READING FLUENCY ASSESSMENT: THE ROLE OF WORD-LEVEL AUTOMATICITY

A Dissertation
by
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Submitted to the Graduate School
at Appalachian State University
in partial fulfillment of the requirements for the degree of
DOCTOR OF EDUCATION

December 2013
Educational Leadership Doctoral Program
Reich College of Education

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Abstract

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This study examined the use of an isolated word recognition assessment, the Appalachian State Word Reading Inventory (ASUWRI), to assess students' automatic word recognition. Grade-leveled lists of isolated words were *flashed* individually, one word at a time, on a computer for a pre-determined amount of time, and students were scored on the percentage of words that were correctly identified. Research has shown this assessment to be effective in predicting students' oral reading accuracy and rate of short grade-leveled passages (Morris et al., 2011, 2012, 2013a), and it has been used as a means to estimate a student's reading level. Frye & Gosky (2012) found that the exposure time for words flashed with this assessment may affect how well the assessment predicts reading performance. However, further research is needed to contrast exact exposure times and determine which flash rate best predicts other reading behaviors. I hypothesized that faster flash speeds would better predict students' overall reading competency. Thus, this study examined how students' scores on the ASUWRI task, under various exposure rate conditions, predicted students' scores on other reading assessments. The assessments included another isolated word recognition test (Test of Word Recognition Efficiency), an informal reading inventory (Appalachian State University Informal Reading—words per minute), a standardized reading comprehension test (Gates-MacGinitie Reading Test), and a standardized picture vocabulary assessment (Peabody Picture Vocabulary Test).

Three different presentation speeds were selected for this study: (a) 400 milliseconds, (b) 1000 milliseconds, and (c) 2000 milliseconds—the last similar to an untimed measure. Three word lists (30 words each) were created by selecting ten words from second-, ten from third-, and ten from fourth-grade leveled lists from *Basic Reading Vocabularies* (Harris & Jacobson, 1982). The word lists were compared to ensure that each list was equivalent in word frequency and average number of syllables. Analyses revealed the three lists to be equivalent. Using a computer program, each list was presented to third-grade students at one of the three speeds, making sure each student experienced each exposure time; conditions were counterbalanced.

Multiple linear regressions (stepwise) were used to determine the predictability of students' scores on the ASUWRI at each presentation speed and their scores on the other reading assessments. Results from this study show that the 400 ms exposure time was significant in predicting scores on each of the reading assessments (TOWRE, ASUIRI wpm, GMRT, and PPVT) and was a better predictor in every analysis. That is, the 1000 and 2000 ms speeds did not add significant value to predicting scores of any of the other reading assessments. Results are interpreted as evidence that flash rates for the ASUWRI should be set at a speed of 400 ms to best predict reading performance. Further research is called for to investigate whether faster flash times are needed for older and more developed readers.

Acknowledgments

There are several people who have helped me through this monumental journey; first and foremost I need to thank my mentor and chairperson, Woody Trathen. Woody immediately took me under his wing and shared his knowledge and experience with me in a way that was encouraging and supportive. The information I have learned under his direction has helped me grow in our field and has empowered me to become an effective teacher of reading. I will be forever grateful for his support. I also need to thank Jennifer McGee for sharing her expertise in statistics so that I could competently muddle through the tables, numbers, and formulas in this paper. I have come a long way thanks to her mentoring and advice. I would also like to thank Carla Meyer and Bob Schlagal for being dedicated members of my committee and offering suggestions and support along the way. I want to give a special thanks to Nora Vines for the numerous hours she put in helping me collect data.

None of this would be possible without my family. I want to thank my husband for believing that I can do whatever I set my mind to. His unwavering confidence helped me tremendously along the way. I also need to thank my sister, Tricia, for the countless hours of watching my children so I could write.

Lastly, I have to thank Dale McCorvey and her Mountain Grounds Coffee Shop in Banner Elk, North Carolina for providing me a comfortable, quiet, and aromatic place for me to read and write for hours.

Dedication

I dedicate this in memory of my mom, Charlene, whose guidance and strength molded me into the woman I am today. I hope I continue to make you proud every day.

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Chapter One: Introduction

A law passed by the North Carolina General Assembly called the *Excellent Public Schools Act of 2012*, in effect for the 2013-14 school year, calls to question the way we look at literacy assessments in North Carolina public schools. Of particular interest is the k-3 literacy initiative entitled *The North Carolina Read to Achieve Program*, which is being put into place to identify students with reading difficulties as early as possible so they may receive the necessary instruction and support to remediate reading deficiencies (*Excellent Public Schools Act,* 2012*).* Through this legislation, the state aims to intensify early reading instruction and stop the social promotion of third graders who do not read proficiently. That is, all third graders who do not score in the proficient range on the language arts portion of the standardized end-of-grade tests (EOGs) will be required to attend summer school and possibly be placed in transitional fourth-grade classrooms where they will receive extra literacy support, or will be retained.

Details of the *Excellent Public Schools Act of 2012*

In order to identify those students needing extra reading support, the law states that "formative and diagnostic assessments and resultant instructional supports and services shall address oral language, phonological and phonemic awareness, phonics, vocabulary, fluency, and comprehension using developmentally appropriate practices" (*Excellent Public Schools Act*, 2012, Section 7A). The state has contracted to use *mCLASS: Reading 3D* from Amplify as its assessment tool in all North Carolina school districts. Amplify partnered with the creators of the *Dynamic Indicators of Basic Early Literacy Skills* (DIBELS) (Good & Kaminski, 2002) for the decoding and early reading skill assessment, and they utilized leveled book sets from Rigby (Houghton Mifflin Harcourt, 2013) for the contextual reading assessment element. This contextual reading assessment format is similar to that of informal reading inventories (IRIs), which have been used by classroom teachers for years (Provost, Lambert & Babkie, 2010). In typical IRI procedures, teachers assess students by having them read leveled passages while the teachers document students' reading errors. From these assessment data, teachers determine an instructional range for students and place the students in appropriate texts for reading instruction and practice. Researchers have made a strong case that IRI assessments are more informative and accurate if teachers measure how long it takes students to read the passages; collecting a measure of reading rate strengthens this assessment (Carver, 1990; Meyer & Felton, 1999; Morris et al., 2011, 2012, 2013a).

An added element of *mCLASS* is that teachers enter assessment data into a mobile device (iPad, Palm Pilot, etc.), which allows data to be submitted for analysis via *mCLASS* software programs. Teachers do not need to analyze their own data but rather are provided with summarized information including charts and reports on each student. Moreover, the analysis is done at a price-per-student cost, which greatly impacts schools' budgets. The plan has been estimated to cost the state of North Carolina about 436 million dollars over the next five years (Glover, 2012). The *Excellent Public Schools Act of 2012* certainly stresses the importance of effective assessments in order to detect reading difficulties in young students. Thus, the need for reliable and accurate reading assessments in North Carolina public schools could not be timelier.

This law puts pressure on teachers and school districts to make sure all students read proficiently and fluently by third grade. This pressure results in a greater frequency of student assessment and a resulting increase in money spent on assessment tools to make sure students are ready for the end-of-grade standardized tests. According to the superintendent of Avery County Schools (a small rural district in North Carolina), the school district pays approximately $10,000 yearly for required reading assessments in grades kindergarten through third and an additional $10,000 for reading assessments for grades third through eighth (David Burleson, personal communication, August 3, 2012). In addition to the financial burden, the superintendent's concerns include the reliability and validity of the assessments used by the district. Currently, the district uses DIBELS (as part of the *mCLASS* system) to assess decoding skills, fluency, and overall reading ability in grades kindergarten through third grade, and IRI passages from the *mCLASS* assessment are used to measure reading growth. However, Mr. Burleson expressed concerns that DIBELS and *mCLASS* may not provide enough reliable information as is needed to make changes in a student's instructional plan for reading. Mr. Burleson emphasized the fact it is not simply collecting the data that is of utmost importance but rather the quality of the data and what teachers are able to do as a result of interpreting the data.

Researchers have argued commonly used fluency assessments in North Carolina (such as DIBELS and *mCLASS*) contain flaws, though some of the confusion lies in the way teachers are being asked to collect data (Morris & Trathen, 2013). With the *mCLASS* system, teachers have students read grade-level passages for one minute and then ask students to provide a retell in their own words and write responses to comprehension questions. Several problems with these procedures call to question the validity of these assessments. For example, reading rate is not taken into account with the *mCLASS* reading assessments, either in passage reading or in isolated word reading. Researchers have demonstrated that reading rate is often *the* determining variable in judging a student's reading performance (Hendrix, 2013; Morris et al., 2011, 2013a), and a timed isolated word recognition task provides valuable information about a student's reading behavior (Morris, 2008; Morris et al., 2012). By not using reading rate data with the *mCLASS* reading assessments, teachers have little knowledge of students' abilities to process words and texts automatically (fluently). In addition, the information provided by timed word recognition assessments enhances teachers' abilities to provide appropriate reading instruction for students. Considering Mr. Burleson's responses, the vast use of DIBELS and *mCLASS* throughout North Carolina, and the k-3 initiative, *North Carolina's Read to Achieve,* it seems important to look more carefully at what research has to say about reading fluency assessment.

Reading Fluency Assessment

The National Institute of Child Health and Human Development (NICHD) issued *The National Reading Panel Report* (NICHD, 2000) identifying reading fluency as one of the most important variables for successful literacy development. In fact, many consider addressing fluency to be an essential component in any reading program because it is a defining characteristic of good readers, while lack of fluency is often associated with poor readers (Hudson, Lane, & Pullen, 2005). Fuchs, Fuchs, Hosp and Jenkins (2001) defined oral reading fluency as the ability to read text quickly, accurately, and with proper phrasing and expression. Fluency extends beyond simply reading fast: It has been said that it serves as the bridge between word identification and text comprehension (Pikulski & Chard, 2005).

The bridge analogy aligns well with Schreiber's (1980) seminal work on prosody. When readers read with the natural rhythmic patterns that are found in language, it is considered prosodic reading. Schreiber (1980, 1991) suggests that fluency and comprehension are influenced by the reader's ability to organize words into meaningful phrases while reading text. Schreiber's theory maintains that fluent readers move beyond accurate single word reading to appropriately grouping words in phrases, and in doing so they are able to comprehend text. Rasinski (2012) posits "fluency can and will make a significant impact on the reading achievement and reading dispositions of all readers, especially those whom we consider most at risk" (p. 521). In a recent study, Hendrix (2013) demonstrated the undeniable link between prosody and reading rate, establishing reading rate as a valuable measure of fluency.

The National Reading Panel Report (NICHD, 2000) confirmed the significance of fluency when it was named as one of the five pillars of reading instruction. According to the report, effective reading instruction must address the following five areas: phonemic awareness, phonics, fluency, vocabulary, and comprehension. Phonemic awareness and phonics are needed for decoding, and vocabulary aids in comprehension (NICHD, 2000). Fluency is actually part of decoding *and* comprehension (Fuchs et al., 2001). Pikulski (2006) explains there is a reciprocal relationship between reading fluency and comprehension. These interactive processes are the basis of Gough's Simple View of Reading (SVR; Gough, Hoover, & Peterson, 1996; Gough & Tunmer, 1986; Hoover & Gough, 1990). One of the fundamental principles of the SVR is that automaticity of decoding—a critical component of fluency—is essential for high levels of reading achievement (Carver, 1990; Logan, 1988; Pikulski, 2006; Wolf & Katzie-Cohen, 2001).

The SVR is based on the formula R = L x D where R is the student's reading comprehension ability: L represents language (or linguistic) knowledge, which is often measured by non-reading vocabulary and comprehension assessments, and D stands for decoding processes, which are often measured by word recognition assessments. The multiplicative nature of this formula means as either language or decoding skills approach nil comprehension is diminished. Simply stated: If children cannot decode words, they will not be able to comprehend text. Also, if children are not able to understand text when it is read to them, they will not comprehend it when they decode it. The SVR supports the panel's opinion (NICHD, 2000) that phonemic awareness, phonics, vocabulary, fluency and comprehension are all essential to comprehending text, which is the ultimate goal of reading (Gough et al., 1996).

The SVR can also be viewed through the lens of LaBerge and Samuels's Theory of Automaticity (1974). Automatic word recognition is a critical component of fluency and fluency's role in the comprehension of text (Samuels, 2006). This is why isolated word recognition assessments can be used to determine oral reading fluency levels. Inefficient word recognition (the D in the SVR) hinders comprehension because readers are spending the majority of cognitive resources on word-level processes, resulting in diminished cognitive resources that could be applied to comprehension processes. These readers can often comprehend a text if it is read to them because someone else is taking on the decoding process and freeing up cognitive resources for comprehension. Once the word recognition processes have become automatic, readers can decode and comprehend simultaneously. Because of this reciprocal relationship, there is often a high correlation between oral fluency scores and overall reading ability (Chard, Vaughn, & Tyler, 2002; Deno & Marston, 2006;

Fuchs et al., 2001; Rasinski, Reutzel, Chard, & Linan-Thompson, 2011; Rasinski, Rikli & Johnston, 2009). Thus, it makes sense that teachers measure students' automatic word recognition accurately and use this information as a critical component in a reading assessment battery.

