MEASURING THE READING ABILITY OF INCOMING FRESHMEN: A PATH ANALYSIS INVESTIGATION INTO READING COMPREHENSION

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Abstract

Reading is a complex process involving numerous skills and abilities contributing to acquiring meaning from text. Individuals without the requisite reading skills will have difficulty not only in school but throughout their lifetimes. The purpose of the study was to compare the reading ability of incoming college freshmen with that of adults with low literacy found in Mellard, Fall, and Woods (2010). Incoming college freshmen took tests on seven critical reading components: phonemic decoding, word recognition, vocabulary, WMS, reading fluency, listening comprehension, and reading comprehension. The associations between the reading components were used to compare the path model derived by Mellard, Fall, and Woods (2010) using adults with low literacy and incoming college freshmen. Subsequently, the best fitting model for incoming college freshmen was found to determine the associations between the reading components for incoming college freshmen. The two groups significantly differed in the path estimates using the path model from Mellard, Fall, and Woods (2010). Adults with low literacy had stronger paths for the early developing reading components, because they typically have difficulty in these areas. Incoming college freshmen had a stronger vocabulary and reading comprehension path than did adults with low literacy. The best fitting model for incoming college freshmen suggested that word recognition does not make a strong contribution on reading fluency once paths between WMS and vocabulary with reading fluency were included in the model. Overall, incoming college freshmen are skilled on most of the critical reading components, especially the later developing ones like vocabulary and reading comprehension.

DEDICATION

I would like to dedicate this document to my parents, Nancy and Michael Schuster, and to my little brother, Ben Schuster. If it was not for your support, I do not think I would be in the same position as I am now. You taught me to work hard, to keep trying when encountering problems, and to never give up on anything. For this, I give my profound thanks. To my brother, I give my thanks to you for showing me that it is fine to choose a career that one enjoys rather than a career that has the best monetary outcome. To my parents and brother, you are awesome! Thanks!

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CHAPTER I

INTRODUCTION

The National Assessment of Education Progress (2006) suggests that individuals with the most basic reading ability have the skills necessary for academic success. With age, reading becomes the crucial mode for learning, and with better reading comes more efficient learning. Thus, reading ability can have an enduring influence on many facets and outcomes of our lives. Because of this importance, society's responsibility is to ensure that everybody has a reading ability to interact sufficiently in society. The educational system needs to target individuals encountering reading difficulty early and ensure that they receive the appropriate help, thereby allowing them to become fully functional members of society.

With its importance on future academic performance, reading is a complicated process, comprising knowledge and numerous skills and abilities that contribute to the extraction of meaning from text. The main reading components consist of phonological awareness, decoding, reading fluency, vocabulary, and reading comprehension (National Reading Panel, 2000). Because reading relies on numerous skills, it is an additive process, in which early reading skills contribute to later developing skills. With this many components involved, it would take only a slight problem early in the process to cause various problems in the higher level processes, such as comprehension. The education system has a difficult task of identifying where in this complicated chain of skills poor readers have their problems. However daunting the challenge might be, a critical task is that the assessment (determination) is done as early, efficiently, and accurately as possible.

With the importance of reading in academic achievement, the educational system contains numerous programs for detecting and correcting reading problems early in education. However, numerous students still progress in their education without the skills necessary for successful reading (Council of Chief State School Officers [CCSSO], 2000). The National Institute of Children and Human Developments (2000) stated that around 10 million children encounter reading problems at one point in their reading development. Additionally, Shaywitz (2003) estimated that about 20% of students have some form of reading difficulty. Numerous literacy studies have also shown that adolescents exhibit reading difficulty (Allington, 2002; Biancarosa & Snow, 2004; Buly & Valencia, 2002; No Child Left Behind, 2001; Franzak, 2006). Thus, some children fall through the cracks in the education system and do not receive the appropriate instruction to over their difficulties, which will only compound as they progress.

Unfortunately, time does not alleviate but increases the trouble these student encounter. Reading difficulties found in the later grades result from early linguistic problems existing from the early grades and even kindergarten (Foster & Miller, 2007; Francis, Fletcher, Shaywitz, Shaywitz, & Rourke, 1996; Shaywitz, Fletcher, Holahan, Schneider, Marchione, & Stuebing, 1999). Additionally, around 70% of adolescents entering the seventh grade have lagging reading skills (Biancarosa & Snow, 2004; NAES, 2006). Even if these individuals are identified later in their education, the late identification of their reading difficulties reduces the likelihood they will ever achieve the same reading ability as readers without any difficulty. Even when struggling readers are identified, remedial programs (e.g., Title 1

reading) or students with disabilities, special education, are not always available to them due to varying qualification criteria across school districts and insufficient funding (Duffy-Hester, 1999). Thus, due to a number of factors, students with reading difficulties can progress without detection, and even with subsequent detection, it does not guarantee that the problems will be resolved.

If struggling readers are not identified early in development, serious repercussions can occur, such as the Matthew Effect (Juel, 1988; Stanovich, 1986). The Matthew Effect states that differences between good and poor readers increase drastically over time. With the development of good reading ability, individuals seek reading opportunities and have more success reading. With more experience, their reading skills and vocabulary increase. However, poor readers read less due to early reading difficulties. These difficulties decrease the amount read and the opportunities they seek, which would highlight their problems. This decrease prevents struggling readers from gaining valuable practice and experience through reading more books. Their vocabularies remain small due to the fewer reading opportunities they have. The gap between good and poor readers widens as good readers gain more reading experience while the poor readers do not (Juel, 1988; Stanovich, 1986).

Thus, reading difficulties can have serious consequences on academic success due to decreased reading ability and confidence (Goetze & Walker, 2004). Sideridis and Padeliadu (2001) found that with increasing experiences of reading problems, individuals could adopt a feeling of ineptitude and begin to view themselves as academic failures. This viewpoint could then decrease the motivation

to improve their reading ability (Ganske, Monroe, & Strickland, 2003). With decreased motivation, poor readers have an increased likelihood of dropping out of high school (Slavin, Karweit, Wasik, Madden, & Dolan, 1994). Despite the fewer experiences of encountering their reading problems, Good, Simmons, and Smith (1998) stated early reading difficulties do not disappear after leaving school but remain and constantly create problems for the rest of their lives.

