	.348	-.522	7	.618	-269.00	515.26	-1487.31	949.31
	Equal not assumed			-.699	6.77	.508	-269.00	384.68	-1184.76	646.76

HF mean stands for mean latency for high frequency words
LF mean stands for mean latency for low frequency words

Table 4.7

Lexical Decision Task Accuracy for College Students

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
HFperWrong	1.00	11	.04909	.043001	.012965
	2.00	12	.02833	.026572	.007671
LFperWrong	1.00	11	.51636	.154937	.046715
	2.00	12	.46250	.186943	.053966

HFperWrong stands for percentage of missed high frequency words.
LFperWrong stands for percentage of missed low frequency words.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HFperWrong	assumed	5.127	.034	1.406	21	.174	.020758	.014760	-.0099	.0514
	not assumed			1.378	16.399	.187	.020758	.015064	-.0111	.0526
LFperWrong	assumed	.347	.562	.748	21	.463	.053864	.071982	-.0958	.2035
	not assumed			.755	20.809	.459	.053864	.071377	-.0946	.2023

HFperWrong stands for percentage of missed high frequency words.
LFperWrong stands for percentage of missed low frequency words.

Table 4.7a

Lexical Decision Task Accuracy for Second Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
HFperWrong	1.000	5	.32020	.170607	.076298
	2.000	10	.20840	.129360	.040907
LFperWrong	1.000	5	.68020	.170592	.076291
	2.000	10	.69340	.215091	.068018

HFperWrong stands for percentage of missed high frequency words.
LFperWrong stands for percentage of missed low frequency words.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HFperWrong	Equal assumed	.336	.572	1.424	13	.178	.1118	.0785	-.057	.281
	Equal not assumed			1.291	6.395	.241	.1118	.0865	-.096	.320
LFperWrong	Equal assumed	.053	.822	-.119	13	.907	-.0132	.1108	-.252	.226
	Equal not assumed			-.129	10.061	.900	-.0132	.1022	-.240	.214

HFperWrong stands for percentage of missed high frequency words.
LFperWrong stands for percentage of missed low frequency words.

Table 4.7b

Lexical Decision Task Accuracy for Fourth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
HFperWrong	1.000	7	.13314	.060889	.023014
	2.000	6	.20250	.198296	.080954
LFperWrong	1.000	7	.57371	.166843	.063061
	2.000	6	.75267	.163885	.066906

HFperWrong stands for percentage of missed high frequency words.
LFperWrong stands for percentage of missed low frequency words

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig. 2-tailed	Mean Difference	Std. Error Difference	Lower	Upper
HFperWrong	Equal assumed	2.623	.134	-.884	11	.396	-.069	.0784	-.2420	.103
	Equal not assumed			-.824	5.80	.442	-.069	.0841	-.2769	.138
LFperWrong	Equal assumed	.015	.905	-1.94	11	.078	-.178	.0920	-.3816	.023
	Equal not assumed			-1.94	10.75	.078	-.178	.0919	-.3818	.023

HFperWrong stands for percentage of missed high frequency words.
LFperWrong stands for percentage of missed low frequency words

Table 4.7c

Lexical Decision Task Accuracy for Sixth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
HFperWrong	1.000	3	.02233	.009238	.005333
	2.000	6	.21667	.377112	.153955
LFperWrong	1.000	3	.59467	.157469	.090914
	2.000	6	.49433	.200281	.081765

HFperWrong stands for percentage of missed high frequency words.
LFperWrong stands for percentage of missed low frequency words.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HFperWrong	Equal assumed	2.702	.144	-.862	7	.417	-.1943	.2259	-.727	.3386
	Equal not assumed			-1.262	5.01	.263	-.1943	.1540	-.590	.2013
LFperWrong	Equal assumed	.483	.510	.751	7	.477	.1003	.1336	-.2157	.4164
	Equal not assumed			.821	5.187	.448	.1003	.1222	-.2106	.4112

HFperWrong stands for percentage of missed high frequency words.
LFperWrong stands for percentage of missed low frequency words.

Table 4.8.

Lexical Decision Task Speed of Six Letter String Length Minus Three Letter String Length for College Students

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
HFDifference	1.00	11	-7.6906	22.47015	6.77500
	2.00	12	-.5889	3.31099	.95580
LFDifference	1.00	11	1.3579	3.38826	1.02160
	2.00	12	1.8533	4.29721	1.24050

HFDifference stands for the difference between six and three letter high frequency words.
LFDifference stands for the difference between six and three letter low frequency words.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HF Difference	assumed	3.325	.082	-1.084	21	.291	-7.1017	6.549	-20.721	6.518
	not assumed			-1.038	10.398	.323	-7.1017	6.842	-22.268	8.064
LF Difference	assumed	.785	.386	-.305	21	.763	-.4953	1.624	-3.873	2.882
	not assumed			-.308	20.572	.761	-.4953	1.607	-3.841	2.850

HFDifference stands for the difference between six and three letter high frequency words.
LFDifference stands for the difference between six and three letter low frequency words.