The Theory of Automaticity (LaBerge & Samuels, 1974) aligns with the SVR and suggests that each component of reading (L and D) can be assessed separately. Hoover and Gough (1990) recommend an assessment for the ability to understand language as well as a word recognition assessment to measure the decoding component. An appropriate assessment for language is the Peabody Picture Vocabulary Test (PPVT) (Dunn & Dunn, 1981, 2007) because it is administered orally and does not require the student to read text. The PPVT is an untimed test that measures one's receptive vocabulary and provides a quick estimate of verbal ability and scholastic aptitude. To measure readers' decoding skills, educators have used performance on grade-leveled isolated word lists and grade-leveled contextualized reading passages that determine words correct per minute (wcpm). Research has shown a timed word-recognition assessment is a better predictor of oral reading fluency than untimed measures (Morris et al., 2011, 2012, 2013a; Torgesen, Rashotte, & Wagner, 1999). One such assessment is the Test of Word Reading Efficiency (TOWRE) (Torgesen et al., 1999, 2012). The TOWRE consists of a word list comprised of increasingly difficult words and allows students 45 seconds to read as far up the list as possible. The TOWRE has demonstrated reliability and validity as a measure of word reading ability and was accepted for use within the Reading First initiative (Hagan-Burke, Burke, & Crowder, 2006). Another timed option is the Appalachian State University Word Recognition Inventory (ASUWRI), which is administered in a timed format on a computer. Each individual word is *flashed* briefly on the computer screen for the student to identify. Reichle, Pollatsek, Fisher, and Rayner (1998) explain as text difficulty increases, so will the amount of time a person fixates on the word. Therefore, as the words continue to increase in difficulty, eventually the student will no longer be able to recognize the word in the given flash time and an instructional level will be obtained. By using a flash technique, each word is its own test because each word has its own timed assessment. This differs from TOWRE, and might make for a more sensitive measure than other timed word recognition measures, where the entire assessment is timed rather than each word. The format of the ASUWRI allows the administrator to check for automaticity, which is essential for efficient reading comprehension. Research demonstrates scores from the ASUWRI better predict reading performance when words are flashed rather than untimed, yet this method is not being utilized in diagnostic reading batteries, such as *mCLASS* (Morris et al., 2011; Morris & Trathen, 2013).

Researchers have clearly demonstrated reading rate is an important part of a reading assessment battery (Hendrix, 2013; Morris et al., 2011). Reading rate is often obtained when a child is reading to understand grade-leveled passages, such as an IRI (Morris, 2008; Morris et al, 2013a). The *mCLASS* reading assessment battery uses only oral reading accuracy and comprehension to analyze children's reading; however, Morris et al. (2013a) posit "while the child's oral reading accuracy and comprehension scores may hover in the instructional-level range across several grade levels (based on an IRI), his or her reading rate tends to drop, sometimes sharply" (p. 53). This drop in reading rate indicates a child is spending more time on decoding text. Thus, reading rate is often the determining factor in defining a student's reading level, so it makes sense that the measure be included in a reading assessment battery.

In addition, researchers have demonstrated the added value of an isolated word recognition measure to a reading assessment battery, especially if timed (Frye & Gosky, 2012; Morris et al., 2011; Torgesen et al., 1999, 2012). Morris et al. (2012) found a timed isolated word recognition measure is a good predictor of oral and silent reading rates. What is lacking in research on isolated word recognition assessments is what exactly *time* means. Several isolated word recognition assessments are available, yet the notion of time varies greatly among them. For example, the San Diego Quick Assessment (LaPray & Ross, 1969) allows students up to five seconds before moving on to the next word. The assessment ends when the word list is complete or the child can no longer read the words. This essentially untimed technique is similar to the graded word list sections of several popular IRIs, such as the Qualitative Reading Inventory-5 (Leslie & Caldwell, 2011) and the Classroom Reading Inventory (Silvaroli & Wheelock, 2004). The Test of Word Reading Efficiency (TOWRE) (Torgesen et al., 1999, 2012) uses time in a different manner: Students are given 45 seconds to read as many words as possible. Conversely, the ASUWRI flashes each word for 400 - 500 milliseconds on a computer, and the test ends when the list is complete or students have missed enough to place them in the frustration range of reading, which means the text is too difficult for the student to read.

The disconnect between research demonstrating the value of assessing reading fluency within time sensitive measures and the lack of such measures in popular diagnostic batteries such as *mCLASS* generated the need for this study. Naturally, educators and administrators are interested in assessments that provide the most accurate data pertaining to reading ability. Research has shown timed oral reading fluency assessments that measure students' automatic word recognition are good predictors of students' overall reading ability

(Fuchs et al., 2001; Morris et al., 2012); therefore, word recognition assessments can be valuable tools for teachers. To accurately measure automaticity, a timed presentation must be employed (i.e., ASUWRI), but there is an absence of empirical evidence to determine the best exposure time for each word in this type of instrument. We know from eye movement research that skilled readers fixate on a word for less time than unskilled or beginning readers (Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001; Rayner & Pollatsek, 1989). Evidence exists supporting a flash time in the 500 ms range, yet there is no evidence that 500 ms is any better than 1000 ms or 2000 ms (Rayner, Chace, Slattery, & Ashby, 2006). One study (Frye & Gosky, 2012) examined the use of different flash times (300 ms, 650 ms, 1000 ms, 2000 ms) and concluded that flash times of 1000 ms or less best predict overall reading ability. However, distinctions between faster presentation times were inconclusive, calling for further examination. This study is designed to address these issues.

The Present Study

For this study, I administered various reading assessments to third-grade students in Avery County, North Carolina. Third grade was chosen because the *Excellent Public Schools Act* (2012) requires students in third grade to be reading at the proficient level before moving onto the next grade level. Third grade is also a pivotal year because it is the first year the students take a standardized reading test, and because these students generally make the transition from *learning to read* to *reading to learn*, meaning they switch their focus from decoding to comprehension.

Students were administered the ASUWRI with three different exposure times: (a) 400 ms because this approximates the time currently used with the flash (Morris, 2008) and is within the range of fixation rates observed in eye movement research (Rayner & Pollatsek, 1989); (b) 1000 ms because one second is a commonly used time in timed assessments; and (c) 2000 ms because it is similar to not being timed at all. Following the isolated word recognition assessment, the other components of the battery were administered, including contextualized reading passages followed by comprehension questions (similar to the *Rigby* passages in the *mCLASS* assessment), a standardized reading test, and a standardized picture vocabulary test.

Students also were assessed with the TOWRE (Torgesen et al., 1999, 2012) because it is a timed isolated word recognition assessment that is widely used and accepted in research (Hagan-Burke et al., 2006; Torgesen et al., 1999, 2012). The scores from the isolated word recognition assessment (ASUWRI) at the different flash speeds were compared to the contextualized reading assessment scores from the IRI (ASUIRI) and the TOWRE, as well as the results of the Gates-MacGinitie Reading Test (GMRT) (MacGinitie, MacGinitie, Maria, Dreyer, & Hughes, 2000), which is a standardized reading assessment aimed at determining a student's overall reading ability. The Peabody Picture Vocabulary Test (PPVT) (Dunn & Dunn, 1981, 2007) was used to measure comprehension free from the decoding demands of print processing. I anticipated that ASUWRI scores from 400 ms condition would better predict scores on contextual reading measures such as rate and other isolated word measures such as TOWRE.

The data from this study answer the following research questions: Does presentation time on an isolated word recognition (ASUWRI) task influence how well the instrument predicts performance on:

1. an isolated word recognition measure (TOWRE)?
2. a contextualized reading measure (ASUIRI)?
3. a standardized measure of reading achievement (GMRT)?
4. a standardized nonprint vocabulary assessment (PPVT)?

Chapter Two: Review of the Literature

We live in a time when our public school systems rely heavily on assessment data for accountability. Nationally, federal programs, such as No Child Left Behind, Reading First, and Race to the Top require constant and reliable assessment data in order to determine funding levels for school districts. Locally, North Carolina schools are impacted by the *Excellent Public Schools Act of 2012*, which requires students to be assessed in third grade and raises the stakes of students' test scores by retaining any third grader who does not score proficiently on the reading portion of the state exam (*Excellent Public Schools Act*, 2012). This law delivers a renewed focus on reading assessments, leaving teachers and administrators needing valid, reliable assessments that provide them with accurate results in a short amount of time.

Assessments that evaluate students in each of the *National Reading Panel Report's* (NICHD, 2000) five pillars—phonemic awareness, phonics, fluency, vocabulary, and comprehension—are gaining importance in the daily activities of teachers. Because fluency links word recognition to comprehension, fluency assessments are becoming more and more prevalent in classrooms. While the use of multiple assessments provides the most accurate determination of a student's reading ability (Kuhn, Schwanenflugel, & Meisinger, 2010), the use of automatic word recognition assessments alone provides a good indicator of the student's overall reading competence (Fuchs et al., 2001; Hasbrouck & Tindal, 2006; Morris et al., 2011; Riedel, 2007). In order to understand why this holds true, it is helpful to examine models of the reading process.

Models of the Reading Process

Understanding the reading process enables one to understand how particular reading assessments are designed to gather information about specific processes involved in reading. Adams's (1990) review of the cognitive psychological research provides a state-of-the-art accounting of the workings of the reading process. The Simple View of Reading (SVR) offers a heuristic for understanding major elements of the reading process and how they interact. Both models are helpful in understanding what readers do when they read and how assessments are designed to measure those reading processes.

Adams's interactive model of reading. Reading depends on connections between spellings, speech sounds, and meanings. Adams's (1990) book *Beginning to Read: Thinking and Learning About Print* describes an interactive model of reading wherein the orthographic, phonological, meaning, and context processors interact to allow the reader to create an understanding from text. In this model skilled readers depend on the appearance of words, their sounds, and their meanings to read efficiently. These three information streams are highly interactive during the reading process. The term processor is used to signify each process the brain uses to read. Each process will be explained in detail beginning with the orthographic processor.

***Orthographic processor*.** The orthographic, or spelling, processor functions to decode all of the individual letter recognition units and the associative linkages between them (Adams, 1990). It is the only processor that receives input directly from the printed page. According to Adams (1990), skilled readers are familiar with letter sequences and have learned to recognize these letter patterns automatically. Furthermore, skilled readers do not process the letters of a word independently of one another; rather, they have made associations among letters and remember patterns of letters often found together (Adams, 1990). Strong associations between letter units are developed over time as the reader encounters more and more words. “It is by binding together the total, ordered letter sequences corresponding to whole familiar words that the interletter associations give us the sense and appearance of recognizing these strings instantly and holistically” (Adams, 1990, p. 111). These interletter associations also assist us with encoding the proper order of letters we see, and word identity depends heavily on the order of letters.

Skillful readers must effortlessly reconstruct the order of letters, and this falls back on the reader’s knowledge of letter patterns. Conversely, less skilled readers tend to have trouble with letter orders because their ability to recall letter patterns within words is weak. “When the reader fixates on a word, the visual percepts of the letters directly stimulate its corresponding letter recognition units then pass along a fraction of their excitation to other letter recognition units” (Adams, 1990, p. 109). When a reader views a word, the entire word is viewed at once, meaning the whole word is more perceptible than the sum of its parts (Adams, 1990). However, understanding a word in its entirety cannot be accomplished without repeated attention to the sequencing of letters. This notion supports the fact that the knowledge skilled readers have about word and spelling patterns cannot supplant the visual information from the actual letters but is still necessary. “The more time it takes a child to identify each successive letter of a word, the less she or he can learn from that reading about the spelling of the word as a whole” (Adams, 1990, p. 113). Hence, word recognition is strengthened through the strong mental representations of individual letters and their patterns.

In order to achieve this development, students should be engaged both in activities that pay particular attention to the patterns of letter structure found in syllables and words and in a vast amount of reading connected text at the appropriate developmental level.

Phonological processor. The phonological processor is excited by the auditory image of a word, syllable or phoneme as it deals with the pronunciation of the word; essentially it allows us to sound out words (Adams, 1990). The phonological processor gets its information from speech; this includes our inner speech or subvocalizing. The phonological activation is an immediate consequence of visual word processing from the orthographic processor. Hence, the phonological processor, the orthographic processor, and the meaning processor work simultaneously in order to understand the printed word. "The phonological processor is critical for maintaining the speed as well as accuracy of word recognition necessary for productive reading" (p. 159).

The more frequently a spelling pattern is processed, the more strongly the letter patterns will be ingrained in memory, and the more frequently the pattern has been mapped onto a particular pronunciation, the stronger and faster the connections will be to and from the phonological processor (Adams, 1990). In other words, as children read words they have encountered many times before, their memories (representations) of the words have been strengthened so much that the orthographic processing takes in the word as a whole unit and the pronunciation from the phonological processor is instantaneous. That being said, the phonological processing (and its interconnectivity with the other processors) is most advantageous when reading less familiar words. This is because more familiar words may excite a direct path from orthographic processing to meaning (sight word recognition), where the path to meaning of less familiar words is aided by the redundant phonological information triggered in the phonological processor. As the processors work together they are able to overcome the weaknesses of each individual processor leading to greater interpretation of text.

***Meaning and context processors*.** For skilled readers both recognition of the printed patterns and deriving meaning from those patterns are largely effortless and automatic. Once the visual image of a string of letters begins to form, signals are sent to the meaning processor as it narrows down the possibilities of meanings for the word (Adams, 1990). The meaning processor works in conjunction with the context processor, which is in charge of constructing a coherent interpretation of the text. The contribution of the context processor depends on the predictability of the text being read. “If the context is strongly predictive of the word to follow, that word’s meaning should receive a strong and focused boost of excitation” (Adams, 1990, p. 139). The context processor deciphers among multiple meaning words and ambiguous text. For skilled readers, the context processor can respond to orthographic information by speeding up and assisting with interpretation, but it cannot overcome a weak orthographic processor (Adams, 1990). However, contextual cues are beneficial when it comes to orthographically difficult words, as the cues can help the reader comprehend the text when only partial information is present. That is to say, when the spelling pattern of a word is only marginally familiar, the context processor may be able to provide enough information that the reader can identify the word from partial information—*guess* if you will. This is significant to the young reader who struggles with decoding words: the reading process is slowed down and often is error prone.

In order to improve text interpretation, the reader must move beyond word-by-word meaning and begin to interpret a chain of words. If the text is difficult, this grouping occurs more frequently, and if the text is easier the reader can read longer without pausing for meaning. Additionally, the greater the time and effort a reader must invest in each individual word the less likely it is the reader will recall all parts of the phrase when it is time to put them all together (Adams, 1990). The context processor can provide some relief from the difficulties of word recognition, which may end up making the difference between some comprehension or no understanding at all.