The frequency of individuals experiencing reading difficulties in school does not decrease upon reaching adulthood. In 1992, about 50% of adults in the United States had poor reading ability (Kirsch, Jungeblut, Jenkins, & Kolstad, 1993), while the National Center for Education Statistics [NCES] (2005) found that 25% of adults attain only the basic reading skills (Pressley & Harris, 2006). According to the National Assessment of Adult Literacy survey (Kutner, Greenberg, & Baer, 2005), 43% of adults in the United States, about 90 million people, do not have above basic reading ability. Despite the focus of education on identifying and treating reading problems, large numbers of adults have below the basic skills necessary for sufficient reading. These numbers indicate the importance of literacy programs aimed at treating adults with little or no literacy.

According to the National Center for Education Statistics (2006), adult basic and secondary education programs typically have an enrollment of 2.8 million adults with low literacy each year in the United States. About 10% (U.S. Department of Education, 2003) to about 28% (Participants by Entering Functioning Level, 2009-2010 Aggregate) of these adults have either no reading ability or the reading ability equivalent to a 4th grader. Based on these figures, literacy programs have a

good portion of the U.S. population that depends on them. However, are these programs arranged to suit the needs of this population?

If literacy programs view reading as a complex process in which problems can arise from numerous places, they should be flexible enough to handle most variations. Thus, adults with low literacy vary in their reading abilities and difficulties, suggesting that they require individualized help (Kutner, Greenberg, & Baer, 2005; Kutner, Greenberg, Jin, Boyle, Hsu, & Dunleavy, 2007). However, some literacy programs view reading as developing in a specific way with only one place in which reading problems can occur. Developing an intervention program with this viewpoint would be unwise because only those adults with that specific pattern of reading difficulties will likely show any gain. Adults with a different pattern of problems will likely not show any improvement, as their difficulties were not addressed (Comings, 2003; Comings & Soricone, 2007). Additionally, Rapp and colleagues (2007) found that some programs determine how good readers read, develop interventions that are focus on these process, and have poor readers adopt the same processes good readers use, regardless of ability level. This method will not produce positive results if the adults do not have the ability to use them (Pressley & Harris, 2006; Snowling & Hulme, 2005). Overall, assessing the adult on each of the key critical reading components is extremely important to identify the reading problems before developing an intervention.

Despite the fact that some literacy programs are inefficient in treating reading difficulties, literacy programs still attempt to provide help to adults with low literacy, because incessant reading problems cause a larger number of negative

life outcomes. Kutner et al. (2007) found that adults with low literacy are less likely to have full-time employment and higher incomes than are adults with high literacy skills. Adults with basic (22-24%) and below basic (30-35%) literacy skills are also more likely to have service jobs than are adults with proficient literacy skills (7-10%). Finally, about 33% of adults with below basic reading ability feel their reading ability prevents them from finding a better job and bettering their lives. Despite wanting to increase their lot in society, poor reading skills prevent adults with low literacy from finding better jobs and from earning a higher salary. Thus, it is critical for these adults to participate in adult literacy programs with the hopes of achieving at least basic reading proficiency and allowing them to gain better employment.

Emphasis on Post-Secondary Education

With the serious consequences resulting from poor reading ability, determining the reading skills of incoming college freshmen is critical. The impact these findings will have on the fields of reading and educational research could be extensive. As can be seen in the number of individuals with reading problems, the education system does not always identify and alleviate these problems. These numbers also indicate that some individuals can circumvent problems in early reading skills and progress in their education by utilizing skills in which they are proficient. Despite this progress, they still might not achieve the same skill level of good readers. Thus, it is crucial we gain an idea of the reading abilities of students entering post-secondary settings, especially universities.

The findings from the proposed study can provide an indication of the problematic and strong areas of incoming college freshmen. Because we will be conducting a path analysis to document the contribution each component has with the others towards reading comprehension, we will know which of the critical reading components is important for this population, further increasing our knowledge of reading development across the lifespan. The current study will also provide information on the reading ability of high school graduates and what, if any, proactive steps in handling their reading abilities universities can make to allow students with reading problems to utilize their college education. Overall, it is critical for universities today to determine what the abilities of incoming college freshmen on the common components involved in reading are and how the relationships between them contribute to reading comprehension.

CHAPTER II

LITERATURE REVIEW

Adults in literacy programs vary in their strengths and weaknesses, which stresses the importance of individualizing interventions. Using ABE and ESOL learners, Strucker and Davidson (2003) found that adults with low literacy do not differ in their comprehension abilities, but they do differ in their reading fluency, decoding, and vocabulary abilities. Similarly, using non-ESOL adults with low literacy, Mellard, Fall, and Mark (2009) found that adults with low literacy differ in the cause of their problems. The causes of their reading difficulties revolve around poor phonemic decoding, word recognition, or phonological ability. Based on these findings, the causes of reading difficulty vary across the critical reading components. These individuals do not form a homogenous group (Davidson & Strucker, 2002; Kruidenier, 2002; Mellard et al., 2009). Thus, utilizing only a comprehension measure for assessing reading ability would miss the distinctions in this population. Instead, Kruidenier (2002) suggests that programs should assess adults with low literacy on each of the critical reading components to gain a better insight into their difficulties.