One-Sample Test

		Test Value = 0					
						95% Confidence Interval of the Difference	
	Fluent	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Diff6Ltr3LtrHF	1.00	-1.497	10	.165	-.03173	-.0789	.0155
Diff6Ltr3LtrHF	2.00	-1.232	11	.244	-.50875	-1.4178	.4003
Diff6Ltr3LtrLF	1.00	1.901	10	.086	.07873	-.0135	.1710
Diff6Ltr3LtrLF	2.00	2.842	11	.016	.23383	.0527	.4149

Diff6Ltr3LtrHF stands for the difference between six and three letter high frequency words.
Diff6Ltr3LtrLF stands for the difference between six and three letter low frequency words.

Table 4.8a

Lexical Decision Task Speed of Six Letter String Length Minus Three Letter String Length for Second Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
HFdiff6and3	1.000	6	.0934	.26849	.10961
	2.000	12	.4249	.75413	.21770
LFdiff6and3	1.000	6	-.2474	.41548	.16962
	2.000	12	.2534	.41019	.11841

HFdiffand3 stands for the difference between six and three letter string for high frequency words.
LFdiff6and3 stands for the difference between six and three letter string for low frequency words.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95 percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HFdiff 6and3	Equal assumed	1.618	.222	-1.031	16	.318	-.3315	.3215	-1.013	.350
	Equal not assumed			-1.360	15.143	.194	-.3314	.2437	-.850	.187
LFdiff 6and3	Equal assumed	.150	.704	-2.43	16	.027	-.5007	.2059	-.930	-.064
	Equal not assumed			-2.42	9.983	.036	-.5007	.2068	-.961	-.03

HFdiff 6and3 stands for the difference between six and three letter strings for high frequency words.
LFdiff6and3 stands for the difference between six and three letter strings for low frequency words

One-Sample Test

		Test Value = 0					
						95% Confidence Interval of the Difference	
	Fluent	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Diff6Ltr3LtrHF	2.00	1.952	11	.077	.42491	-.0542	.9041
Diff6Ltr3LtrHF	1.00	.852	5	.433	.09337	-.1884	.3751
Diff6Ltr3LtrLF	2.00	2.140	11	.056	.25338	-.0072	.5140
Diff6Ltr3LtrLF	1.00	-1.45	5	.205	-.24738	-.6834	.1886

Diff6Ltr3LtrHF stands for the difference between six and three letter high frequency words.
Diff6Ltr3LtrLF stands for the difference between six and three letter low frequency words.

Table 4.8b

Lexical Decision Task Speed of Letter String Length for High Frequency Words for Fourth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
HFdiff6and3	1.000	7	-.0272	.22635	.08555
	2.000	9	.1312	.31484	.10495
LFdiff6and3	1.000	7	.1829	.68624	.25937
	2.000	9	.4025	.57664	.19221

HFdiff6and3 stands for the difference between six and three letter high frequency words.
LFdiff6and3 stands for the difference between six and three letter low frequency words.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95 percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HFdiff 6and3	Equal assumed	1.364	.262	-1.121	14	.281	-.1583	.1412	-.4613	.1446
	Equal not assumed			-1.170	13.951	.262	-.1583	.1354	-.4488	.1321
LFdiff 6and3	Equal assumed	.377	.549	-.696	14	.498	-.2195	.3154	-.896	.4570
	Equal not assumed			-.680	11.743	.510	-.2195	.3228	-.924	.4855

HFdiff 6and3 stands for the difference between six and three letter high frequency words.
LFdiff 6and3 stands for the difference between six and three letter low frequency words.

One-Sample Test

		Test Value = 0					
						95% Confidence Interval of the Difference	
	Fluent	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Diff6and3HF	2.00	1.250	8	.247	.13120	-.1108	.3732
Diff6and3HF	1.00	.466	4	.666	.06257	-.3105	.4356
Diff6and3LF	2.00	2.094	8	.070	.40245	-.0408	.8457
Diff6and3LF	1.00	-.047	4	.965	-.01500	-.9046	.8746

Diff6and3HF stands for the difference between six and three letter high frequency words.
Diff6and3LF stands for the difference between six and three letter low frequency words.

Table 4.8c

Lexical Decision Task Speed of Letter String Length for High Frequency Words for Sixth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
HFdiff6and3	1.000	3	-1.8707	3.31754	1.91538
	2.000	8	-6.0346	17.97341	6.35456
LFdiff6and3	1.000	3	2.1137	4.63308	2.67491
	2.000	8	2.9149	5.80601	2.05273

HFdiff6and3 stands for the difference between six and three letter high frequency words.
LFdiff6and3 stands for the difference between six and three letter low frequency words.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95 percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HFdiff 6and3	Equal assumed	1.122	.317	.386	9	.708	4.163	10.783	-20.229	28.557
	Equal not assumed			.627	8.09	.548	4.163	6.636	-11.109	19.437
LFdiff 6and3	Equal assumed	.000	.988	-.213	9	.836	-.801	3.768	-9.326	7.724
	Equal not assumed			-.238	4.59	.822	-.801	3.371	-9.704	8.101

HFdiff6and3 stands for the difference between six and three letter high frequency words.
LFdiff6and3 stands for the difference between six and three letter low frequency words.

One-Sample Test

	Fluent	Test Value = 0					
						95% Confidence Interval of the Difference	
		t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Diff6and3HF	2.00	-.950	7	.374	-6.03462	-21.0608	8.9915
Diff6and3LF	2.00	1.420	7	.199	2.91488	-1.9391	7.7688

Diff6and3rHF stands for the difference between six and three letter high frequency words
Diff6and3LF stands for the difference between six and three letter low frequency word.