The meaning processor works similarly to the orthographic processor in that it deals with small chunks of meanings and makes associations (Adams, 1990). When a child encounters something for the first time, characteristics of this object are observed and stored away for later use. These characteristics, which can be seen as units of meaning, likely expand as the child continues to encounter similar objects. If a child encounters an unknown word in isolation, the meaning processor can be of no assistance because no prior associations have been made for that word. However, if the word is presented in context, the context processor is excited and works simultaneously with the orthographic, phonological, and meaning processors to provide possible meaning to the unknown word, although relying solely on the context processor may not lead to an exact meaning of the word. These episodes of reading words in context can lead to partial representation of words in memory, followed by fuller representations with repeated exposure to the words. Most children learn many new vocabulary words on their own through context (Nagy, Herman, & Anderson, 1985); thus, encouraging students to engage in meaningful reading is one of the most efficient ways for children to learn new words (Adams, 1990).

In summary, for the skilled proficient reader, the orthographic, phonological, meaning, and context processors work together to enable the reading of a text with fluency and adequate comprehension. The associations among the perceptual units connect the individual letters to the sounds and meanings of words and are strengthened by the frequency of encounters. Sequences of individual letters that have been frequently encountered by the reader develop into clear spelling patterns in memory. This overlearned knowledge of spelling patterns enables word recognition automaticity. As Adams (1990) states, “The most salient characteristic of skillful readers is the speed and effortlessness with which they seem to breeze through text” (p. 409). Breezing through the text is contingent upon the extent to which the reader has automatized the sequences of the individual letters and bonded that with phonological and meaning representations that compose the words they read.

The Simple View of Reading. Though reading is not considered a simple process, Gough and Tunmer (1986) offer a Simple View of Reading (SVR) with the aim of providing an overall framework for understanding the complex process of reading. According to the SVR, reading is comprised of two equally valued components: decoding and linguistic (language) comprehension (Hoover & Gough, 1990). While the model specifies only two macro components, it is important to recognize that each component represents a complex conglomerate of interconnected microprocesses.

The SVR defines decoding as “efficient word recognition: the ability to rapidly derive a representation from a printed input that allows access to the appropriate entry in the mental lexicon, and thus, the retrieval of semantic information at the word level” (Hoover & Gough, 1990, p. 130). In other words, a reader must translate a meaningless set of letters into a recognizable object in a fraction of a second (Gough et al., 1996). The SVR posits that for a person to become literate, a phonologically-based system must be acquired; as beginning readers learn the phonological representations for each letter and group of letters, they will begin to develop a mental lexicon based on the letter-sound relations (Hoover & Gough, 1990). However, mere word recognition is not sufficient; readers must also know what words mean (Gough et al., 1996). This notion further explains how decoding and language (linguistic) comprehension are separate but interrelated components of the reading process.

In the SVR "linguistic comprehension is the ability to take lexical information (i.e., semantic information at the word level) and derive sentence and discourse interpretations" (Hoover & Gough, 1990, p. 131). Linguistic or language comprehension is essentially what can be understood when the information is read aloud to the person. Oral language comprehension represents all of verbal ability, including vocabulary, syntax, inferencing, and the construction of mental schemas (Kirby & Savage, 2008). The definition of linguistic comprehension further attests that, although the SVR offers a simpler lens (heuristic) through which to view the reading process, it by no means assumes reading is simple. It is important to note that Gough et al. (1996) claim that many of the skills required for comprehension are necessary for both the reader (visual signal) and the auder (auditory signal), and that reading and listening comprehension are essentially the same processes.

The SVR also suggests a way to view the interconnectedness of two components of reading. The SVR claims both decoding and linguistic comprehension are "necessary for reading success, neither sufficient by itself" (Hoover & Gough, 1990, p. 132). Thus, the relation between the two components, decoding (D) and language comprehension (L), and reading comprehension (R) is multiplicative, which is expressed as R = D x L (Hoover & Gough, 1990). This technically means it is the interaction of the two that is important, not the two individually. In other words, the effect of an increase in either depends upon the level of the other (Kirby & Savage, 2008). Furthermore, if either decoding or language comprehension equals zero then reading comprehension cannot occur. That is, if a child cannot decode words then no reading comprehension can take place. Additionally, if a child has no language comprehension, reading comprehension will not take place even if the child can decode words. Conversely, an increase in either component will result in an increase in reading comprehension (assuming neither component approaches a value of zero). This formula has several implications for instruction and assessment.

Implications. The SVR makes it clear that strong reading comprehension cannot occur unless both decoding skills and language comprehension abilities are strong. Therefore, educators must teach students to decode expertly as early as possible, while at the same time encouraging vocabulary and language development. Hoover and Gough (1990) suggest a child needs to learn the print-sound relation, becoming aware of the alphabetic units of the printed word as well as the phonemic units of the spoken word, to strengthen the decoding component. This could be achieved through phonics instruction and meaningful interaction with developmentally appropriate text.

As the SVR suggests, it is equally important to develop the language component. Hoover and Gough (1990) argue instruction that improves language comprehension should likewise improve reading comprehension. “In terms of the simple view, the greater the knowledge base expressible through linguistic comprehension, the greater the reading comprehension [assuming non-zero decoding skills]” (Hoover & Gough, 1990, p. 153). This formula stresses the importance of developing vocabulary and comprehension skills. Comprehension strategies, which generally lead to active, reflective, and sometimes collaborative approaches to learning, should be taught and modeled in the classroom by teachers (Kirby & Savage, 2008).

Regarding assessment, the SVR demonstrates scores from reading comprehension assessments do not provide enough data to identify students' areas of weakness (decoding or language comprehension) with certainty. Rather, separate assessments are needed for both components of the SVR.

> Knowledge about the student's ability in these domains (decoding and linguistic comprehension) of the reading process is important in order to get necessary knowledge about reading and reading difficulties—knowledge which is of critical importance when planning reading instruction for students having difficulties in acquiring efficient reading ability. (Høien-Tengesdal, 2010, p. 435)

Therefore an effective assessment of decoding and oral language fluency is vital.

A measure of linguistic comprehension must assess the ability to understand language separate from decoding demands (Hoover & Gough, 1990). When assessing listening comprehension, for example, it is necessary to read the text to the student so that the student has the ability to understand text without reading. Gough et al. (1996) emphasized in order "to separate the decoding and comprehension factors, we need tasks that measure each other without involving the other" (p. 4). Assessing both components separately helps determine whether a weakness in reading is due to trouble in decoding, comprehending, or both. The idea is that if the reader's ability to decode words and to understand spoken passages is ascertained, the reader's skill level at reading comprehension can be predicted (Høien-Tengesdal, 2010).

Alternative views. As with any theory, the SVR has its critics. There are two main arguments facing the SVR; one is that an additive model (R = L + D) is more appropriate than the multiplicative model, and the other issue is that researchers continue to try to find a third component to reading. Those who argue for an additive model of the SVR are essentially claiming that reading comprehension can take place even if a child has zero decoding skills or zero language comprehension skills (Conners, 2009; Høien-Tengesdal, 2010; Kirby & Savage, 2008; Savage & Wolforth, 2007). Although, Hoover and Gough (1990) affirm that this instance may occur in rare cases of dyslexia or hyperlexia, they maintain these instances are not substantial enough to disprove the multiplicative model. Gough et al. (1996) assert:

> We have observed that decoding and comprehension are positively correlated. The skilled decoder is also apt to be a skilled comprehender, and the child poor at either is likely to be poor at the other. But the simple view says that the relationship between decoding and comprehension must depend on reading level. (p. 8)

While there is much empirical evidence to support decoding and language comprehension constituting up to 85% of the variance in reading comprehension, some researchers continue to look for a third factor to include in the SVR formula (Chen & Vellutino, 1997; Conners, 2009; Cutting & Scarborough, 2006; Savage & Wolforth, 2007; Tiu, Thompson, & Lewis, 2003). Conners (2009) investigated attentional control, which is the ability to suppress irrelevant responses and conjure up relevant responses, as a possible third component to reading comprehension. In his study of 67 eight-year olds, he found attentional control to be a significant factor for reading comprehension (Conners, 2009). Several researchers have tested other factors such as IQ, phonemic awareness, and rapid letter naming (Conners, 2009; Høien-Tengesdal, 2010; Tiu et al., 2003). Most factors have come up insignificant, and while Tiu et al. (2003) claim IQ is a significant factor, Cutting and Scarborough (2006) later concluded it is not. It seems there is still controversy as to whether or not there should be a third component to the simple view, but no one seems to deny decoding and language comprehension are essential components.

Fluency is often seen as the bridge between decoding and comprehension in reading models (Pikulski, 2006). Automatic word recognition is at the heart of fluency because it allows the reader to process print effortlessly and efficiently while saving cognitive resources for thoughtful engagement with the meaning of the text. Thus, it is important to examine the role automaticity plays in the reading process.

Automaticity

As mentioned earlier, oral reading fluency assessments that measure students' automatic word recognition are valuable because research has demonstrated they are good indicators of overall reading ability (Fuchs et al., 2001; Hasbrouck & Tindal, 2006; Morris et al., 2012). The goal for readers is to read words accurately and automatically so more cognitive energy can be utilized for text comprehension (Rasinski, 2012; Rasinski et al., 2011). Automatic word recognition and fluency go hand in hand. Since fluent readers are able to read most words automatically, they are able to free up cognitive resources for comprehension. There are a couple of time-tested theories in the reading field that explain why automatic word recognition is central to improving overall reading ability.

LaBerge & Samuels'ss Theory of Automaticity. Fuchs et al. (2001) refer to LaBerge and Samuels'ss theory of automaticity as "a framework for conceptualizing oral reading fluency as an indicator of overall reading competence" (p. 241). LaBerge and Samuels (1974) attest reading is a complex process, and during the execution of such a complex skill, it is necessary to coordinate many component processes within a very short period of time. "The journey taken by words from their written form on the page to the eventual activation of their meaning [in the mind of the reader] involves several stages of information processing" (LaBerge & Samuels, 1974, p. 293). While this occurs within a fraction of a second for skilled readers, beginning readers tend to allot much of their cognitive processes to decoding words, resulting in little attention left for comprehension. In other words, for the beginning reader to understand what is being read, the student first directs attention to decoding, and then switches attention to comprehending the text, a process that is slow and can overload memory (Schrauben, 2010). LaBerge and Samuels (1974) explain that we can only attend to a few things at a time, so if decoding requires attention, minimal comprehension can take place. On the other hand, we may be able to process many things at once so long as no more than one requires focused attention (LaBerge & Samuels, 1974). Consider the example of novice drivers versus skilled drivers: Beginning drivers need to expend a substantial amount of energy focusing on the road, oncoming traffic, and the functions of the vehicle—thus, all of their attention is focused on driving the vehicle, and talking with a friend can be distracting and can interfere with driving performance. Conversely, skilled drivers can effectively drive a car while attending to other functions such as playing with the radio, talking on a phone, or eating because operating the vehicle has become automatic (Samuels & Flor, 1997). Simply stated, if something does not require attention, it is considered automatic (LaBerge & Samuels, 1974). Automatic word recognition allows higher order thinking skills to take place in a reading episode. When decoding becomes automatic and a minimum of cognitive resources are used in this task, a student will be able to decode and comprehend simultaneously, placing fewer demands on memory (Schrauben, 2010).

LaBerge and Samuels's automaticity theory contends there are two main components of fluent word reading: accurate word decoding and automaticity in word recognition (Schrauben, 2010). Because working memory is limited in cognitive processing, the successful acquisition of these two components will allow readers to have memory left for understanding text (Schrauben, 2010). When the decoding and comprehension processes are automatic, reading appears to be smooth and fluid; however, when they require attention to complete their operations, reading seems to be laborious and slow.

A great deal of practice must take place in order for a skill to become automatic. Often, students only practice until accuracy is reached; although accurate, the students might not be automatic (Samuels & Flor, 1997). There is evidence that learning beyond accuracy to automaticity is a necessary step in skill development in a variety of areas, including reading (Schrauben, 2010). For example, a child may be quite accurate in naming or sounding the letters of the alphabet, but we may not know how much attention it costs him to do it. This information may be useful in an instructional setting because it could be helpful in predicting how easily he can manage new learning skills that build on associations he has learned already.

LaBerge and Samuels's (1974) theory explains how readers can acquire automatic word recognition through successive exposures to print. As readers are repeatedly exposed to words, they should be able to recognize words with increasing accuracy and automaticity. Additionally, Samuels (1988) recommends extensive enjoyable reading as well as repeated readings of short passages to develop automaticity in reading. Research on eye movement supports this notion: Frequency and predictability of words affect fixation time (Rayner et al., 2006). In other words, as a child becomes more familiar with a word, less time is needed to decipher the word. Additionally, if the word is presented in context and the word can be deciphered via meaning, less fixation time is needed. Reichle et al. (1998) posit that "of course, this relation—higher frequency words are fixated on average for shorter periods of time—only forces the conclusion that lexical access of the word (or some related cognitive process) influences the duration of the fixation on at least some of the fixations" (p. 127). When the reader encounters difficult words or complex sentence structures, fixation time increases.

Regarding assessment of automatic word recognition, Samuels and Flor (1997) recommend administering an oral reading comprehension assessment along with a listening comprehension assessment. "For students who are automatic at word recognition, the listening and oral reading scores should be comparable. But for students who are not automatic, the listening scores should be better" (Samuels & Flor, 1997, p. 107). This is because those students with automatic word recognition should be able to spend an equal amount of time on comprehension, whether they are reading the text or it is being read to them. Those students who are not able to process words automatically will need to focus more attention on the decoding processes, leaving less cognitive memory for comprehension and resulting in lower scores on the oral reading comprehension test. Another indicator of automatic word recognition is prosody, because nonfluent readers exhibit poor reading prosody (Samuels & Flor, 1997). Prosody refers to the natural rhythm and flow of language that honors the syntactic structure of the text. Prosody is evident when students read text aloud. Ultimately, teachers should use a combination of indicators such as speed, accuracy, prosody, and comprehension to assess the automaticity of decoding (Samuels & Flor, 1997).