The Constructivist Framework Of Reading

Before determining how to assess reading acquisition, some conceptualization of the learning processes involved in reading development must be defined. One such conceptualization is Constructivist Approach to Reading (Cambourne, 2002). Constructivism involves understanding how individuals acquire knowledge and the routes they take in getting there. This approach consists

of three main components: 1) Learning is not independent of the context in which it occurs; 2) Student goals will influence learning; and 3) Knowledge is socially constructed. The first component suggests that how information or skills are learned is just as important as the acquired information or skills. The environment or context in which individuals learn to read will greatly influence their understanding of how to read and how they use this understanding. The second component revolves around the idea that students will only become active learners if they feel that the goal behavior is achievable and of some importance to them. The last component pertains to the fact that individuals construct their own meaning from the context, allowing personal experiences, thoughts, and feelings to influence learning. Thus, the constructivist approach can account for slight variations in reading ability by the context in which they learned to read, their involvement in learning to read, and how they viewed reading.

The Simple View of Reading

Besides the Constructivist Approach to Reading (Cambourne, 2002), the Simple View of Reading (Gough & Tunmer, 1986) best accounts for variability in reading ability. The Simple View of Reading states that reading results from the combined activity of decoding and oral language comprehension. Decoding starts as sounding out the letters in written words based on their associated phonemes, the individual speed sounds of a language (Gough & Hillinger, 1980; Gough & Tunmer, 1986). Decoding then progresses into the quick and accurate reading of isolated words (Gough & Tunmer, 1986), referred to as word recognition. On the other hand, oral language comprehension comprises the ability to interpret spoken words,

sentences, and discourse correctly. Thus, decoding and word recognition turn the orthographic forms of words into a linguistic from, while oral language comprehension derives meaning from this linguistic form (Gough & Tunmer, 1986; Hoover & Gough, 1990). Besides these differences, decoding has its greatest effect on reading ability early in development, while oral language comprehension is more influential later in development (Aaron, Joshi, & Williams, 1999; Gough, Hoover, & Peterson, 1996).

However, decoding and oral language comprehension are not sufficient individually. Being able to decode words without comprehending them would be of no benefit to the reader, while being able to comprehend without decoding words will limit what the reader can comprehend, decreasing its value. Thus, both decoding (Bell & Perfetti, 1994; Cunningham, Stanovich, & Wilson, 1990; Lundquist, 2004; Nation, 1999; Shankweiler, Lundquist, Dreyer, & Dickinson, 1996; Stothard, 1994; Stothard & Hulme, 1992) and oral language comprehension (Bruck, 1988; Catts, Hogan, Adlof, & Barth, 2003; Joshi, Williams, & Wood, 1998; Palmer, MacLeod, Hunt, & Davidson, 1985; Sticht, 1978; Rack, Snowling, & Olson, 1992; Torgesen, 1999) make important contributions to reading ability. Gough and Tunmer (1986) suggest only the interaction of decoding and oral language comprehension will produce good reading ability.

Numerous studies have tested the accuracy of the Simple View of Reading (Gough & Tunmer, 1986) in accounting for individual differences in reading. Using participants from the 2nd and 3rd grades and from the 6th and 7th grades, Vellutino, Tunmer, Jaccard, and Chen (2007) investigated the relationships between the

critical reading components using structural equations modeling. They found that phonological ability and word recognition were more influential on reading comprehension for only the younger participants, while oral language comprehension and vocabulary were only influential on reading comprehension for the older participants (Curtis, 1980; Hoover & Gough, 1990; Sticht, 1979; Vellutino et al., 1991; Vellutino, Scanlon, & Tanzman, 1994). Similarly, Cutting and Scarborough (2006) and Cunningham, Stanovich, and Wilson (1990) found that decoding, word recognition, and oral language comprehension had strong relations with reading comprehension for samples of 1st to 10th graders and college students, respectively. These findings provide corroborating evidence to the validity to the claims of the Simple View of Reading that differences in decoding and oral language comprehension determine individual differences in reading ability.

By having only two main components involved in reading ability, the Simple View concisely organizes readers of varying ability into groups as seen in Table 1. The profile of good readers is good decoding and oral language comprehension abilities (Catts, Hogan, & Adlof, 2005; Gough & Tunmer, 1986). Another group comprises readers with good oral language comprehension but poor decoding. Dyslexia is associated with this latter group (Catts, Hogan, & Adlof, 2005; Frith, 1972; Gough & Tunmer, 1986; Vellutino, 1979). Individuals with good decoding but poor oral language comprehension comprise the hyperlexia or special comprehension deficit category (Catts, Hogan, & Adlof, 2005; Gough & Tunmer, 1986; Healy, 1982; Huttenlocher & Huttenlocher, 1973; Silberberg & Silberberg, 1967, 1968, 1971). Finally, readers in the last group have poor decoding and oral

language comprehension, and they have mixed or garden-variety reading disability (Catts, Hogan, & Adlof, 2005; Catts & Kamhi, 1999; Curtis, 1980; Gough & Tunmer, 1986; Lombardino, Leonard, & Eckert, 2001; Olson, Kliegl, Davidson, & Foltz, 1985; Perfetti & Hogoboam, 1975). Thus, these four groups can correctly categorize all the different variations of reading ability individuals can have.

Table 1.

The Four Categories of Reading Groups According to the Simple View of Reading.

Critical Components Contributing to Reading Ability	Good Listening Comprehension	Poor Listening Comprehension
Good Decoding Ability	Good Readers	Hyperlexia/Special Comprehension Deficit
Poor Decoding Ability	Dyslexia	Mixed/Garden-Variety Readers

Despite the various studies demonstrating the importance of decoding and oral language ability in contributing to reading ability, some researchers suggest that other skills contribute as well, such as rapid naming ability. In the Component Model of Reading (Aaron, 1997; Joshi, 1999), Joshi and Aaron (2000) found that processing speed significantly predicted reading ability. They suggest that letter naming speed along with the interaction of decoding and oral language comprehension ability accurately accounts for the reading variability. Similarly, Wolf and Bowers (1999) proposed a double-deficit hypothesis in which both phonological and naming abilities influence reading ability. They suggest that

individuals can have difficulties in their phonological ability, rapid naming ability, or both. Difficulty in rapid naming ability would cause word recognition, reading fluency, and reading comprehension problems. Good word recognition develops from faster naming speed (Sabatini, 2002). Additionally, children and adults with reading problems tend to have deficits in naming speed (Wolf, Bowers, & Biddle, 2000). Thus, rapid naming ability might also contribute to reading ability through quicker access to letter names, which increases word recognition speed.