One-Sample Test

	Fluent	N	Mean	Std. Deviation	Std. Error Mean
Diff6and3HF	1.00	1[a]	-5.1790	.	.
Diff6and3LF	1.00	1a	1.3100	.	.

a. t cannot be computed because the sum of caseweights is less than or equal 1.

Diff6and3HF stands for the difference between six and three letter high frequency words.
Diff6and3LF stands for the difference between six and three letter low frequency words.

Table 4.9.

Sentence Reading Speed for College Students

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
Sentwpm	1.00	11	226.7245	134.03698	40.41367
	2.00	12	132.4758	29.09252	8.39829

Sentwpm stands for words read per minute on the sentence assessment

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Sentwpm	assumed	23.832	.000	2.380	21	.027	94.24871	39.59705	11.902	176.595
	not assumed			2.283	10.864	.044	94.24871	41.27706	3.259	185.237

Sentwpm stands for words read per minute on the sentence assessment

Assessing Reading Fluency

Table 4.9a

Sentence Reading Speed for Second Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
Sentwpm	1.000	6	122.93867	31.960453	13.047800
	2.000	11	106.01345	44.561748	13.435873

Sentwpm stands for words per minute read on the sentence assessment.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Sentwpm	Equal assumed	3.845	.069	.817	15	.426	16.925	20.704	-27.206	61.056
	Equal not assumed			.904	13.587	.382	16.925	18.728	-23.358	57.209

Sentwpm stands for words per minute read on the sentence assessment.

Table 4.9b

Sentence Reading Speed for Fourth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
Sentwpm	1.000	7	169.37357	52.807651	19.959416
	2.000	9	195.53956	46.304842	15.434947

Sentwpm stands for words per minute read on the sentence assessment.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Sentwpm	Equal assumed	.577	.460	-1.055	14	.309	-26.165	24.793	-79.341	27.009
	Equal not assumed			-1.037	12.081	.320	-26.165	25.231	-81.099	28.767

Sentwpm stands for words per minute read on the sentence assessment.

Table 4.9c

Sentence Reading Speed for Sixth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
Sentwpm	1.000	3	119.02333	35.001527	20.208141
	2.000	8	221.27300	116.343780	41.133738

Sentwpm stands for words per minute read on the sentence assessment.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Sentwpm	Equal assumed	1.554	.244	-1.453	9	.180	-102.249	70.356	-261.407	56.908
	Equal not assumed			-2.231	8.960	.053	-102.249	45.829	-205.994	1.494

Sentwpm stands for words per minute read on the sentence assessment.

Table 4.10.

Sentence Multiple Choice Question Accuracy for College Students

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
SentAcc	1.00	11	.6364	.50452	.15212
	2.00	12	.6667	.49237	.14213

a. t cannot be computed because the standard deviations of both groups are 0.
SentAcc stands for percent correct on the comprehension question.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff*	Std. Error Difference	Lower	Upper
Sent Acc	assumed	.084	.775	-.146	21	.886	-.0303	.20796	-.46277	.40217
	not assumed			-.146	20.723	.886	-.0303	.20819	-.46361	.40300

Sent Acc stands for percent correct on the comprehension question.
**Diff stands for difference*

Table 4.10a

Sentence Multiple Choice Question Accuracy for Second Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
SentenceAcc	1.000	6	.00	.000	.000
	2.000	12	.42	.515	.149

SentenceAcc stands for accuracy on multiple choice questions regarding the sentence

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Sent Acc	Equal assumed	186.667	.000	-1.95	16	.069	-.417	.213	-.869	.036
	Equal not assumed			-2.80	11.00	.017	-.417	.149	-.744	-.089

Sent Acc stands for accuracy on multiple choice questions regarding the sentence

Table 4.10b

Sentence Multiple Choice Question Accuracy for Fourth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
SentAcc	1.000	4	.75	.500	.250
	2.000	9	.89	.333	.111

SentAcc stands for percent correct on the comprehension question.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
SentAcc	Equal assumed	1.323	.274	-.599	11	.561	-.139	.232	-.649	.372
	Equal not assumed			-.508	4.240	.637	-.139	.274	-.882	.604

SentAcc stands for percent correct on the comprehension question.

Assessing Reading Fluency

Table 4.10c

Sentence Multiple Choice Question Accuracy for Sixth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
SentAcc	1.000	0[a]	.	.	.
	2.000	8	1.00	.000	.000

a. t cannot be computed because at least one of the groups is empty.

SentAcc stands for percent correct on the comprehension question.

Table 4.11.

Sentence-by-Sentence Paragraph Speed for College Students

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
SbySPara	1	11	74.9206	16.68747	5.03146
	2	12	79.1152	22.20498	6.41003

SbySPara stands for mean wpm read on the paragraph of text delivered sentence-by-sentence.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95percent Confidence Interval of the Difference Lower	Upper
SbyS Para	assumed	.307	.585	-.508	21	.617	-4.19453	8.25270	-21.356	12.967
	not assumed			-.515	20.267	.612	-4.19453	8.14887	-21.178	12.789

SbyS Para stands for mean wpm read on the paragraph of text delivered sentence-by-sentence.