In summary, because of the brain's limits on focusing attention to more than one thing at a time, certain subskills of reading must become automatic in order for a reader to fully comprehend what was read. LaBerge and Samuels's (1974) theory of automaticity maintains that accuracy of words is not enough; rather automaticity must be reached in order to allow sufficient attention to be spent on comprehension. As a child becomes more fluent as a reader and decoding processes become routine and automatic, deeper comprehension of the text ensues because decoding and comprehension can occur simultaneously, with the majority of attentional resources devoted to comprehension.

Perfetti's Verbal Efficiency Theory. Another theory that relates to automaticity is Perfetti's (1985) Verbal Efficiency Theory. Reading is a cognitive process, which utilizes several components simultaneously. The two main components, according to Perfetti, are word recognition and comprehension. However, there are subcomponents, also called local processors, which contribute to the reading process: schema activation, propositional encoding, and lexical access (Perfetti, 1985, 2007). These subcomponents help the reader understand what is being read. As a reader becomes more proficient within the main components and subcomponents, reading ability increases. This is the premise of Perfetti's (1985) Verbal Efficiency Theory. "According to the Verbal Efficiency Theory, each reader has a unique profile of verbal efficiency. The more efficient a reader's profile of verbal efficiency, the more attention and working memory resources are available for other uses by the reader" (Walczyk, 2000, p. 560). In other words, the Verbal Efficiency Theory is a concept of product and cost: The product is reading and the cost is the processing resources required to achieve the outcome. "Verbal efficiency is the quality of verbal processing outcome relative to its cost to processing resources" (Perfetti, 1985, p. 102). Consider children who decode text but have little to no comprehension of what they read: This is likely the result of too many cognitive resources being allocated to decoding the text. The Verbal Efficiency Theory assumes that efficient processing is crippled when there is a high demand on attention and memory to operate subroutines associated with decoding. Conversely, as efficiencies in the various reading components increase, so will comprehension. A given reading task is limited by the momentary efficiency of processing and by the previous learning of the individual. Perfetti (1985) concluded individual differences in reading comprehension were due to the differences in efficiency of the local processes. The theory clarifies how less automated reading subcomponents impair comprehension (Perfetti, 2007).

Verbal efficiency is the extent to which reading subcomponents capable of automatization operate quickly and free of errors (Walczyk, 2000). In this respect, verbal efficiency is analogous to one's level of reading ability. According to the Verbal Efficiency Theory, context-free word recognition is the most salient characteristic of reading ability (Perfetti, 1985). Verbal ability depends on symbol retrieval and activation; therefore it is this process that limits overall reading ability (Perfetti, 2007). In elementary school, decoding limits the reading process, and “high ability readers show more rapid access to symbol names in memory” (Perfetti, 1985, p. 158). Verbal Efficiency Theory predicts a positive association between verbal efficiency and comprehension (Walczyk, 2000). Thus, instruction in word recognition strategies and high volume reading will likely increase comprehension.

Fluency Assessment

LaBerge and Samuels’s (1974) Theory of Automaticity and Perfetti’s (1985, 2007) Verbal Efficiency Theory both attest to the importance of automatic word recognition for fluent reading. By assessing automatic word recognition, the data can be used to gain a better understanding of students' fluency levels and overall reading abilities (Rasinski, 2004). Therefore, it is important to examine what research says about fluency assessments.

Curriculum-based measurements. Fluency assessment is composed of three parts: accuracy, rate, and prosody (Kuhn et al., 2010). An assessment that addresses each component is ideal (Hudson, Pullen, Lane, & Torgensen, 2009; Rasinski, 2003). If at all possible, we should use multiple measures of oral reading fluency assessments including rate, accuracy, prosody, and even passage comprehension to acquire specific diagnostic information needed to inform instruction (Valencia et al., 2010). An example of this kind of assessment is an informal reading inventory (IRI). Traditionally, an IRI uses multiple grade-leveled word lists, grade-leveled passages and comprehension questions to determine fluency and overall reading competency. While the IRI provides a thorough look at a student's reading skills, it is a time-consuming assessment and not always practical for a classroom teacher to perform on more than several students. In 1985, Stanley Deno developed a quick, effective assessment approach known as curriculum-based measurement (CBM), which focused on producing reliable indicators of student growth (Deno, 1985). CBM procedures were developed to measure oral-reading fluency (Deno, 2003).

The CBM approach to reading assessment requires students to read a grade-level passage for one minute; during that time the administrator times the reading and marks the errors in order to determine speed and accuracy expressed in words correct per minute (wcpm). Because this assessment is so quick, multiple passages can be administered during one sitting in order to attain more accurate data. The idea is this assessment is administered several times throughout the year using different passages at the same level to measure growth and adjust instruction. "CBMs were designed to meet several criteria: They were to be reliable and valid, simple and efficient to administer, easily understood by teachers, and inexpensive" (Valencia et al., 2010, p. 272). Moreover, these assessments can be used to diagnose students' fluency in the beginning of the year, to quickly determine those students who fall below the target norms. Finally, by using the assessments throughout the year, students who are not making sufficient progress can be identified rather quickly and receive the necessary intervention.

Reading rate provides a way to measure automaticity because fast reading tends to reflect automatic word recognition if students are reading for meaning (Morris et al., 2011, 2012, 2013a). Referring back to LaBerge and Samuels's (1974) Theory of Automaticity, it is understood automaticity is important because it frees up cognitive resources to allow comprehension to take place. Therefore, since CBM data reveal reading rate by determining words correct per minute (wcpm), this assessment can be used to monitor student growth in both word recognition and comprehension (Deno & Marston, 2006). Ultimately, "reading development presumes increasing word recognition speed, which is associated with enhanced capacity to allocate attention to integrative comprehension processing when engaging with text" (Fuchs, et al., 2001, p. 242). This means a fluency assessment that measures accuracy and rate should serve as an indicator of word recognition skill as well as comprehension skills.

A popular assessment that uses the CBM approach is called the Dynamic Indicator of Basic Early Language Skills or DIBELS (Good & Kaminski, 2002). DIBELS was approved for use in the federal Reading First program in 45 states to monitor progress in fluency as well as other reading skills. It was designed to facilitate early and accurate detection of those in need of reading intervention. This oral-reading fluency assessment is administered three times a year to measure student progress towards grade-based benchmarks (Good & Kaminski, 2002; Good, Wallin, Simmons, Kame'enui, & Kaminski, 2002). In a study conducted with over 1,500 first grade students, it was demonstrated that the DIBELS Oral Reading Fluency subtest proved to be a good predictor of overall comprehension (Riedel, 2007). However, some researchers argue DIBELS does not sufficiently assess comprehension (Deeney, 2010; Paleologos & Brabham, 2011; Samuels, 2006). In regards to the SVR (Gough & Tunmer, 1986), if only one component of reading ability is accounted for (word recognition) and the other is neglected (comprehension) then it may not be an appropriate measure of fluency.

Additionally, some researchers claim use of a CBM independently is insufficient in determining the possible sources of the underlying problems (Hudson et al., 2005; Murray, Munger, & Clonan, 2012). "Although assessment of students' oral reading fluency has undoubtedly led to quicker identification and provision of interventions to students with reading difficulties (Good et al., 2003), these data alone do not provide a complete representation of students' reading needs" (Murray, et al., 2012, p. 149). However, it is important to restate that both proponents and critics of DIBELS and other CBM assessments advocate the use of multiple means of assessment in order to obtain the most thorough and accurate results.

Timed automatic word recognition assessment. In addition to CBMs where students read words in context, isolated word-recognition tests are commonly used in reading battery assessments. According to Frye and Gosky (2012), word-list reading provides a purer measure of a student's word recognition skill because the ability to rely on contextual support is eliminated. This type of assessment provides data about the child's ability to rapidly identify words, which serves as a strong predictor of reading rate (Morris et al., 2011, 2012). A few researchers have argued that reading rate is a good measure of oral reading fluency (Carver, 1990; Good & Kaminski, 2002; Morris et al., 2013a). "Reading rate is a crucial assessment measure because it indicates the ease or efficiency with which a student can process text of different difficulty levels" (Morris et al., 2011, p. 225).

The question is whether to administer the isolated word-recognition assessment as a timed or untimed assessment. Durrell (1937) recognized the value of determining whether students immediately recognized a word or utilized some type of mediation. He developed the technique of using a tachistoscope, which is a device that displays an image for a specific amount of time, to expose each word for a fraction of a second to see if a child could recognize the word immediately. Betts (1946) continued Durrell's research by solidifying the technique. In Betts's tachistoscopic technique, the examiner flashes each word to the child for approximately one quarter to one half of a second and records his or her response. If the children misread the word on the flash presentation, they receive another chance to read the word on the untimed presentation. This type of administration yields two percentage-correct scores on each grade-level list: a *flash score* representing accuracy and automaticity, and an *untimed score* representing just accuracy. Stauffer, Abrams, and Pikulski (1978) later argued that the timed flash score was the better predictor of contextual reading ability. Despite the work of these early researchers, most reading batteries that include graded word lists do not present words in a timed format. Furthermore, when assessments are timed there seems to be no standard for how long a word should be exposed. Frye and Gosky (2012) found that flash times 1000 ms or faster better predicted other measures of reading ability, yet no definitive differences between flash times under a second were found. The researchers explained limitations to the research design may have contributed to the unexpected results and called for further research in this area.

Recently, Morris et al., (2012) conducted a study with 274 students ranging from grades two to six. The purpose of the study was to comprehensively examine the domain of print processing skill while looking at the relations among other factors such as spelling, silent reading rate, and oral reading rate (Morris et al., 2012). The study utilized the flash technique at 500 ms to measure word-level automaticity. If the child misread a word, the examiner allowed additional time (up to 3 seconds) for the child to decode the word. In this way, the student received a score on the timed presentation as well as the untimed presentation. The study revealed the timed word-recognition (flash technique) and spelling component were significant predictors of oral reading rate and silent reading rate. However, no empirical evidence exists to support that a 500 ms exposure to words is better or worse than 1000 ms, or 2000 ms for that matter. It is the purpose of this study to examine these issues.

Summary

Adams's (1990) model explains how reading is primarily a bottom-up process. Beginning with the printed letters on the page, a reader recognizes patterns, matches these with sounds and meaning stored in memory, and builds the meaning of the text. All of these processes occur in less than a second for a fluent reader (Gough, 1972). Similarly, the SVR model (Gough et al.1996) identifies processes responsible for carrying the meaning from a page of text into the mind of the reader. SVR is helpful in thinking about reading assessment because it posits a decoding or print processing set of processes and a language or linguistic set of processes; these two sets work together to allow a reader to build meaning from a text.

Automaticity is at the heart of these processes being able to efficiently function together. When the processes work as they should, reading is fast and accurate, or in other terms *fluent*.

Fluency assessments are commonly used in schools because fluency scores demonstrate children's growth in reading ability (Pikulski 2006; Rasinski, 2004, 2006). Research has shown that a timed automatic word recognition assessment (using the flash technique) is a good indicator of overall reading competency (Morris et al., 2012), yet this approach to assessment is rarely utilized. One concern is no solid evidence exists justifying the correct flash exposure time for each word.

In an attempt to provide the much needed empirical evidence to find the optimal flash time for the assessment technique, Frye & Gosky (2012) conducted a study utilizing four different flash times (300 ms, 650 ms, 1000 ms, and 2000 ms). The research indicated that flash times one second or less were better predictors of oral reading performance than the slower 2000 ms, yet no significant differences were found between 300, 650, and 1000 ms flash times. The lack of differences between these flash times was unexpected and likely due to a weakness in the design of the study—flash conditions were presented as between subjects variables and their participant sample was too small to overcome the added error value created by the between subjects design. While their study established the notion that time does matter, more work needs to be done to narrow down the most efficient flash exposure time.

The Present Study

This brings us to this study, which used various flash times (400 ms, 1000 ms, and 2000 ms) to determine if flash presentation duration influences how well the word recognition instrument predicts performance on other reading assessments. A within subjects (or repeated measures) design was used for the flash variable—each participant received all presentation conditions—to overcome the between design weakness mentioned above. Also assessed were performances on another measure of automatic word recognition (TOWRE), on an IRI (ASUIRI), on a standardized reading achievement measure (GMRT), and on a standardized picture vocabulary measure (PPVT).

The data from this study will answer the following research questions: Does presentation time on an isolated word recognition (ASUWRI) task influence how well the instrument predicts performance on:

1. an isolated word recognition measure (TOWRE)?
2. a contextualized reading measure (ASUIRI)?
3. a standardized measure of reading achievement (GMRT)?
4. a standardized nonprint vocabulary assessment (PPVT)?

Chapter Three: Methodology

As a consequence of *The North Carolina Read to Achieve* goals, effective reading assessments are in high demand in North Carolina, indeed across the country. Ideally, several assessments should be used in order to obtain sufficient data on a student, yet teachers do not always have the time to perform multiple assessments. That being said, the Appalachian State University Word Recognition Inventory (ASUWRI) quickly assesses automatic word recognition by flashing isolated words on a computer screen for students to identify. Previous research has established that scores from isolated word recognition assessments closely align with overall reading competency (Fuchs et al., 2001; Morris et al., 2011, 2013a; Reidel, 2007; Torgesen et al., 1999, 2012). While previous research has demonstrated the ASUWRI to be a valid assessment of oral reading fluency (Frye & Gosky, 2012; Morris et al., 2012), a lack of empirical evidence exists stating exactly how long each word should be exposed during the assessment. Therefore, the purpose of this study is to examine the relations of scores on the ASUWRI under different exposure time conditions to other assessments of reading.

In order to address this issue, third-grade students in Avery County North Carolina were assessed with the ASUWRI at three different flash times, 400 ms, 1000 ms, and 2000 ms. The three scores were compared to students' scores on other measures of reading, including a standardized reading test, to see which exposure time best aligns with the children's overall reading abilities. The following research questions were addressed within this study: Does presentation time on an isolated word recognition (ASUWRI) task influence how well the instrument predicts performance on:

1. an isolated word recognition measure (TOWRE)?
2. a contextualized reading measure (ASUIRI)?
3. a standardized measure of reading achievement (GMRT)?
4. a standardized nonprint vocabulary assessment (PPVT)?