Phonemic Awareness

While individuals develop their oral language abilities, the initial focus is on grasping word meaning and not on the component parts of the words. However, the realization that different types of spoken sounds, such as syllables and phonemes, comprise words is crucial for reading development (Adams, 1990; Caravolas, Hulme, & Snowling, 2001; Ehri, 1998; Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967; Morais, Mousty, & Kolinsky, 1998; Nation & Hulme, 1997; Share, 1995; Share & Stanovich, 1995). Shaywitz (1998) suggests our reading skills start by learning that syllables and phonemes compose words. This knowledge will provide the phonological foundation for developing the more complex reading processes. Thus, phonemic awareness is not an innate skill we have at birth; it develops as our oral language develops and as we gain letter knowledge.

Phonological awareness, the ability to detect spoken words, syllables, and rimes, develops before phonemic awareness. When learning a language, individuals focus initially on the entire word (Ferguson, 1986; Studdert-Kennedy, 1986; Suomi, 1993; Walley, 1993) and gradually begin to segment words into syllables and

phonemes (Ehri, 1999; Goswami & Bryant, 1990; Juel, Griffith, & Gough, 1986). This typically occurs when oral vocabulary reaches a certain point in which it needs finer distinctions between words to encode them effectively (Charles-Luce & Luce, 1990; Jusczyk, 1986; Walley, 1993). However, this process only occurs after we have gained alphabetic knowledge, which is understanding the associations between letters and sounds, and have developed our metacognitive abilities (Gleitman & Rozin, 1977; Liberman, Shankweiler, & Liberman, 1989; Morais, Cary, Alegria, & Bertelson, 1979; Rozin, 1976). Once we have acquired alphabetic knowledge, phonemic awareness contributes to the identification, separation, and alteration of sounds while reading (Caravolas & Bruck, 2000; Ehri, 1999; Thomas & Sénéchal, 1998), and has its greatest impact on reading development during decoding (Adams, 1990).

Since phonological awareness, and phonemic awareness in particular, is the first of the critical reading components to develop, it builds the foundation on which the remaining reading components depend. If individuals have problems in phonological awareness, they will have problems in the subsequent skills due to the additive nature of reading. An example of this is the phonological limitation hypothesis (Liberman et al., 1989; Shankweiler & Crain, 1986). The phonological limitation hypothesis states that poor phonological ability is the cause for reading difficulties (Perfetti, 1985; Shankweiler, Crain, Brady, & Macaruso, 1992; Shankweiler & Liberman, 1972; Stanovich, 1988; 1991; Vellutino, 1979, 1991).

Because of the importance of phonemic awareness in reading development, phonological awareness can be used to differentiate between good and poor readers

(Blachman, 2000; Bradley & Bryant, 1983; Iversen & Tunmer, 1993; Torgesen, Wagner, & Rashotte, 1999; Tunmer, 1989; Vellutino, Fletcher, Snowling, & Scanlon, 2004; Vellutino & Scanlon, 1987a, 1987b; Vellutino, Scanlon, Sipay, Small, Pratt, Chen, et al., 1996; Wagner & Torgesen, 1987). Beginning and poor readers have trouble developing their awareness of the phonological structure of spoken words. However, beginning readers eventually acquire this awareness while poor readers do not always (Adams, 1990; Bruck, 1992; Edwards, Walley, & Ball, 2003; Greenberg, Ehri, & Perin, 1997; Kruidenier, 2002; Macaruso, Locke, Smith & Powers, 1995; Pratt & Brady, 1988). Thus, poor readers have trouble linking the phonological aspects of oral language with the orthographic characteristics of printed words (Adams, 1990; Bruck, 1992; Liberman et al., 1989), preventing them from developing the orthographic representations crucial for word recognition. On the other hand, good readers gradually become aware of the phonemes comprising oral language at the same time as they acquire alphabetic knowledge. This acquisition allows them to begin learning how to decode printed material.

If phonological ability is crucial for later reading development, it should be influential in predicting reading ability. Morris, Steubing, Fletcher, Shaywitz, Shankweiler, Katz, Franic, and Shaywitz (1998) tested this assumption by giving students of varying reading abilities tests of phonological awareness, vocabulary, rapid naming ability, and oral language comprehension. Phonological ability was the root cause of the problems experienced by the students with poor reading ability, because each of the students with reading trouble had phonological problems (Morris et al., 1998). Every problem they exhibited was related to their poor

phonological ability, and the students only differed in what other non-phonological problem also existed. Similarly, Leinonen, Müller, Leppänen, Aro, Ahonen, and Lyytinen (2001) found that phonological ability differentiated between subgroups of dyslexia. Overall, they found that phonological problems influence reading errors while orthographic difficulties produce a slower reading time. Thus, phonological ability influences reading ability, and a poor phonological ability will cause reading problems to occur.

In summary, phonological awareness is the crux on which the remaining reading components build. This finding is based on the fact that individuals with reading problems have phonological difficulties. Although individuals learn their letters around the same time as becoming aware of the phonemes comprising individual words, the development of phonemic awareness provides the impetus in reading development. The importance of phonemic awareness is documented by the fact that it is the main cause for reading difficulty.

Decoding

Phonemic awareness contributes to early reading skills by combining with letter knowledge to facilitate the acquisition of the alphabetic principle (Adams, 1990; Catts & Kamhi, 1999; Cupples & Iacono, 2000; Hohn & Ehri, 1983; Johnston, Anderson, & Holligan, 1996). In decoding, individuals sound out the letters of written words, combine the letters together in memory, and recognize the word based on the specific pattern (Torgesen, 1997). When learning to read, individuals initially focus on the orthographic word features, the letters, then shift attention to phonemes after acquiring letter knowledge, and finally create phonological and

orthographic representations of these word features (Ehri, 1992; Rack, Hulme, Snowling, & Wightman, 1994). Thus, decoding allows for the generation of word representations, which are crucial, especially the orthographic representations, for word recognition to become automatic.