Table 4.11a

Sentence-by-Sentence Paragraph Speed for Second Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
SbSPara	1.000	5	72.40220	19.179955	8.577536
	2.000	12	72.61708	24.843551	7.171715

SbySPara stands for mean wpm read on the paragraph of text delivered sentence-by-sentence.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
SbyS Para	Equal assumed	.456	.510	-.017	15	.987	-.214883	12.49141	-26.839	26.409
	Equal not assumed			-.019	9.805	.985	-.214883	11.18068	-25.194	24.764

SbyS Para stands for mean wpm read on the paragraph of text delivered sentence-by-sentence.

Table 4.11b

Sentence-by-Sentence Paragraph Speed for Fourth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
SbySPara	1.000	4	115.59150	30.180918	15.090459
	2.000	9	126.02222	63.938891	21.312964

SbySPara stands for mean wpm read on the paragraph of text delivered sentence-by-sentence.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
SbyS Para	Equal assumed	1.539	.241	-.306	11	.765	-10.430	34.10824	-85.502	64.641
	Equal not assumed			-.399	10.796	.697	-10.430	26.11444	-68.040	47.179

SbyS Para stands for mean wpm read on the paragraph of text delivered sentence-by-sentence.

Table 4.11c

Sentence-by-Sentence Paragraph Speed for Sixth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
GSbySPara	1.000	1	118.20300	.	.
	2.000	8	183.78075	56.669677	20.035756

SbySPara stands for mean wpm read on the paragraph of text delivered sentence-by-sentence.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
SbyS Para	Equal assumed	.	.	-1.091	7	.311	-65.577	60.107	-207.708	76.553
	Equal not assumed			.	.	.	-65.577	.	.	.

SbyS Para stands for mean wpm read on the paragraph of text delivered sentence-by-sentence.

Table 4.12.

Sentence-by-Sentence Paragraph Multiple Choice Question Accuracy for College Students

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
SbyStotalPercentCorrect	1.00	11	.3409	.28002	.08443
	2.00	12	.4167	.26827	.07744
SbySpercentKcorrect	1.00	11	.5000	.38730	.11677
	2.00	12	.5417	.33428	.09650
SbySpercentIcorrect	1.00	11	.1818	.33710	.10164
	2.00	12	.2917	.25746	.07432

SbyStotalPercentCorrect stands for the total percent correct for all questions.
SbySpercentKcorrect stands for the total percent correct for knowledge questions.
SbySpercentIcorrect stands for the total percent correct for inferential questions.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95percent Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PercentCorrect	assumed	.057	.813	-.663	21	.515	-.07576	.11434	-.313	.162
	not assumed			-.661	20.630	.516	-.07576	.11457	-.314	.162
PercentKcorrect	assumed	.179	.677	-.277	21	.785	-.04167	.15048	-.354	.271
	not assumed			-.275	19.889	.786	-.04167	.15149	-.357	.274
PercentIcorrect	assumed	.143	.709	-.883	21	.387	-.10985	.12441	-.368	.148
	not assumed			-.872	18.694	.394	-.10985	.12591	-.373	.153

PercentCorrect stands for the total percent correct for all questions.
PercentKcorrect stands for the total percent correct for knowledge questions.
PercentIcorrect stands for the total percent correct for inferential questions.

Table 4.12a

Sentence-by-Sentence Paragraph Multiple Choice Question Accuracy for Second Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
SbystotalPercentCorrect	1.000	5	.60000	.223607	.100000
	2.000	12	.93750	.113067	.032640
SbyspercentKcorrect	1.000	5	.70000	.273861	.122474
	2.000	12	1.00000	.000000	.000000
SbyspercentIcorrect	1.000	5	.50000	.353553	.158114
	2.000	12	.87500	.226134	.065279

SbyStotalPercentCorrect stands for the total percent correct for all questions.
SbySpercentKcorrect stands for the total percent correct for knowledge questions.
SbySpercentIcorrect stands for the total percent correct for inferential questions

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Percent Correct	assumed	5.383	.035	-4.20	15	.001	-.33750	.080	-.508	-.166
	not assumed			-3.20	4.878	.025	-.33750	.105	-.609	-.065
Percent Kcorrect	assumed	254.118	.000	-3.98	15	.001	-.30000	.075	-.460	-.139
	not assumed			-2.44	4.000	.070	-.30000	.122	-.640	.040
Percent Icorrect	assumed	.019	.893	-2.64	15	.018	-.37500	.141	-.676	-.073
	not assumed			-2.19	5.423	.076	-.37500	.171	-.804	.054

Percent Correct stands for the total percent correct for all questions.
Percent Kcorrect stands for the total percent correct for knowledge questions.
Percent Icorrect stands for the total percent correct for inferential questions

Table 4.12b

Sentence-by-Sentence Paragraph Multiple Choice Question Accuracy for Fourth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
PsbysPercentCorrect	1.000	4	.62500	.322749	.161374
	2.000	9	.69444	.300463	.100154
PsbysPercentKcorrect	1.000	4	.75000	.288675	.144338
	2.000	9	.83333	.250000	.083333
PsbysPercentIcorrect	1.000	4	.50000	.408248	.204124
	2.000	9	.55556	.390868	.130289