Participants

Fifty-nine third-grade students from three different elementary schools in the Avery County Schools system participated: Banner Elk, Freedom Trail, and Riverside Elementary Schools. Each third grader was given a parental consent form in order to participate in the research, and each student who returned the form was included in the study. (See Appendix C for IRB approval letter.) Third grade was chosen because of the unique impact the students in this grade will face with the *Excellent Public Schools Act of 2012* legislation. Third grade, also, is a transition year between learning to read and reading to learn, and is the first year that students take standardized tests in North Carolina.

Avery County Schools are located in a rural mountain area in the northwest section of North Carolina. Avery County Schools have approximately 2,100 students; 76% of students are Caucasian, 12% are Hispanic, 5% are African-American, and 7% are from other nationalities (North Carolina Department of Public Instruction, 2012). These figures reflect the ethnic makeup of the northwest rural mountain region of North Carolina. Sixty-two percent of students qualify for free or reduced lunch. According to the United States Census Bureau, in Avery County 81% of people 25 and older are high school graduates and 20% hold bachelor’s degrees or higher (United States Department of Commerce, 2012). These figures are similar to North Carolina's averages, which are 83% and 26% respectively (United States Department of Commerce, 2012). In Avery County 18% of people fall below poverty level compared to 15% at the state level.

Assessment Tasks

Data collection commenced in February of 2013 and was completed by May of 2013. The school provided a quiet place for testing, which was unused throughout the school day. Most of the testing took place on Monday, Wednesday, and Friday mornings. Each student participated in three 20-45 minute sessions. During the first session, the TOWRE and the PPVT were administered to each student individually. The TOWRE is a 45 second timed test while the PPVT is untimed but generally did not take longer than 15 minutes. For the second session, the ASUWRI (which includes the flash assessment) and the ASUIRI were both administered individually. For the ASUWRI each student sat in front of a computer while the words were flashed on the screen. Students' responses were recorded on a paper answer sheet. For the ASUIRI students were given a paper copy of two stories, which students read aloud while being timed and the errors were recorded. This was followed by asking questions pertaining to the stories and recording students' responses. The total time for administering the ASUWRI and the ASUIRI during session two was approximately 20 minutes. Lastly, in the third session, the GMRT (a 35-minute timed exam) was administered (whole group) to all students participating in a particular school. This was a multiple-choice assessment completed with paper and pencil.

ASU Word Recognition Inventory. The Appalachian State University Word Recognition Inventory (ASUWRI) used in this study contains three separate lists of 10 second-grade level, 10 third-grade level, and 10 fourth-grade level words. The ASUWRI has been used in previous studies (Frye, 2012; Morris et al., 2011, 2012, 2013a) and was found to be reliable and valid (Morris et al., 2011). It was developed by randomly sampling grade level lists from *Basic Reading Vocabularies* (Harris & Jacobson, 1982). Previous research has reported on the validity and reliability of this assessment. Analyses of the results in this study, as well as Morris et al. (2011), demonstrated the hierarchical nature of the word lists: children's accuracy scores decreased as the grade level of the words increased. When initially created, Harris and Jacobson (1982) sampled grade level readers and selected the words in their corpus only if they appeared in four or more basal reader series at that grade level. The grade level and hierarchical structure of the graded word lists used in this study (ASUWRI) were determined by calculating the mean word frequency of each list based on the index of word frequency, the Standard Frequency Index (SFI) of the *Educator's Word Frequency Guide* (Zeno, Ivens, Millard, & Duvvuri, 1995) and by calculating the mean syllable count of each list. Tables 1, 2, and 3 display each word along with its grade level, SFI rating, and syllable count for the three lists.

Administration of the ASUWRI. Three presentation times (400 ms, 1000 ms, and 2000 ms) were used in the administration of the three lists of the ASUWRI. Each student (tested individually) received three lists (comprised of 10 second-grade, 10 third-grade, and 10 fourth-grade words) at each of the three presentation times, totaling 90 words in all. (See Tables 1, 2, 3, and Appendix A for the lists of words used in the ASUWRI.) On each list the second-grade words were presented first, followed by the third-grade words and then the fourth-grade words at the assigned presentation speed. The presentation time for each list was assigned randomly for participants and counterbalanced. Thus, participants experienced all three different presentation speeds and all 90 words, but the flash times varied on the lists of words. Counterbalancing the design provided an opportunity to compare the three lists for consistency and validity, which meant the lists could not be considered a skewing factor in the results.

Table 1

Second-Grade Word Lists for ASUWRI

List 2.1			List 2.2			List 2.3		
Word	SFI	Syllable	Word	SFI	Syllable	Word	SFI	Syllable
heart	60.1	1	plant	62.5	1	inside	64.4	2
lines	61.5	1	wrote	60.5	1	basket	55.9	2
person	66.1	2	break	60.0	1	perfect	57.2	2
week	61.5	1	north	64.4	1	dug	54.4	1
carry	61.9	2	change	65.6	1	third	61.9	1
gate	56.1	1	hospital	57.9	3	since	66.3	1
rush	54.9	1	pull	58.9	1	shoot	54.0	1
manner	58.0	2	center	62.4	2	felt	64.8	1
short	63.5	1	angry	58.6	2	able	64.8	2
taken	63.8	2	thick	59.9	1	practice	60.2	2
AVG =	**60.7**	**1.4**	**AVG =**	**61.1**	**1.4**	**AVG =**	**60.4**	**1.5**

Note. SFI = Standard Frequency Index—higher values indicate increased frequency.

Table 2

Third-Grade Word Lists for ASUWRI

List 3.1			List 3.2			List 3.3		
Word	SFI	Syllable	Word	SFI	Syllable	Word	SFI	Syllable
scream	50.1	1	closet	51.9	2	straw	53.9	1
bandage	44.9	2	moat	43.9	1	instant	54.4	2
further	60.0	2	accept	57.1	2	slipper	41.7	2
packed	54.6	1	favor	54.2	2	receive	58.3	2
pleasure	55.6	2	heated	54.0	2	jungle	53.2	2
seal	53.4	1	storyteller	43.8	4	canoe	52.1	2
buffalo	54.7	3	icy	51.3	2	forever	55.3	3
haircut	43.2	2	noon	54.3	1	happiness	53.3	3
customer	53.2	3	perform	56.2	2	thread	53.6	1
lonely	54.6	2	duty	55.8	2	legend	51.8	2
AVG =	**52.4**	**1.9**	**AVG =**	**52.3**	**2.0**	**AVG =**	**52.8**	**2.0**

Note. SFI = Standard Frequency Index—higher values indicate increased frequency.

Table 3

Fourth-Grade Word Lists for ASUWRI

List 4.1			List 4.2			List 4.3		
Word	SFI	Syllable	Word	SFI	Syllable	Word	SFI	Syllable
relationship	57.5	4	preparation	53.5	4	coyote	48.7	3
stockade	41.5	2	tobacco	54.6	3	doubtful	47.6	2
gradual	48.7	3	resolution	49.2	4	explode	47.1	2
melody	42.0	3	sausage	45.5	2	opinion	57.2	3
deny	48.8	2	coward	42.6	2	miracle	49.9	3
disguise	46.0	2	suffer	52.7	2	wrestle	41.7	2
entertain	48.2	3	furnace	50.1	2	average	59.1	3
amusing	45.9	3	impress	45.2	2	hamster	41.1	2
select	54.7	2	liberty	53.7	3	brilliant	53.0	2
disease	58.4	2	solemn	47.9	2	honorable	45.4	4
AVG =	**49.2**	**2.6**	**AVG =**	**49.5**	**2.6**	**AVG =**	**49.1**	**2.6**

Note. SFI = Standard Frequency Index—higher values indicate increased frequency.

Scoring the ASUWRI. Each student received ASUWRI scores based on the number of words read correctly. The number of words read correctly on each list was divided by the total number of words for each list (30), and a percentage score was recorded. Each student received a total of three percentage scores (one for each list at the different exposure speeds).

Test of Word Recognition Efficiency (TOWRE). The TOWRE was originally published in 1999 to provide professionals in schools and clinics with an efficient measure of fluency and accuracy of print-based word reading strategies (Torgesen, et al., 1999). The TOWRE-2 (second edition) (Torgesen, et al., 2012) contains two subtests, each with four alternate forms. The subtest that was used in this study, the sight word efficiency subtest, assesses the number of real words printed in vertical lists that an individual can accurately decode in 45 seconds. Each form of the subtest has been shown to be equivalent in difficulty. This assessment was selected because of its reliability and proven effectiveness. “The TOWRE-2 was normed on over 1,700 individuals ranging in age from 6 to 24 years and residing in 12 states and Washington, DC” (Torgesen, et al., 2012, p. 7).

Administration of the TOWRE-2. I administered this assessment individually to students, and I informed them that they should read the provided list of words as fast as they could. Students were instructed to read the words in order (from the top-down) and if they came across a word they didn’t know they were instructed to skip it. The assessment began with a short practice list, and when the practice test was completed, I set a timer for 45 seconds and marked all words that students read correctly.

Scoring the TOWRE-2. I recorded the total number of words the student read correctly in 45 seconds by marking any word read correctly with 1 and any word missed with 0. No student finished reading the entire list of words in the 45 seconds allotted. If a student skipped a word or hesitated more than three seconds, it counted as a miss and was scored 0. A total score of words read correctly in 45 seconds was calculated.

ASU Informal Reading Inventory (ASUIRI). An IRI is designed to measure word recognition in a contextual reading setting, followed by a comprehension check. Two third-grade passages were selected from the ASUIRI battery (see Appendix B) and scores from these passages were averaged. The passages were chosen from well-known commercially published reading inventories, have been used in other studies (Morris et al., 2011, 2012, 2013a) and have been found to be valid and reliable.

Administration of the ASUIRI. Students read each passage from a paper copy as they were timed and audio recorded (using Audacity software). Each child received the same two third-grade passages. Students read the passages as I checked for oral reading errors. If a child came to a word and hesitated, I allowed three seconds before providing the word. When the last word in the passage had been read, I recorded the time and proceeded to ask the six comprehension questions pertaining to the passage. From each oral reading, I calculated oral reading accuracy, oral reading rate, and a comprehension score.

Scoring of the ASUIRI. Each third-grade passage from the ASUIRI yielded three scores: oral reading accuracy (ASUIRI accuracy), oral reading rate (ASUIRI wpm), and oral reading comprehension (ASUIRI comprehension). Oral reading accuracy (ASUIRI accuracy) is the percentage of words read correctly. Oral reading rate (ASUIRI wpm), expressed in words read per minute (wpm), was computed for each passage read. The formula for computing reading rate (wpm) is: [60 × number of words in passage ÷ number of seconds to read passage]. Thus, if a student read a 150-word passage in 75 seconds, his rate was 120 wpm ($60 \times 150 \div 75 = 120$) (Morris et al., 2013a). Oral reading comprehension (ASUIRI comprehension) was calculated from the number of questions answered correctly. There were six questions for the third-grade passages, and the number correct out of six was converted into a percentage. The scores for the two third-grade passages were averaged for each student to produce three scores: ASUIRI accuracy, ASUIRI wpm, and ASUIRI comprehension.

Gates-MacGinitie Reading Tests (GMRT). The GMRT are standardized reading and vocabulary tests designed to provide a general assessment of reading achievement. The

GMRT grew out of the Gates Primary Reading Tests, which were developed by Columbia University Professor Arthur I. Gates. Published in 1926, these assessments were some of the first nationally used standardized reading tests (Jongsma, 1980). The tests were revised in the 1950's and 1960's, with the assistance of William H. MacGinitie, and became the Gates-MacGinitie Reading Tests. The tests are currently in their fourth edition (MacGinitie, et al., 2000).

The tests are formatted into grade levels, and each level consists of a vocabulary test and a comprehension test. Only the comprehension test was used in this study. The comprehension test measures a student's ability to read and understand different types of prose. The GMRT contains 11 passages of various lengths and about various subjects, all selected from published books or periodicals (MacGinitie, et al., 2000). There are a total of 48 questions for students to answer. Some of the questions are literal and require students to use information that is explicitly stated in the passage, while others are based on information that is implied in the passage.

Administration of the GMRT. This test can be given to groups of students, though its authors recommend no more than 35 students at one time. For this study, the assessment was administered whole group in each class that participated. This number never exceeded 35 students. Each student needed access to a desk or table spaced away from others in order to prevent copying. In some situations desks were separated, and in other instances folders served as barriers between students. I followed instructions in the administration manual and provided the directions exactly as they appeared in the manual. Students silently read the passages and marked their responses directly in the test booklets. They had exactly 35 minutes to complete the comprehension test. If students finished early, they were asked to sit quietly until the allotted time had ended.

Scoring of the GMRT. I determined a raw score by totaling the number of correct responses. Once the raw score was established, I could use the *Manual for Scoring and Interpretation* (MacGinitie et al., 2000) to align the score with five types of norming data: norm curve equivalence, percentile rank, stanine, grade equivalent, and extended scale score. However, only the raw score (GMRT) was utilized in analyses for this study.

Peabody Picture Vocabulary Test (PPVT). The PPVT-4 (Dunn & Dunn, 2007) was selected for this study for its ability to assess linguistic comprehension. The PPVT is a norm-referenced assessment that measures receptive vocabulary of children and adults. According to the authors, the PPVT measures an individual's receptive (hearing) vocabulary for Standard American English and provides, at the same time, a quick estimate of verbal ability or scholastic aptitude (Dunn & Dunn, 2007). This assessment is also beneficial for assessing non-readers and those with limited written-language abilities. The test includes 228 test questions, each with a stimulus word (the vocabulary item tested) and four corresponding pictures. Five training items are included for practice.