To depict how individuals develop their decoding and word recognition abilities, Adams (1990) created a word recognition model consisting of four components or processors: orthographic, phonological, meaning, and context. When encountering new words, individuals use the orthographic processor for finding an orthographic match in memory. At the same time, the phonological processor generates the word's pronunciation by combining the phonemes associated with the word's letters. The result of these two processors activates the meaning processor, which retrieves all possible word meanings. Finally, the context processor uses the surrounding words in the current and previous sentences to ascertain the most appropriate word meaning for that specific context.

As individuals become more adept at decoding words and have gained knowledge of word arrangement, they shift from decoding words using the grapheme-phoneme transformations and begin automatically to recognize words visually based on their orthographic pattern (Adams, 1994; Backman, Bruck, Hebert, & Seidenberg, 1984; Chall, 1983; Cunningham, Koppenhaver, Erickson, & Spadorcia, 2004; Doctor & Coltheart, 1980; Ehri, 1991, 1992). Supporting this conclusion, Morais, Cary, Alegria, and Bertelson (1979) found that phonemic awareness makes identifying and encoding orthographic word characteristics easier, leading to better word recognition once they gain more word patterning knowledge. However, when

encountering new words or low frequency word, they use decoding for word recognition (Andrews, 1982; Seidenberg, Waters, Barnes, & Tanenhaus, 1984; Waters, Seidenberg, & Bruck, 1984). In sum, individuals initially decode words by pronouncing the phonemes associated with the letters and then begin to recognize words purely on a visual basis after completely acquiring word patterning knowledge.

However, individuals with reading disability usually have difficulty in word reading (Fletcher, Shaywitz, Shankweiler, Katz, Liberman, Fowler, Francis, Stuebing, & Shaywitz, 1994; Stanovich & Siegel, 1994). Perfetti and Hart (2002) suggested that the quality of their word representations influences word recognition. They suggest that poor readers develop deficient orthographic representations because they do not have the phonological ability to develop them adequately. Using young adults of differing reading abilities, Braze, Tabor, Shankweiler, and Mencl (2007) collaborated these findings by stating that individuals with poor word representations have more difficulty in word recognition than have individuals with better word representations. Nation and Snowling (1999) discovered that individuals with reading difficulties have weaker orthographic and semantic representations and weak associations between them than do good readers. The poor association between the word associations makes decoding and word recognition more difficult, because the phonemes and letters necessary for decoding are almost independent of one another. Thus, word recognition difficulty can result from the formation of poor word representations, and a potential underlying cause

for these poor representations is deficient phonological awareness and decoding abilities.

Due to these problems in word recognition, individuals with poor word recognition largely utilize the contextual information for word identification (Chall, 1994; Davidson & Strucker, 2002; Stanovich, 1986). Prior sentences allow them to predict the content of the subsequent sentence, allowing their semantic knowledge to facilitate word recognition. With good word recognition, reading is so quick that it causes the contextual benefits to occur after word recognition. However, for individuals with poor word recognition, decoding problems slow down their reading. This slowing of reading allows the late arriving contextual information to facilitate word recognition before the word is correctly identified. It aids in word recognition but at a cost. This process consumes valuable memory resources, leaving fewer resources available for inference generation and comprehension (LaBerge & Samuels, 1974; Lesgold & Perfetti, 1978). Thus, the use of contextual information during reading is crucial for poor readers, because it circumvents their poor word recognition, allowing them to have at least some comprehension.

As a specific case of poor reading ability, adults with low literacy typically have poor decoding ability, and their ability is the equivalent of the decoding abilities of third and fourth graders (Bear, Truex, & Barone, 1989; Bruck, 1988; Read & Ruyter, 1985; Szeszulski & Manis, 1987; Treiman & Hirsch-Pasek, 1985). Again, the cause of their decoding problems results from difficulty grasping the alphabetic principle (Bruck, 1985, 1990; Forell & Hood, 1986; Kruidenier, 2002; Labuda & DeFries, 1988). Comparing children learning to read with adults in literacy

programs on word identification, reading, and vocabulary tasks, Greenberg, Ehri, and Perin (1997) found that the adults exhibited difficulty reading irregular words, which is suggestive of decoding problems and the inability to use orthographic-phonological transformations while reading. Thus, adults with low literacy show the same pattern in decoding and word recognition as poor readers still in school.

To overcome their decoding problems, adults with low literacy use the common visual word patterns for word recognition. This process is different than the word recognition process of good readers. Good readers identify words based on the entire pattern of letters, while poor readers cannot do this because of their lack of alphabetic knowledge. Instead, Greenberg, Ehri, and Perin (2002) found that the adults in literacy programs used the letters at the beginning and ends of words for word recognition (Davidson & Strucker, 2002; Siegel, Share, & Geva, 1995). They make guesses as to the word's identity based on these few letters, which will often be erroneous when numerous words share the same pattern. Without being able to decode words adequately, adults with low literacy have trouble increasing their vocabulary, which depends on decoding for creating the phonological and orthographic representations of the new words in memory (Greenberg, Ehri, & Perin, 1997, 2002).

Dyslexia is a widely studied reading disorder. Adult dyslexics have phonological problems, and these problems result in poor decoding ability. Bruck (1990) found that adult dyslexics performed worse than did sixth graders in reading non-words. Reading non-words is a good indication of decoding ability since it requires individuals to use their alphabetic knowledge for sounding words. Without

alphabet knowledge, adult dyslexics could not decode the non-words for pronunciation. It also prevented them from developing and using their orthographic representations for word recognition. Because of their lack of word recognition ability, adult dyslexics had to adapt and use their faulty decoding ability to the best of their ability. They used the same process for both low- and high-frequency words, which is similar to beginning readers and children with dyslexia. Good readers only use decoding for low frequency words (Bruck, 1988; Seidenberg, Bruck, Fornarolo, & Backman, 1985). Meaningful contextual information does improve their word recognition ability of adult dyslexics, which could explain their comprehension (Bruck, 1990). Thus, adult dyslexics have a poor decoding ability that makes it difficult to acquire new words and to develop automatic word recognition. These problems force them to utilize the contextual information to aid word identification.