PSbySPercentCorrect stands for the total percent correct for all questions.
PSbySPercentKcorrect stands for the total percent correct for knowledge questions.
PSbySPercentIcorrect stands for the total percent correct for inferential questions.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PsbysPercent Correct	Equal assumed	.010	.922	-.377	11	.713	-.069	.184	-.475	.336
	Equal not assumed			-.366	5.453	.728	-.069	.189	-.545	.406
PsbysPercent Kcorrect	Equal assumed	.423	.529	-.531	11	.606	-.083	.156	-.428	.262
	Equal not assumed			-.500	5.120	.638	-.083	.166	-.508	.342
PsbysPercent Icorrect	Equal assumed	.096	.763	-.234	11	.820	-.055	.237	-.579	.467
	Equal not assumed			-.229	5.594	.827	-.055	.242	-.658	.547

PSbySPercent Correct stands for the total percent correct for all questions.
PSbySPercent Kcorrect stands for the total percent correct for knowledge questions.
PSbySPercent Icorrect stands for the total percent correct for inferential questions.

Table 4.12c

Sentence-by-Sentence Paragraph Multiple Choice Question Accuracy for Sixth Grade

Group Statistics

	Fluency	N	Mean	Std. Deviation	Std. Error Mean
PsbysPercentCorrect	1.000	1	.00000	.	.
	2.000	8	.40625	.265165	.093750
PsbysPercentKcorrect	1.000	1	.00000	.	.
	2.000	8	.31250	.258775	.091491
PsbysPercentIcorrect	1.000	1	.00000	.	.
	2.000	8	.50000	.377964	.133631

PSbySPercentCorrect stands for the total percent correct for all questions.
PSbySPercentKcorrect stands for the total percent correct for knowledge questions.
PSbySPercentIcorrect stands for the total percent correct for inferential questions.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PsbysPercent Correct	Equal assumed	.	.	-1.44	7	.192	-.406	.281	-1.071	.258
	Equal not assumed			.	.	.	-.406	.	.	.
PsbysPercent Kcorrect	Equal assumed	.	.	-1.13	7	.292	-.312	.274	-.961	.336
	Equal not assumed			.	.	.	-.312	.	.	.
PsbysPercent Icorrect	Equal assumed	.	.	-1.24	7	.252	-.500	.400	-1.447	.447
	Equal not assumed			.	.	.	-.500	.	.	.

PSbySPercent Correct stands for the total percent correct for all questions.
PSbySPercent Kcorrect stands for the total percent correct for knowledge questions.
PSbySPercent Icorrect stands for the total percent correct for inferential questions.

Appendix N

Figures
(IRB# 0408S62606)

Figure 1: Ellis and Young Model (1988) of Grapheme to Phoneme Conversion and Visual Lexicon to Semantic Route