Administration of the PPVT-4. Two parallel forms of this assessment were available; Form A was used in this study. The starting point for this assessment was determined by the age of the student; in this study I began with item 9. However, a base level must be established for each student, where the student has no more than one error on the beginning list. If the student had more than one error on the first list, I tested that student from the beginning of the test. After establishing the base level, I proceeded forward testing the students until a ceiling score was reached, which was when a student made eight consecutive errors. For each vocabulary item on the PPVT-4, I called out the vocabulary word while the student examined the four pictures in the booklet in front of him, looking for the picture that most closely exemplified the word. The student could point to the picture he thought represented the meaning of the vocabulary item or verbally state the number that corresponded with his response. I noted the student's correct and incorrect responses on the answer form. I stopped testing once the student reached the ceiling.

Scoring of the PPVT-4. A raw score for the PPVT was calculated by adding the number of total questions tested, including the base set and the ceiling set, then subtracting the number of errors. The raw score (PPVT) was used in this study.

Summary of Assessment Tasks. The selected assessments align with the Simple View of Reading (SVR) (Gough et al., 1996; Gough & Tunmer, 1986; Hoover & Gough, 1990), which is represented by the formula R = L x D, where R is a child's overall reading ability or reading comprehension, L is language or linguistic comprehension, and D represents decoding or print processing. Automatic word recognition, considered one important aspect of a student's reading ability, represents the D in SVR. The ASUWRI and the TOWRE were selected because they are widely used isolated word recognition assessments, and TOWRE has been used as a measure of D in studies of SVR (Adolf, Catts, & Little, 2006; Morris et al., 2013a; Torgesen et al., 1999, 2012). The ASUIRI assesses reading accuracy and words per minute (the D factor measured in connected discourse) as well as reading comprehension (the R factor or overall reading ability of the child). The ASUIRI has been proven to be an effective measure of reading in previous studies (Morris et al., 2011, 2013a). The GMRT is a standardized reading assessment that measures overall reading ability or the R component of the SVR equation (MacGinitie, et al., 2000). The

PPVT was selected to measure language or linguistic comprehension because it is a nonprint vocabulary assessment and has been used to measure the L part of the equation (Adolf et al., 2006; Dunn & Dunn, 1981, 2007).

Research has established the use of multiple assessments to measure the components of the SVR, and so this study was designed to do that as well. For example, Pierce, Katzir, Wolf and Noam (2007) conducted a study that examined at-risk readers in grades two and three and found different profiles of reading skills pertaining to SVR: Some students had average word reading skills (D) but deficits in vocabulary (L); others exhibited low sight word efficiency (D) but average passage reading (L) (Pierce et al., 2007). Including assessments that measure each component of SVR expands the assessment information collected and connects that information to a meaningful theory of the reading process.

Data Analysis

Descriptive statistics and correlations were conducted in order to establish convergent validity across the different measures that were used in this study. These correlations also served as a basis for selecting options for multivariate analyses. *Pearson's r* correlation coefficient was used to examine the relations between the assessments. One-Way Analysis of Variance (ANOVA) was used with the word lists in order to confirm that the three word lists were not statistically different from one another. Furthermore, a conditional frequency table of the words showed that second grade words are easier than third grade words and third grade words are easier than fourth grade words.

Stepwise multiple linear regressions were used to determine how well scores from the ASUWRI at the different presentation times predicted scores from the TOWRE, from the ASUIRI (wpm), from the reading comprehension test of the GMRT, and from the PPVT. The goal of multiple regression is to assess the relations between a dependent variable (predicted) and more than one independent variables (predictors). Stepwise regression is used to determine what variable or set of variables best predicts the dependent variable. In this analysis, predictor variables are entered into the regression equation one at a time based upon statistical criteria—the strongest predictor being selected first—and the analysis stops when no more meaningful information can be added to the regression equation (Cohen, Cohen, West, & Aiken, 2003). Thus, for this study, the regression analyses would determine which (if any) flash time scores predicted each of the dependent variables—other measures of students' reading abilities. The first predictor variable in the regression equation would be the better predictor of the dependent variable in question and would account for more of the variance of the scores on that variable.

Chapter Four: Results

The purpose of this study was to determine which flash presentation speed of the Appalachian State University Word Reading Inventory (ASUWRI) best predicted students' overall reading ability. The ASUWRI is an isolated word recognition test, where students identify each word that is presented for a predetermined amount of time. The ASUWRI word lists were flashed on a computer screen for each participant at three different times (400 ms, 1000 ms, and 2000 ms). Morris et al. (2011, 2012) used a manual flash time of approximately 500 ms and found the ASUWRI to be an effective measure of students' reading levels, although the exact flash time could not be controlled because of the manual procedure that was used. Frye and Gosky's (2012) used a computer to flash the words on the ASUWRI to control presentation speeds and determine if flash time affected the instrument's ability to predict other reading assessment scores. Their research concluded that faster flash speeds (1000 ms or faster) were better predictors of other reading measures than slower flash speeds (slower than 1000 ms), yet advantages of specific flash times were not determined. The present study builds on the work of these researchers.

The ASUWRI was used as a measure of automatic word recognition, considered one important aspect of a student's reading ability. Other measures of reading ability were used to determine how well the ASUWRI (at different flash speeds) predicted overall reading ability. Those other measures included: (a) the Test of Word Reading Efficiency (TOWRE), a 45-second word reading assessment that is most similar to the ASUWRI; (b) the

Appalachian State University Informal Reading Inventory (ASUIRI), leveled contextual reading passages followed by comprehension questions; (c) the Gates-MacGinitie Reading Test (GMRT), a standardized reading comprehension test; and (d) the Peabody Picture Vocabulary Test (PPVT), a standardized nonprint vocabulary assessment.

Descriptive Data Analyses, Correlations, and ANOVA

Descriptive analyses were used to examine the data for consistency and to establish means and standard deviations for the variables analyzed. Correlations among the assessment variables were calculated to examine patterns in the relations of these variables. One-Way Analysis of Variance (ANOVA) tests were used to check for validity and equivalence of the three word lists used in the study; these were conducted for each of the presentation time conditions. Then, stepwise multiple regressions were used to determine which exposure speeds on the ASUWRI were significant in predicting overall reading ability, as determined by multiple assessments (ASUIRI words-per-minute, TOWRE, PPVT, GMRT).

Before conducting further analyses, the data were screened for missing data, outliers, and assumptions. One student's scores were significantly lower than the other participants', and she was deemed a nonreader. She had the lowest scores on each of the five assessments and read 35 words per minute at the third grade level with only 50% comprehension as determined by the ASUIRI. On average, third graders are expected to read approximately 110 words per minute (Hasbrouck & Tindal, 2006; Morris et al., 2011). This student's data were removed from the data set prior to analyses to prevent any skewing of the data, bringing the total number of participants to 58.

Also, prior to conducting analyses, scores for the ASUIRI had to be computed into a single score since two passages (Passage A and Passage B) were used. Computing average scores from two passages allowed for a more valid measure of contextual reading. A mean score was computed for ASUIRI accuracy, ASUIRI comprehension, and ASUIRI wpm from Passage A and Passage B. Descriptive statistics for each assessment are reported in Table 4.

Table 4

Descriptive Statistics of Assessments (n= 58)

Assessment	*M*	*SD*
ASUWRI at 400 ms	71.64	20.67
ASUWRI at 1000 ms	75.10	19.99
ASUWRI at 2000 ms	77.31	18.28
*ASUIRI accuracy	96.49	4.08
*ASUIRI comprehension	82.13	15.17
ASUIRI words per minute	112.31	33.93
GMRT	30.64	9.22
PPVT	147.95	14.34
TOWRE	59.38	11.03

* ASUIRI accuracy and comprehension scores were not used in the regression analyses. ASUIRI wpm has been shown to be a better measure of reading performance, and so it was used in subsequent analyses (Hendrix, 2013; Morris et al., 2011, 2012, 2013).

Pearson's r correlation coefficient was used to examine the relations between the assessments. These results are found in Table 5.

Table 5

Reading Assessment Correlations (n=58)

	TOWRE	PPVT	ASUWRI at 400 ms	ASUWRI at 1000 ms	ASUWRI at 2000 ms	GMRT	ASUIRI accuracy	ASUIRI words-per-minute
TOWRE	--							
PPVT	.29	--						
ASUWRI at 400 ms	.74*	.48*	--					
ASUWRI at 1000 ms	.74*	.36*	.84*	--				
ASUWRI at 2000 ms	.67*	.32*	.86*	.90*	--			
GMRT	.62*	.49*	.68*	.67*	.66*	--		
ASUIRI accuracy	.41*	0.33	.48*	.59*	.53*	.36*	--	
ASUIRI wpm	.84*	0.28	.77*	.75*	.72*	.70*	.44*	--
ASUIRI comprehension	.09	.45*	.30	.19	.30	.35*	.02	.17

Note. (a) TOWRE is raw score on Test of Reading Efficiency, PPVT is raw score on Peabody Picture Vocabulary Test, ASUWRI at 400 msec is percentage scored on ASUIRI when words were exposed for 400 milliseconds, ASUWRI at 1000 msec is percentage scored on Appalachian State Word Reading Inventory when words were exposed for 1000 milliseconds, ASUWRI at 2000 msec is percentage scored on Appalachian State Word Reading Inventory when words were exposed for 2000 milliseconds, GMRT is the raw score on the comprehension portion of the Gates-MacGinitie Reading Test, ASUIRI accuracy is the accuracy score on the Appalachian State Informal Reading Inventory, ASUIRI words-per-minute is the words correct per minute score on the Appalachian State Informal Reading Inventory, ASUIRI comprehension is the comprehension score on the Appalachian State Informal Reading Inventory; (b) *p <.01.

The descriptive statistics and correlations revealed that the data were normally distributed and the means were within the normal range for average third-grade readers and conformed to norms established by Morris et al. (2011). Correlations revealed expected relations among the variables. The scores on the three lists of the ASUWRI are highly and significantly correlated with each other, yet the means show a linear pattern—the faster the list is flashed, the lower the performance score. This may indicate that faster times capture more variance in student performance, which is supported by the fact that the standard deviations were larger for faster flash times. All three flash time scores for the ASUWRI were highly and significantly correlated with TOWRE scores. This was expected because the ASUWRI and TOWRE are similar assessments, designed to measure recognition of words presented out of context. Both TOWRE and ASUWRI were highly and significantly correlated with ASUIRI wpm scores, replicating a finding from Morris et al. (2012). ASUIRI accuracy scores were significantly correlated at a moderate level with both TOWRE and ASUWRI, but ASUIRI comprehension was not correlated to either. However, the mean score on ASUIRI comprehension was 82%, indicating a ceiling effect. This also indicated that the students in this study understood Passage A and Passage B, adding validity to the ASUIRI wpm scores. The print processing measures (ASUWRI and TOWRE) were moderately and significantly correlated with GMRT; ASUIRI wpm and GMRT were highly and significantly correlated. This last finding was expected because both ASUIRI and GMRT are measuring performance when students are reading connected discourse. Finally, the correlations showed a weak or nonexistent relation between print processing variables (the D in SVR) and PPVT (the L in SVR); this was expected because the theory posits that these are two different dimensions of the reading process.

As referenced in Chapter 3: Methodology, three word lists were used in the ASUWRI. Each list contained 10 words at the second-, third-, and fourth-grade levels, totaling 30 words in each list (see Appendix A). Each student received all three lists (List A, List B, and List C) at the three different exposure speeds. For a more detailed description of administration procedures, including how these lists were counterbalanced, see Chapter 3: Methodology. Because each list comprised different words, it was important to make sure there was no statistical difference between the three word lists. In order to examine this, three One-Way Analysis of Variance (ANOVA) tests were conducted using SPSS version 20. The first ANOVA examined the three word lists at the 400 ms speed. Results of the first One-Way ANOVA indicated that there was no statistically significant difference between the three word lists ($F(2,55) = 1.67$, $p = .20$). (See Table 6 for descriptive statistics.)

Table 6

One-Way ANOVA for word lists flashed at 400 ms (n = 58)

	M	*SD*
List A	68.80	17.86
List B	78.63	21.41
List C	67.63	20.67

The second One-Way ANOVA examined the three word lists at the 1000 ms speed. Results indicated that there was no statistically significant difference between the three word lists ($F(2,55) = 1.81$, $p = .17$). (See Table 7 for descriptive statistics.)

Table 7

One-Way ANOVA for word lists flashed at 1000 ms (n = 58)

	M	*SD*
List A	75.35	19.42
List B	81.05	16.34
List C	68.89	22.85

The third One-Way ANOVA examined the three word lists at the 2000 ms speed. Results indicated that again there was no statistically significant difference between the three word lists ($F(2,55) = 1.53$, $p = .22$). (See Table 8 for descriptive statistics.)

Table 8

One-Way ANOVA for word lists flashed at 2000 ms (n = 58)

	M	*SD*
List A	73.56	19.02
List B	75.00	16.64
List C	83.00	18.67

Multivariate Data Analysis

After initial data screening and analyses, stepwise multiple regressions using SPSS version 20 were used to determine which flash speed on the ASUWRI was a better predictor of students' overall reading ability, as measured by scores on the TOWRE, ASUIRI wpm, PPVT, and GMRT. In order to minimize type I errors the alpha was set at .01 *a priori*.

The first stepwise multiple regression was conducted to determine which flash speed on the ASUWRI (400 ms, 1000 ms, 2000 ms) was a better predictor of students' overall reading ability as measured by the TOWRE. In this regression model, the TOWRE score was the dependent variable and scores for each flash time were the independent variables. Before the standard regression was performed, the independent variables were examined for collinearity. Some collinearity was expected to exist as word lists were not statistically different and the only difference between the independent variables was exposure time. Results of the variance inflation factor (VIF) (all less than 7) and the collinearity tolerance (all greater than .15) suggested that there was collinearity between the independent variables. As this was an expected result, data analyses proceeded.