To investigate the impact that poor phonological ability has on decoding and reading ability, Bruck (1992) investigated whether dyslexic children and adults utilize orthographic information while making phonological judgments. Both dyslexic groups performed worse on the phonological tasks than did their peers, indicating that the adults continue to have phonological awareness problems that they had during childhood (Bradley & Bryant, 1978; Bruck & Treiman, 1990; Pratt & Brady, 1988). Dyslexics did not utilize their orthographic understanding on phonological tasks, which indicated that they do not have a developed phonemic awareness. Without phonemic awareness, they could not acquire the alphabetic principle and cannot decode words, causing poor reading ability.

Comparing the performance of individuals with garden-variety reading problems, dyslexia, and good readers, Bell and Perfetti (1994) investigated the influence of word recognition on reading ability. No significant differences were noted between the garden-variety and dyslexic readers on word recognition, comprehension, and reading fluency. Expectedly, good readers had better comprehension and a faster reading speed than did the garden-variety and dyslexic readers. They also had better word recognition than the two groups of less-skilled readers. Poor orthographic and phonological representations caused the poor performance of the garden-variety and dyslexic readers, which hindered their decoding abilities (Bell & Perfetti, 1994; Bruck 1990; Perfetti, Finger, & Hogaboam, 1978; Scarborough 1984; Stanovich & West, 1989).

In summary, good readers can gain knowledge of the letters in the language, which helps in identifying and manipulating the phonemes in spoken language. These two components form the basis of acquiring alphabetic knowledge. Using the alphabetic knowledge, decoding involves the sounding out of the phonemes associated with the letters comprising written words. Individuals begin to develop phonological and orthographic representations for the word characteristics using this alphabetic knowledge. With word patterning knowledge, they begin to use the orthographic word characteristics for recognition, which becomes automatic with experience.

However, individuals with low literacy typically have a poor phonological ability, so they have difficulty using letter and other orthographic information for acquiring the alphabetic principle. Without the alphabetic principle, they cannot

decode words, preventing them for developing phonological and orthographic word representations. To circumvent these problems, they rely heavily on contextual information for word identification.

Reading Fluency

Because the automaticity and accuracy of word recognition (National Institute of Child Health and Human Development, NIH, & DHHS, 2000) influences the speed of word processing, reading fluency can indicate the degree of word recognition success (Bell, McCallum, Burton, Gray, Windingstad, & Moore, 2006). Reading fluency positively contributes to reading comprehension by allowing memory resources to be allocated to higher-order reading processes, such as inference generation and comprehension (Fuchs, Fuchs, & Maxwell, 1988; Jenkins, Fuchs, van den Broek, Espin, & Deno, 2003; Lovett, 1987; Rupley, Willson, & Nichols, 1998; Swanson & Trahan, 1996). Aaron, Joshi, & Williams (1999) found that this relationship increases in importance as children progress in their education and gain more reading experience.

If reading fluency is crucial to reading ability, then improving it should increase comprehension. Bourassa, Levy, Dowin, and Casey (1998) taught fourth grade poor comprehenders to read more fluently by having them read a story multiple times and then read another story containing words from the original story. This intervention increased their word reading abilities. Bourassa et al. (1998) found that word reading instruction improves reading fluency and decreases errors. Additionally, this improvement generalized to new texts containing some of the words used in training, suggesting that increases in word reading ability can

improve reading comprehension. Unfortunately, this improvement did not generalize to texts with unfamiliar words. Medo and Ryder (1993) had similar findings using eighth-graders. Thus, word identification is crucial to reading fluency, and if you improve it, reading speed increases.

Using children with language impairments in the 2nd through 8th grades, Adlof, Catts, and Little (2006) found that reading fluency does not account for a significant portion of variance in reading comprehension beyond the effects of word recognition and oral language comprehension. Reading fluency was highly correlated with word recognition in the early grades but became independent of word recognition by the fourth grade. However, this independence did not allow reading fluency to influence significantly reading comprehension. Thus, good reading fluency is an emergent property of good word recognition and oral language comprehension abilities and does not make an independent contribution to reading comprehension.

With the contribution that word recognition has on reading fluency, fluent readers devote less time to word recognition than do less fluent readers. This fluency allows them to divert more memory resources to the higher-reading components (Rasinski, 2004), such as comprehension (Worthy & Broaddus, 2001) and predictive inferences (Hook & Jones, 2002). This reallocation of memory resources decreases processing time. Another aspect of fluent reading is the increased association among the various word representations. For example, fluent readers can process larger orthographic units due to the association they have with the phonological representations, and these units automatically activate while

reading (Ehri, 1992). Thus, reading fluency is a great indicator of word recognition, and when word recognition does not expend a large amount of memory resources, reading fluency is fast.

Unfortunately, due to their poor phonological awareness and decoding problems, adults with low literacy have poor reading fluency. Poor reading fluency is a common feature for adults in literacy programs (Kruidenier, 2002) and dyslexics (Bowers & Wolf 1993; Cunningham & Stanovich 1997; Wimmer 1993). Their reading fluency is similar to that of children beginning to read. For less fluent readers, word recognition problems are the cause for the slow reading. When they take longer to read due to the poor word recognition and their heavy reliance on the context, the slow rate prevents the other critical reading components from functioning optimally by consuming valuable WM resources. This bottleneck results in the inadequate integration of the textual information since the text receives less processing and encoding time than it would receive with fluent readers who have more resources. Thus, only a portion of the information ends up in the text representations (Allington, 1983; Kame'enui & Simmons, 2001; Kuhn, 2004; Samuels, Ediger, & Fautsch-Patridge, 2005; Torgesen & Burgess, 1998). Furthermore, without adequate textual representations, readers cannot make predictive, bridging, or elaborative inferences (Bell et al., 2006; Rupley, Willson, & Nichols, 1998), negatively affecting reading comprehension. Overall, problems early in the reading process will carry over into the higher order cognitive processes involved in reading.