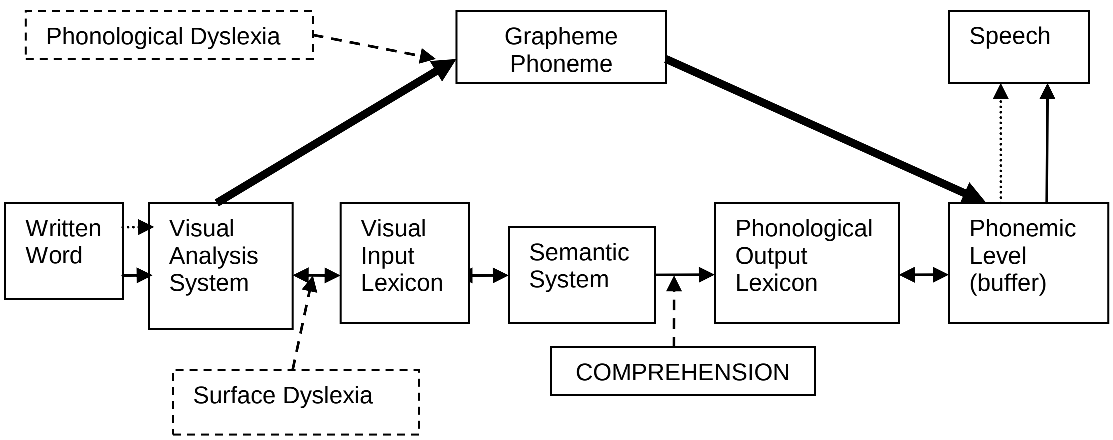


Figure 2: Marsolek Model (2004) of Parallel Processing

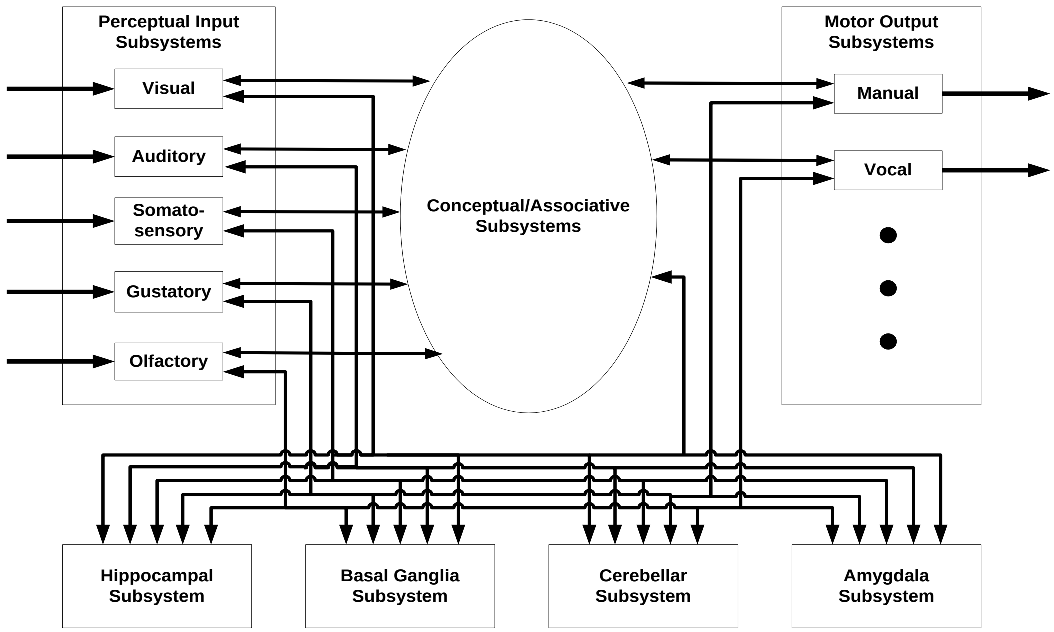


Figure 3a: Beginning reading. Decoding is not automatic.

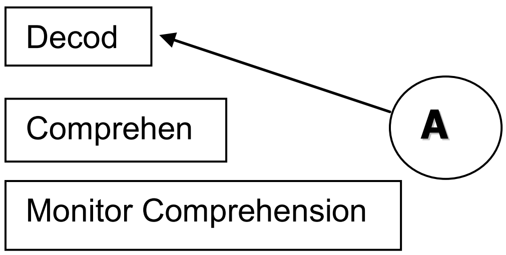


Figure 3b: Beginning Reading: Decode then Comprehend.

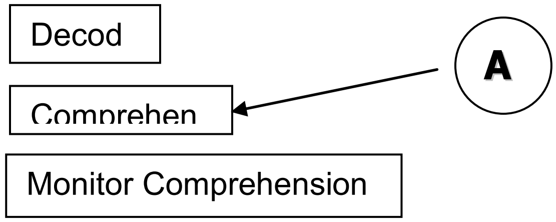
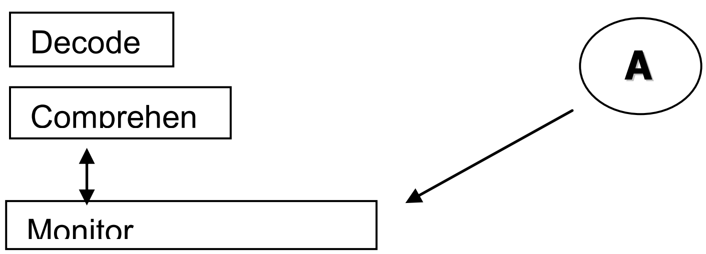


Figure 3c: Beginning Reading: Decode, Comprehend then Metacognition



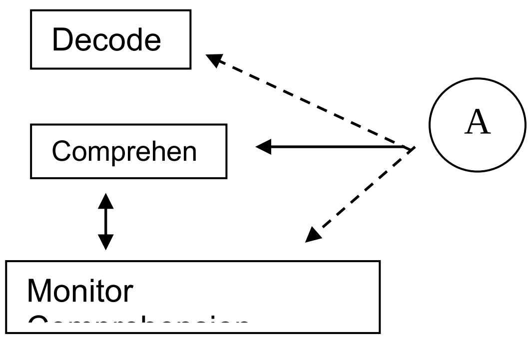
Progressing with attention

Automatic Processing with little attention

Attention: cognitive effort and resources used to perform a task such as decoding

Bi-directional communication & interaction between comprehension

Figure 4: Fluent Reading



Progressing with attention

Automatic Processing with little attention

Attention: cognitive effort and resources used to perform a task such as decoding