The results of this regression indicated that the variance accounted for (R^2) by ASUWRI at 400 ms equaled .54, which was statistically significantly different from zero (F (1, 56) = 66.26, p < .001). When ASUWRI at 1000 ms was entered into the regression equation, the change in variance accounted for (ΔR^2) was equal to .05, which was not statistically significantly different from zero (F (1, 55) = 5.96, p = .018). When ASUWRI at 2000 ms was entered into the regression equation, the change in variance accounted for (ΔR^2) was .009, which was not statistically significantly different from zero (F (1, 54) = 1.21, p = .28). The unstandardized regression coefficients (B) and intercept, and the standardized regression coefficient (β) for the full model are reported in Table 9. Results of this stepwise regression indicated that the ASUWRI at 400 ms contributed significantly to the prediction of students' overall reading ability, as measured by the TOWRE. The other flash times did not add to the significance of the prediction.

Table 9

Unstandardized Regression Coefficients (B) and Intercept, the Standardized Regression Coefficients (β), t-values, and p-values for Variables as Predictor of Reading Ability Measured by the TOWRE

Variables	*B*	*β*	*t*-value	*p*-value
Intercept	29.60		7.11	< .01
ASUWRI at 400 ms	.26	.10	2.73	< .01
ASUWRI at 1000 ms	.30	.12	2.58	.013
ASUWRI at 2000 ms	-.15	.14	-1.10	.277

The second stepwise multiple regression was conducted to determine which flash speed on the ASUWRI (400 ms, 1000 ms, 2000 ms) was a better predictor of students' overall reading ability as measured by the ASUIRI wpm. ASUIRI wpm was the dependent variable and scores for each flash time were the independent variables.

The results of this regression indicated that the variance accounted for (R^2) by ASUWRI at 400 ms equaled .59, which was statistically significantly different from zero (F (1, 56) = 81.80, $p < .001$). When ASUWRI at 1000 ms was entered into the regression equation, the change in variance account for (ΔR^2) was equal to .04, which was not statistically significantly different from zero (F (1, 55) = 5.49, $p = .02$). When ASUWRI at 2000 ms was entered into the regression equation, the change in variance account for (ΔR^2) was less than .001, which was not statistically significantly different from zero (F (1, 54) = .05, $p = .83$). The unstandardized regression coefficients (*B*) and intercept, and the standardized regression coefficient (*β*) for the full model are reported in Table 10.

Table 10

Unstandardized Regression Coefficients (B) and Intercept, the Standardized Regression Coefficients (β), t-values, and p-values for Variables as Predictor of Reading Ability Measured by the ASUIRI words-per-minute

Variables	*B*	*β*	*t*-value	*p*-value
Intercept	12.74		1.04	.30
ASUWRI at 400 ms	.80	.48	2.83	< .01
ASUWRI at 1000 ms	..65	.39	1.91	.06
ASUWRI at 2000 ms	-.84	-.05	-.21	.83

Results of this stepwise regression indicate that the ASUWRI at 400 ms contributes significantly to the prediction of students' overall reading ability, as measured by ASUIRI wpm.

The third stepwise multiple regression was conducted to determine which flash speed on the ASUWRI (400 ms, 1000 ms, 2000 ms) was a better predictor of students' overall reading ability as measured by the GMRT. In this regression model, the GMRT score was the dependent variable and scores for each flash time were the independent variables. The results of this regression were interesting. As stepwise regression chooses the order in which variables are entered into the equation based on their correlation to the dependent variable, ASUWRI at 1000 ms was entered into the equation and then removed. The overall model with ASUWRI at 400 ms and ASUWRI at 2000 ms did not fit the regression equation, as indicated by insignificant p values in the full model (see Table 11).

Table 11

Unstandardized Regression Coefficients (B) and Intercept, the Standardized Regression Coefficients (β), t-values, and p-values for Variables as Predictor of Reading Ability Measured by the GMRT

Variables	*B*	*β*	*t*-value	*p*-value
Intercept	5.54		1.42	.16
ASUWRI at 400 ms	.19	.43	2.25	.03
ASUWRI at 2000 ms	.15	.29	1.54	.13

It is meaningful, however, to report that the variance accounted for (R^2) by ASUWRI at 400 ms equaled .46, which was statistically significantly different from zero (F (1, 56) = 48.25, p < .001). When ASUWRI at 2000 ms was entered into the regression equation, the change in variance account for (ΔR^2) was .02, which was not statistically significantly different from zero (F (1, 55) = 2.39, p = .13). The unstandardized regression coefficients (*B*) and intercept, and the standardized regression coefficient (*β*) for the full model are reported in Table 11. Results of this stepwise regression indicated that the ASUWRI at 400 ms contributed significantly to the prediction of students' overall reading ability, as measured by the GMRT, but that results of this analysis should be taken with caution as collinearity is an issue throughout this study and all variables were not considered in the full model.

To remain consistent with Gough's SVR (Gough et al., 1996; Gough & Tunmer, 1986; Hoover & Gough, 1990), another stepwise multiple regression was used with the Peabody's Picture Vocabulary Test (PPVT) as the dependent variable. According to the SVR both decoding and language comprehension affect reading competency (R = D x L). The flash assessment at the different exposure speeds assessed the decoding component; the

PPVT assessed the language comprehension factor. Therefore, the fourth stepwise multiple regression was conducted to determine which flash speed on the ASUWRI (400 ms, 1000 ms, 2000 ms) was a better predictor of students' language comprehension ability as measured by the PPVT. In this regression model, the PPVT score was the dependent variable and scores for each flash time were the independent variables. The results of this regression were interesting as well. ASUWRI at 1000 ms was entered into the equation and then removed. The overall model with ASUWRI at 400 ms and ASUWRI at 2000 ms did not fit the regression equation, as indicated by insignificant p values in the full model (see Table 12). Again, it is meaningful to report that the variance accounted for (R^2) by ASUWRI at 400 ms equaled .48, which was statistically significantly different from zero (F (1, 56) = 17.03, p < .001). When ASUWRI at 2000 ms was entered into the regression equation, the change in variance account for (ΔR^2) was .04, which was not statistically significantly different from zero (F (1, 55) = 2.63, p = .11). The unstandardized regression coefficients (B) and intercept, and the standardized regression coefficient (β) for the full model are reported in Table 12.

Table 12

Unstandardized Regression Coefficients (B) and Intercept, the Standardized Regression Coefficients (β), t-values, and p-values for Variables as Predictor of Reading Ability Measured by the PPVT

Variables	*B*	*β*	*t*-value	*p*-value
Intercept	130.52		18.11	< .001
ASUWRI at 400 ms	.56	.16	3.52	< .01
ASUWRI at 2000 ms	-.29	-.37	-1.62	.11

Results of this stepwise regression indicate that the ASUWRI at 400 ms contributes significantly to the prediction of students' overall reading ability, as measured by the PPVT, but that results of this analysis should be taken with caution as collinearity is an issue throughout this study and all variables were not considered in the full model.

The results of the third and fourth stepwise multiple regressions and the differences between these analyses and the first two stepwise analyses can be explained further by the relatively low correlation between the ASUWRI at 400 ms and those dependent measures (PPVT and GMRT) as compared to higher correlations between ASUWRI at 400 ms and TOWRE and ASUIRI words-per-minute. Although all of these relations denoted by Table 5 are statistically significant, there are differences in the aspects of reading that the PPVT and GMRT are assessing versus the TOWRE and ASUIRI wpm as discussed earlier. The result of interest in all of these studies is the amount of variance accounted for by the students' scores on the ASUWRI at 400 ms as compared to longer flash times. Other limitations to the generalizability of the results will be discussed in Chapter 5: Discussion and Implications.

Summary of Findings

The present study investigated the role of automaticity in oral reading fluency by means of an isolated word reading inventory (ASUWRI). The study involved utilizing three word lists, equal in complexity, flashed at three different exposure speeds. The results at each speed were then compared to other reading measurements including the TOWRE, the ASUIRI wpm, the PPVT and the GMRT in order to determine which exposure speed would predict students' overall reading competency.

It was important to examine the relations among all of the assessment batteries utilized in this study. This information was presented in Table 5 as correlations. Next, all three word lists were analyzed with One-Way Analysis of Variance (ANOVA) in order to make sure each of the lists was equivalent to the others. Using a One-Way ANOVA each word list (A, B, C) was examined at each of the three exposure speeds (400 ms, 1000 ms, 2000 ms) and data revealed that there were no statistically significant differences among the three lists. These data can be found in Tables 6, 7, and 8.

Next, stepwise multiple regressions were used to determine which exposure speeds on the ASUWRI were significant in predicting overall reading ability, as determined by multiple assessments (TOWRE, ASUIRI wpm, GMRT, PPVT). The focus of a stepwise regression is to answer the question about what combination of independent variables would be the best in predicting the dependent variable. At each step in the analysis the independent variable that contributes the most to the prediction equation is entered first, but when no additional independent variables add anything statistically meaningful to the regression equation, the analysis stops (Cohen et al., 2003). In this study, four separate stepwise multiple regressions were conducted with the three exposure speeds (400 ms, 1000 ms, 2000 ms) as the independent variables in each analysis. The dependent variables were TOWRE, ASUIRI wpm, GMRT, and PPVT (in that order). In each regression, results indicated that the ASUWRI at 400 ms contributed significantly to the prediction of students' overall reading ability. However analyses for the GMRT and PPVT should be taken with caution as collinearity was an issue throughout this study and all variables were not considered in the full model; specifically the scores at 1000 ms were rejected from the regression equations. A thorough examination of these results is discussed in Chapter 5: Discussion and Implications.

Chapter 5: Discussion and Implications

The k-3 literacy initiative of North Carolina's *Excellent Public Schools Act of 2012* was enacted to ensure that every student read at or above grade level by the end of third grade (*Excellent Public Schools Act, 2012*). The hope is students who struggle with reading are identified as early as possible and receive the appropriate instruction and services needed for growth in reading. According to this law, progression to the next grade level will depend, in part, upon proficiency in reading (*Excellent Public Schools Act*, *2012*). There are serious implications for students who do not read proficiently by the end of the third-grade year (as determined by standardized and district level assessments). These students will be required to attend summer school programs with intensive reading support, and then, if they still are not reading at grade-level, they will be placed in transitional fourth-grade classes or repeat third grade. This law increases pressure on teachers to quickly and accurately assess students' reading performances throughout the year. This study closely examined the Appalachian State University Word Reading Inventory (ASUWRI), an isolated word assessment that can be used to measure students' automaticity and reading fluency levels.

Automaticity means getting the words off the page quickly and effortlessly, without conscious attention (Fuchs et al., 2001). Readers have limited resources available for complex tasks, so if they spend more time and effort decoding printed words, less attention is available for comprehension (Laberge & Samuels, 1974; Perfetti, 1985, 2007). Adams (1990) states, "Human attention is limited. To understand connected text, our [conscious] attention cannot be directed to the identities of individual words or letters” (p. 228). Thus the need for instant word recognition, or automaticity, is essential for fluent reading (Morris et al, 2011, 2012, 2013a; Rayner et al., 2006; Reichle et al., 1998; Samuels & Flor, 1997; Schrauben, 2010).

The importance of efficient word recognition is reiterated within the Simple View of Reading (Gough et al., 1996; Gough & Tunmer, 1986; Hoover & Gough, 1990; Kirby & Savage, 2008). According to the SVR, reading is the result of the multiplicative nature of two components, decoding and linguistic (language) comprehension, captured in the formula R = D x L (Gough & Tunmer, 1986). Gough et al. (1996) further explain the relation between decoding and linguistic comprehension: “A child who cannot decode cannot read; a child who cannot comprehend cannot read either. Literacy—reading ability—can only be found in the presence of both decoding and comprehension. Both skills are necessary; neither is sufficient” (p. 3). Following this line of thought, a reader may struggle to read efficiently because decoding skills or language comprehension skills or both are weak. Only an appropriate battery of reading assessments can determine the strengths and weaknesses of these skills, and the value of an assessment battery is increased if measures are included that can assess decoding (word recognition) and language comprehension separately (Høien-Tengesdal, 2010; Hudson et al., 2009; Morris, 2008; Morris et al., 2012, 2013a).

The SVR served as a framework for this study and was the basis for the selection of the assessments used. The ASUWRI and the Test of Word Reading Efficiency (TOWRE) are both isolated word recognition assessments that measure automaticity, which relates to the decoding (D) factor of Gough’s SVR formula (Gough & Tunmer, 1986). Though both assess decoding skills, each is administered differently. The ASUWRI uses a computer to flash (for a predetermined amount of time) individual words in front of the student. The TOWRE, on the other hand, provides a list of words and gives examinees 45 seconds to read as many as possible. Both measure decoding of isolated words. The Appalachian State University Informal Reading Inventory (ASUIRI) measures decoding of words in context, when students are reading for meaning. The rate (wpm) of reading is a measure of reading fluency (Fuchs, et al., 2001; Hendrix, 2013; Morris et al., 2011, 2012, 2013a; Wolf & Katzie-Cohen, 2001). The Peabody Picture Vocabulary Test (PPVT), a nonprint vocabulary test, was selected to measure linguistic (language) comprehension, the L of the SVR. The Gates-MacGinitie Reading Test (GMRT) is a multiple-choice reading comprehension assessment, which provides data on students' overall reading competencies (R).

While many analyses could be conducted with these data, the focus of this study was to learn which flash exposure speed (400 ms, 1000 ms, or 2000 ms) of the words in the ASUWRI best predicted students' reading behaviors, as measured by scores on TOWRE, ASUIRI wpm, GMRT, and PPVT.

Major Findings of the Study

The repeated measures design of this study, which was a strength and corrected a weakness in the Frye & Gosky (2012) study of automatic word recognition, required each student to read three separate graded lists of words, presented at three different flash speeds. Analyses revealed the three lists were not statistically different from one another; therefore, comparisons between the different flash exposure speeds of the lists were appropriate. Differences were due to the flash speeds and not the lists themselves.