In summary, although reading fluency makes only a small contribution to overall reading ability, fluency is a great indicator of word recognition ability. The faster individuals are at recognizing words, the faster is their reading fluency. With faster reading fluency, readers can use their working memory resources for integrating information and generating inferences, which increases reading comprehension. However, individuals with low literacy frequently have poor word recognition ability, which slows does reading fluency. Without the excess memory resources, they have to make do with fewer resources for integration and inference generation. This results in poor reading comprehension.

Vocabulary

Although oral language development contributes to early meaning acquisition, decoding becomes the critical factor in increasing the knowledge bank of words and their meanings as reading development progresses. Baddeley, Logie, Nimmo-Smith, and Brereton (1985) found that vocabulary influences reading ability by providing the meanings for integrating information, generating inferences, and comprehending the information. With greater vocabulary, word recognition improves because of the increased number of potential candidates for each word and increased word pattern knowledge. Vocabulary is especially important in predicting reading ability when word recognition becomes automatic (Stanovich, Cunningham, & Freeman, 1984), which is when individuals become skilled at decoding.

For comprehension to occur, individuals must have a sufficient vocabulary. During the early stages of reading development, individuals transform written

words into spoken words to utilize the advanced nature of their oral receptive vocabularies (Kamil, 2004). Words are heard for a very short time. This creates a challenge in generating word representations in long-term memory, and requires repeated exposure for adequate encoding.

Individuals with a more efficient working memory can circumvent this problem by retaining a better trace of the word in memory for further encoding than can individuals with a small working memory. Gathercole and Baddeley (1993) suggested that working memory also allows readers to create more associations with other related words by simultaneously storing more words in memory during integration, firmly establishing it in memory with fewer encounters. Additionally, a more efficient working memory facilitates the quick generation of inferences generation, because individuals can store more words in working memory crucial for the inferences (Calvo, Estevez, & Dowens, 2003; Estevez & Calvo, 2000). Thus, working memory plays an important role in reading ability by aiding vocabulary in the acquisition of new words.

As mentioned previously, vocabulary is also very important for inference generation (Dixon, LeFevre, & Twilley, 1988). Inferences require the retrieval of previously encoded text information and prior topical knowledge for combining with the currently processed information. A large vocabulary contains more representations and more meanings in its semantic network than does a smaller vocabulary. With a more detailed network, individuals have an easier time retrieving word meanings (Ouellette, 2006), providing the information crucial to generate the inferences.

Individuals with a large vocabulary easily generate inferences without the use of contextual information, speeding up processing. Because of the fewer possible alternatives, a small vocabulary allows individuals to generate inferences only when the context provides sufficient information as to word meanings. The context then facilitates the inferring of word meanings absent from vocabulary. However, the use of contextual information for meaning resolution is a slow process and places heavy demands on memory resources. Thus, individuals with small vocabularies take longer to create inferences and are less accurate in making them than are individuals with large vocabularies (Calvo, Estevez, & Dowens, 2003; Estevez & Calvo, 2000).

To assess the difference between good and poor readers in the use of contextual information, McKeown (1985) had them complete a meaning-acquisition task. In this task, the participants read six short paragraphs related to one invented category word. The participants then heard sentences describing a potential meaning of the invented word and chose whether the meaning was contextually correct. Poor readers had difficulty grasping word meaning from the context due to difficulty combining information from different contexts (paragraphs). They used the contextual information for narrowing the list of potential word meanings in more localized parts of the text though. Even when the poor readers did acquire the appropriate word meaning, they used it incorrectly. However, McKeown, Beck, Ohmanson, and Perfetti (1983) found that teaching new words in multiple contexts improves vocabulary and comprehension. Thus, poor readers have difficulty using word meanings acquired from the context as a result of their poor vocabulary.

The vocabulary knowledge of adults in literacy programs is typically poor, and remains stagnant due to their decoding difficulties (Kruidenier, 2002). Because decoding is crucial for the acquisition of new words, they have to rely on the vocabulary developed during oral language development; their deficiencies in decoding abilities limit vocabulary acquisition. Thus, Greenberg and colleagues (1997) found that although adults in literacy programs have larger vocabularies compared to third and fourth grade children, this advantage disappears as the children progress in their development, increasing their vocabularies beyond those of the adults in the literacy programs. Despite these problems, Davidson and Strucker (2002) found that adults in literacy programs rely heavily on their receptive vocabulary for word recognition.

In summary, vocabulary plays an important role in reading ability. Along with working memory span, a large vocabulary will aid in integrating information together and in inference generation by providing the meaning of words. Individuals with a small vocabulary will have a hard time in integration and inference generation due to the small number of word meanings they possess, forcing them to use the contextual information for acquiring word meanings. However, poor readers have difficulty even using the context. Finally, adults in literacy programs have a stagnant reading vocabulary as a result of their poor decoding abilities.

Reading Comprehension

Reading comprehension is the result of each of the preceding reading components. Thus, the performance of the previous components will determine the degree of comprehension achieved. If any of the components falters, comprehension

suffers. Even with a faulty component, some degree of comprehension can still be achieved by circumventing the problem areas. Reading comprehension brings all the information derived from the components together into a text representation, from which we gather the meaning.