Bi-directional communication & interaction between comprehension

Figure 5. Distribution of Reading Fluency Scores – College

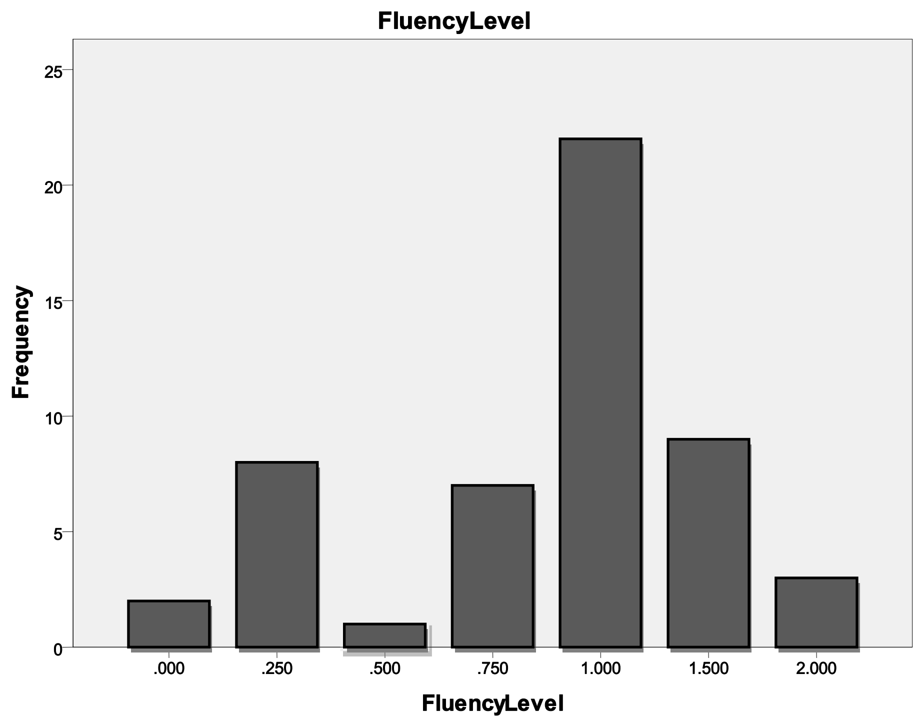


Figure 6. Distribution of Reading Fluency Scores – Elementary

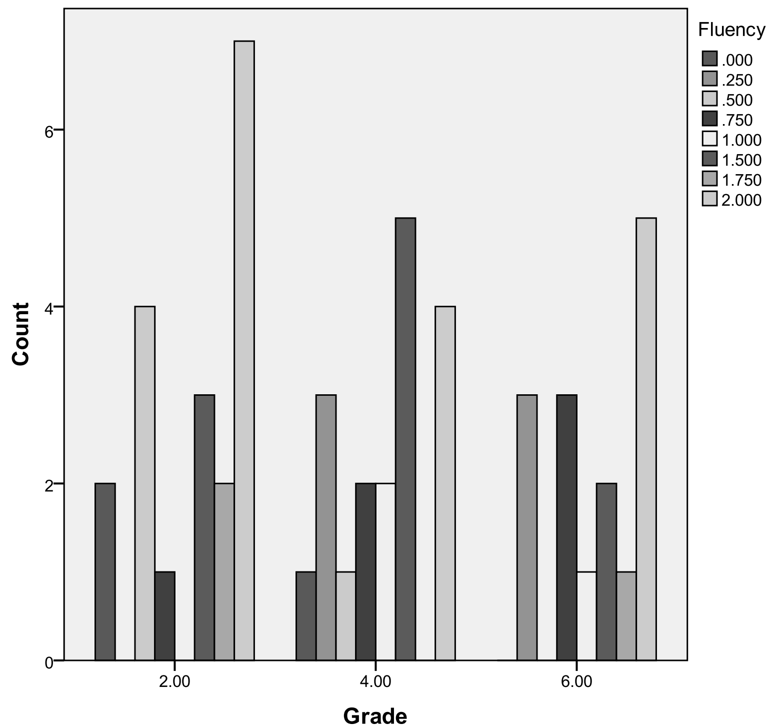


Figure 7. Woodcock Johnson Grade Level Scores – Elementary.