Descriptive statistics revealed that the data were normally distributed, and the means of the ASUIRI were within the normal range for average third-grade readers established by research (Good et al., 2002; Hasbrouck & Tindal, 2006; Morris, 2008; Morris et al., 2011). Means of ASUIRI accuracy ($M = 96$, $SD = 4$) and comprehension ($M = 82$, $SD = 15$) were almost identical to the means on the same measures for third-grade readers from Morris et al. (2011), accuracy ($M = 96$, $SD = 4$) and comprehension ($M = 85$, $SD = 17$). Furthermore, the high scores on the comprehension measure revealed students were reading for meaning and did understand the passages of the ASUIRI. The consistency of these findings gave validity to the ASUIRI wpm scores; the mean ($M = 112$ wpm, $SD = 34$) from this study was similar to the mean ($M = 119$ wpm, $SD = 36$) from Morris et al. (2011) and the mean ($M = 119$ wpm) from Good, et al. (2002). In addition, means of the ASUWRI were within the expected grade-level range of 60 to 80 established by Morris (2008) for this assessment and showed a pattern of lower scores and more variance for faster flash times, suggesting more discrimination with the faster presentation speeds.

The faster exposure time (400 ms) of the ASUWRI was significantly and more highly correlated to scores from TOWRE, ASUIRI wpm, GMRT, and PPVT. In addition, stepwise multiple linear regressions clearly revealed that the 400 ms exposure speed was the best predictor of overall reading competency as measured by the TOWRE and ASUIRI wpm. The 400 ms speed did contribute to more variance in reading competency as measured by the GMRT and PPVT, but the full model was not supported; specifically, the scores at 1000 ms were rejected from the regression equations.

In summary, other flash speeds (1000 ms and 2000 ms) did not make significant differences in the regression analyses. The ASUWRI at 400 ms contributed significantly ($p < .01$) to the prediction of students' scores on the TOWRE and the ASUIRI wpm. This makes sense because like the ASUWRI, the TOWRE also assesses words in isolation. The

ASUIRI wpm is a measure of reading fluency in connected text and has been shown to be highly correlated with measures of isolated word automaticity (Frye & Gosky, 2012; Morris et al. 2011, 2012, 2013a; Riedel, 2007; Torgesen et al., 1999, 2012). These findings represent expected relations between established measures of print processing or decoding, the D in SVR. Neither the GMRT nor the PPVT directly assess decoding skills, so the relation to ASUWRI was not expected to be as strong, and it was not. Although scores from 400 ms of ASUWRI predicted scores on PPVT (somewhat surprising), they did not reach significance for GMRT (although the findings approached the .01 significance set *a priori* for this study). It is likely the collinearity of the three word lists impacted the stepwise regression equations for GMRT. Taken together, these data revealed that the ASUWRI was a better predictor of other measures of reading when flash exposure time was faster, 400 ms, and that, therefore, the ASUWRI 400 ms scores could be used as proxy measures for reading ability.

Implications

With North Carolina's commitment to Race to the Top federal requirements for literacy assessments and the *Excellent Public Schools Act of 2012*, administrators and teachers in North Carolina public schools need valid and reliable assessments to determine students' reading abilities and to track students' growth. Researchers have made a strong case for the importance of using multiple measures in literacy assessment (Kuhn, et al., 2010; Meyer et al., 2013; Morris, 2008; Morris et al., 2011, 2013a; Rasinski et al., 2011; Valencia et al., 2010). The ASUWRI is easily administered and could be used to monitor progress in reading performance of public school students.

Currently in North Carolina public schools, k-3 teachers are required to use DIBELS and *mCLASS: Reading 3D* to assess and progress monitor students. DIBELS (Good &

Kaminski, 2002) was created following Deno's (1985, 2003) CBM design and, therefore, is appropriate for progress monitoring. With the assessment tasks only requiring, in most cases, a minute to administer, teachers can assess students without much cost to instructional time. However, *mCLASS: Reading 3D* was not designed to be administered efficiently, taking as much as one hour to assess a single third grader (Amie Snow, personal communication, September 20, 2013). To make matters worse, the assessment was not field-tested and has no research to show its reliability or validity. Researchers have questioned its accuracy (Morris & Trathen, 2013) when the reading data that are collected do not consider rate. In this current climate of high-stakes testing with less than adequate instruments, alternative assessments are needed that are proven to be easy to administer and offer accurate and reliable information about students' reading progress. Data from this study show that setting a flash speed on the ASUWRI at 400 ms provides scores that predict other reading measures. Thus, the ASUWRI provides teachers with an alternative means to progress monitor students.

This is good news for classroom teachers and school administrators, but it is important that the information here is not misinterpreted. This study highlighted the value of assessing reading automaticity and demonstrated the effectiveness of the ASUWRI at the 400 millisecond exposure speed as opposed to the slower speeds. This does not mean that teachers should train students to read faster. Instead, teachers should provide plenty of opportunities for students to engage in reading authentic literature at the appropriate reading level. Reading practice should be frequent and natural.

Limitations

As with most studies, there are limitations to be considered. The GMRT assessment showed the weakest relation to the ASUWRI. The multiple-choice and group administration of the GMRT may have introduced error into the scoring. This was the first time that these third-grade students took a test like this. Perhaps a better measure would have been a comprehension test administered individually, like the *Woodcock Reading Mastery Tests—Revised* (Woodcock, 1987). Indeed, researchers have used the Woodcock test with other third graders with great success (Morris et al., 2013b). The study's sample size was small; increasing the sample size or replicating the study with another group of students would add to the validity of the findings. Similarly, the participants were from only one grade level: third grade. By selecting only one grade level, the notion of automaticity as a developmental process cannot be examined. The participants also were selected from only one school district, but this likely did not impact the results. It is hard to imagine that a group of students in a different setting would react differently to the assessments. In fact, results from this study mirror results from other studies conducted with different students in different school districts (Good et al., 2002; Hasbrouck & Tindal, 2006; Morris, et al. 2011).

Future Research

As mentioned above, future research should replicate the results of this study with another group of students, and perhaps a different measure of comprehension should be used. Researchers should also test the 400 ms flash time on the ASUWRI with older and more advanced as well as younger and less advanced readers. It may be the case that 400 ms is not fast enough for older and too fast for younger students. These studies would address the developmental aspect of word level automaticity.

Another area not discussed in the literature but discussed by reading clinicians is the topic of student hesitations when they are being assessed. When measuring automaticity, hesitations can surface, especially as students approach frustration levels in reading. Some reading professionals score hesitations as errors (Good & Kaminski, 2002; Morris, 2008; Morris et al., 2011, 2012, 2013a), others do not (Fountas & Pinnell, 2013; Goodman, Watson, Burke, & Cambourne, 2005). Should hesitations be considered reading errors? What, if any, differences do hesitations make to an instrument's (like ASUWRI) ability to predict other measures of reading? Are there developmental differences between the number and frequency of hesitations? How long is a hesitation, anyway? Future research is needed to address these issues.

In addition to challenging *mCLASS: Reading 3D*, researchers have questioned the validity of DIBELS (Morris & Trathen, 2013; Murray et al., 2012; Samuels, 2006), and they should consider and test alternative assessments to DIBELS (Good & Kaminski, 2002). The ASUWRI has proven to be a possible alternative assessment, and researchers (Morris et al., 2013b) are designing other assessments that may work as well or better than DIBELS. This is an area where much more research is needed.

Conclusions

This study supports the idea from early pioneers in the field of reading (Betts, 1946; Durrell, 1937; Stauffer, et al., 1978) that measures of isolated words provide important data on students' reading abilities, and the findings add to the existing research that supports the use of the flash method of assessing isolated word recognition (Frye & Gosky, 2012; Morris et al., 2011; 2012; 2013a). This study focused on a specific time for the flash assessment method in hopes to increase the usage of this assessment because most reading batteries that include graded word lists, currently, do not present words in a timed format. For example, with the *mCLASS: Reading 3D* reading assessments mandated by the state of North Carolina to be used in every public school k-3 classroom, reading rate is not taken into account either in passage reading or isolated word reading. These assessments are neither effective nor efficient, and teachers are frustrated with the loss of instruction time to these assessments. The need for quick and effective alternative assessments continues to grow in North Carolina as well as other states. Therefore, research findings such as those from this study are valuable and necessary and remind us that overreliance on any one reading assessment is not beneficial to the academic success of students; rather, a variety of assessments that measure the different components of reading are needed in our schools.

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Appendix A
ASUWRI Word Lists (A, B, and C)

Word List A	**Word List B**	**Word List C**
heart	plant	inside
lines	wrote	basket
person	break	perfect
week	north	dug
carry	change	third
gate	hospital	since
rush	pull	shoot
manner	center	felt
short	angry	able
taken	thick	practice
scream	closet	straw
bandage	moat	instant
further	accept	slipper
packed	favor	receive
pleasure	heated	jungle
seal	storyteller	coyote
buffalo	icy	doubtful
haircut	noon	explode
customer	perform	opinion
lonely	duty	miracle
relationship	preparation	wrestle
stockade	tobacco	average
gradual	resolution	hamster
melody	sausage	brilliant
deny	coward	honorable
disguise	suffer	canoe
entertain	furnace	forever
amusing	impress	happiness
select	liberty	thread
disease	solemn	legend

Appendix B
ASUIRI 3rd Grade Reading Passages (A and B)

THIRD GRADE **Form A** (168 words) "Edward's Kitten"

Examiner's Introduction: *This story is about a boy and his new pet.*

Edward's friend had a cat named Bell that liked to sit by a sunny window. Edward liked to pet Bell's smooth fur, and the cat seemed to enjoy being petted, sitting very still and purring softly. One day, when Edward learned that Bell was going to have kittens, he begged his mom to let him have a cat. She said yes, and Edward was thrilled.

When the kittens were born, Edward chose an orange and white kitten from the litter. The kitten, which looked just like Bell, slept a lot, so Edward named her Sleepy. Sleepy had to stay with her mother for eight weeks, but at last she was old enough for Edward to take her home. Edward put a towel by a sunny window in the kitchen, thinking that Sleepy would like to sit there. But Sleepy never seemed to sit still. She was too busy running, jumping, and playing—all day long. Sleepy was a delightful pet, but she was not like her mother, Bell.

(Error Quotient = 100 ÷ 168 = **.60**)

Questions

1. Where did Edward meet the cat named Bell?
(At his friend's house)

2. What did Edward like about Bell?
(She sat still while he petted her fur.)

3. Why was Edward glad to know that Bell was going to have kittens?
(He wanted one of the kittens.)

4. What name did Edward give to his new kitten?
(Sleepy)

5. How long did Sleepy have to stay with his mother before Edward could take her home?
(8 weeks)

6. How was Sleepy different from his mother, Bell?
(Sleepy never sits still.)

Total Errors = _____

Meaning Changes = _____

Oral Read. Acc. = _____%

Comprehension = _____%

Rate = _____wpm

THIRD GRADE **Form B** (147 words) "Maggie and the Goose"

Examiner's Introduction: *This story is about a little girl and some animals.*

Maggie lived on a farm with lots of animals. She loved the cows, pigs, sheep, and chickens, but she did not like the geese. In fact, she was afraid of them. They were large, white birds with orange beaks. Whenever Maggie got too close, the geese extended their wings and stretched out their necks toward her. Then they would rush at her making terrible honking and hissing sounds. One warm afternoon, Maggie went into the barn to play. The light was dim in there so she didn't see the geese until it was too late. One huge, upset goose ran toward Maggie and grabbed the seat of her shorts with its beak. Maggie turned and ran out of the barn yelling, but the angry goose did not let go. Maggie's parents got a good laugh watching her with that crazy goose before they finally helped her escape.

(Error Quotient = 100 ÷ 147 = **.68**)

Questions

1. Where did the girl in this story live?
(On a farm)

2. Why didn't Maggie like the geese on her farm?
(They scared her or *they chased her* or *they hissed at her.)*

3. What did the geese look like?
(Large white birds with orange beaks)

4. Where on the farm did Maggie get into trouble with the geese?
(In the barn)

5. Why did Maggie come running out of the barn yelling?
(The goose was biting the seat of her pants.)

6. What did Maggie's parents do at the end?
(They laughed [1/2]; Probe: And then what did they do?
(They helped her get away from the goose. [full credit]*)*

Total Errors = ____

Meaning Changes = ____

Oral Read. Acc. = ____%

Comprehension = ____%

Rate = ____wpm

Appendix C
IRB Approval Letter

To: Nicole Schneider

CAMPUS MAIL

From: Jessica Yandow, Office of Research and Sponsored Programs
Date: 12/05/2012
RE: Notice of IRB Exemption
Study #: 13-0145

Study Title: Reading Fluency Assessment: The Role of Word-Level Automaticity

Exemption Category: (1) Normal Educational Practices and Settings

This submission has been reviewed by the IRB Office and was determined to be exempt from further review according to the regulatory category cited above under 45 CFR 46.101(b). Should you change any aspect of the proposal, you must contact the IRB before implementing the changes to make sure the exempt status continues to apply. Otherwise, you do not need to request an annual renewal of IRB approval. Please notify the IRB Office when you have completed the study.

Best wishes with your research!

CC:
Woodrow Trathen, Reading Education And Special Education (rese)

Vita

Nicole Schneider was born in upstate New York and attended the State University of New York in Plattsburgh. She graduated in 1996 with a Bachelor of Science degree in Elementary Education. In 2002 she was accepted into the College of Education at California State University in Fullerton. In January of 2005, she was awarded a Master of Science degree in Reading Education. In the summer of 2010, Mrs. Schneider commenced work toward her Doctorate in Educational Leadership at Appalachian State University in North Carolina and earned her Ed.D. in December 2013.

Mrs. Schneider is a National Board Certified Teacher and holds a teaching credential as well as a reading specialist credential in California. She spent over ten years teaching elementary school in southern California. Currently, Mrs. Schneider is an adjunct professor at California Baptist University and teaches online courses at Grand Canyon University.

Mrs. Schneider resides with her husband and three children in Riverside, California.