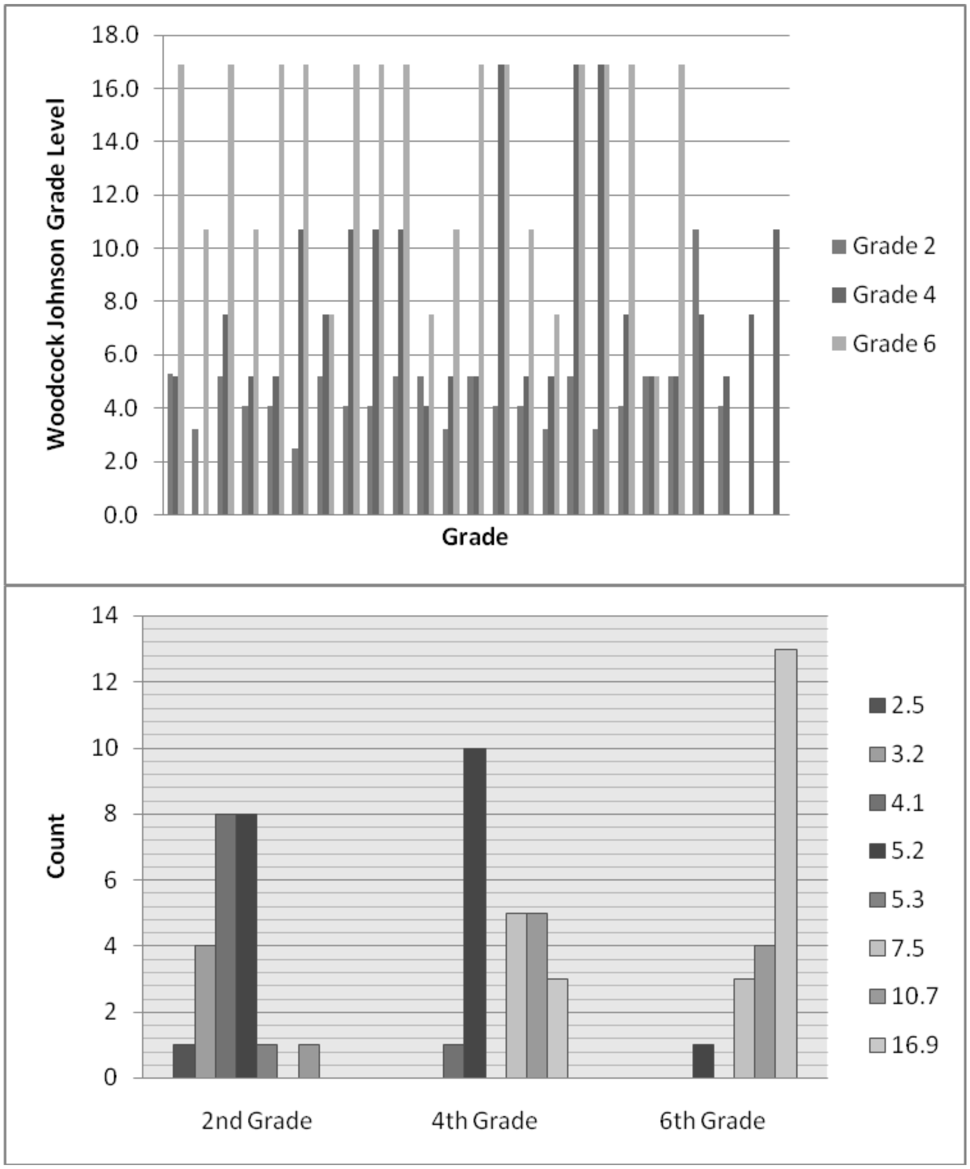


Figure 8. Sentence Accuracy of Multiple Choice Question – Elementary.

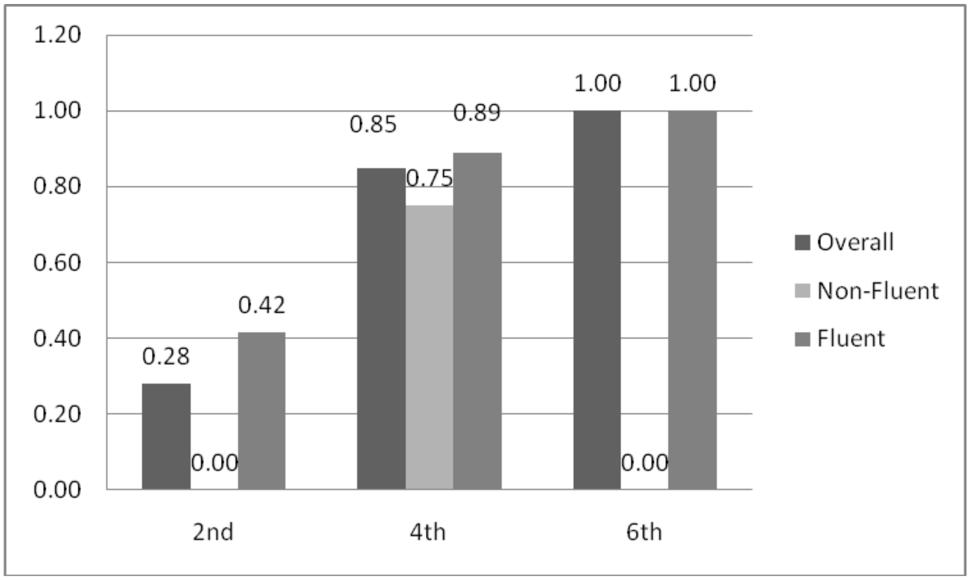


Figure 9. Sentence-by-Sentence Paragraph Accuracy of Multiple Choice Questions – College.

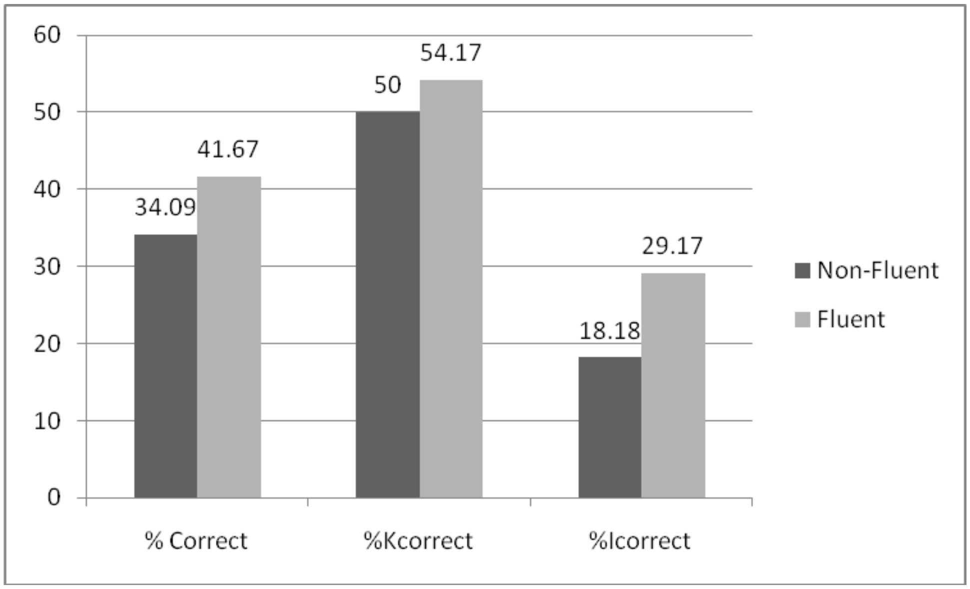


Figure 10. Sentence-by-Sentence Paragraph Accuracy – Elementary.