While reading, each piece of information attains a different activation level in the text representation, which readers continuously update (Conway, Tuholski, Shisler, & Engle, 1999; Engle, Cantor, & Carullo, 1992). Gernsbacher, Varner, and Faust (1990) found that contextually relevant topical information becomes increasingly active in memory and receives multiple associations with other information, which aids in future recall. However, as information becomes more contextually irrelevant, attention and its activation level decrease, and more relevant information replace it in memory. For good comprehension, readers must process and encode only the most contextually relevant information (Brown, Armbruster, & Baker, 1986; Garner, 1987) for integration and for building the foundation for subsequent information.

Because comprehension requires the increased activation of relevant information and the suppression of irrelevant information, working memory can benefit or hinder the updating process, depending on the learner's capacity, for example to focus attention, to control or manipulate the information, and to sort relevant and irrelevant information (Hasher & Zacks, 1988; Rosen & Engle, 1997, 1998). Working memory provides a buffer for the current text information, recently processed textual information, and prior topical knowledge for integration into a coherent representation (Cooke, Halleran, & O'Brien, 1998; Graesser, Singer, &

Trabasso, 1994). Thus, Kintsch (1988, 1998) suggests that working memory affects reading at the end of sentences where the information is integrated into a mental representation, after the contributions of lexical access and vocabulary have occurred.

As working memory capacity increases, more manipulation and movement of information can occur within the mental representation for the text. This process allows the representation to become more interconnected, and as the representation becomes more interconnected, comprehension improves (Cain, Oakhill, & Bryant, 2004; Radvansky & Copeland, 2001). Working memory also facilitates inference generation by retaining the important information necessary for the inferences (Daneman & Carpenter, 1980; Just & Carpenter, 1992; Singer, Andrusiak, Reisdorf, & Black, 1992; Singer & Ritchot, 1996). However, Just and Carpenter (1992) found that if working memory function is limited, individuals maintain only a limited set of information for processing, encoding, and storing in the representation. This limitation in working memory forces them to spend more time and resources processing the information, possibly preventing important, relevant information from being encoded. Overall, working memory span provides the basis for integrating and storing information in text representations, thereby influencing the degree of comprehension.

Besides working memory span, Carroll (1993) found that vocabulary also facilitates reading comprehension during reading development. Reading provides opportunities for encountering new words, and with new words, readers would need less time to recognize words due to a large number of alternatives located in

memory. Thus, vocabulary aids comprehension by using a small amount of resources in word recognition (Beck, Perfetti, & McKeown, 1982). However, encountering too many unknown words will cause comprehension difficulties due to the time and resources it requires for determining each word meaning. Thus, poor comprehenders typically have smaller vocabularies (Catts, Adlof, & Weismer, 2006; Nation, Clarke, Marshall, & Durand, 2004; Nation & Snowling, 1997; Yuill & Oakhill, 1991) and use the context more in word meaning acquisition (Cain, Oakhill, & Lemmon, 2004) than do good comprehenders.

Poor comprehenders have difficulty integrating incoming information into a coherent and elaborate representation (Cain & Oakhill, 1999; Long, Oppy, & Seely, 1997). They are also unable to create the associations between distant information located in the text. The combination of these two difficulties causes their representations to lack global coherence (Cain & Oakhill, 1999; Garnham, Oakhill, & Johnson-Laird, 1982; Long, Oppy, & Seely, 1994, 1997; Oakhill, Yuill, & Parkin, 1986). Similarly, Kruidenier (2002) found that adults in literacy programs have problems integrating the information for more complex texts, causing them difficulties in creating inferences. However, Barnes, Dennis, and Haefele-Kalvaitis (1996) found that they still have access to their representations and prior knowledge though, since good and poor comprehenders do not differ in memory retrieval.

Despite the fact that they have difficulty integrating information, poor readers do make inferences for comprehension, but they make fewer of them and take longer to create them than do good comprehenders (Casteel, 1993; Casteel &

Simpson, 1991; Long, Oppy, & Seely, 1994; Oakhill, 1982, 1984; Omanson, Warren, & Trabasso, 1978; Paris & Lindauer, 1976; Paris & Upton, 1976). Additionally, Rapp, van den Broek, McMaster, Kendeou, and Espin (2007) found that some poor readers kept rereading or paraphrasing the text instead of generating inferences while reading. Thus, poor readers have difficulty making inferences, which compound their difficulty in creating an integrated and coherent representation from which to derive comprehension.

In summary, good readers typically combine the results from the previous reading components to form a coherent text representation, which is comprised of the most relevant information. Working memory and vocabulary aid in the process of integrating information and forming inferences crucial for comprehension. The mental representation provides the readers with the meaning of the text. On the other hand, poor readers have trouble in all facets of the comprehension process, since they might have encountered problems on many of the previous reading components, especially decoding.

Summary

The five reading components are crucial for successful reading. Phonemic decoding allows individuals to identify the individual spoken sounds in words, which they link with the alphabetic letters. Once established, individuals begin to decode words by sounding out the individual letters for identifying words. With experience, they begin to recognize words based on their orthographic pattern instead of through decoding, which speeds up word identification. The faster individuals can recognize words, the faster and more accurate they will be in

reading a text. The ease of word recognition and reading will benefit the acquisition of new words into vocabulary. Finally, the quickness of word recognition and the large number of words in vocabulary will increase reading comprehension. Thus, the reading components are connected to each other, and it takes the correct functioning of each of them to maximize reading ability.

Two other variables also influence reading ability, working memory (WM) and listening comprehension. WM positively interacts with vocabulary and reading comprehension during reading, but vocabulary and reading comprehension can occur and influence reading ability regardless of WM capacity. It makes vocabulary and reading comprehension easier with a greater efficiency. The Simple View of Reading (Gough & Tunmer, 1986) states that listening comprehension is a major contributor to reading ability along with decoding ability. Because language, written and oral, is transformed first into oral language, listening comprehension becomes a critical factor in determining how well individuals read (Torgesen, 1997). Overall, the five major reading components along with WM and listening comprehension determine reading ability.

The seven reading components make a substantial contribution on reading ability. Additionally, the four different reading ability groups postulated by the Simple View of Reading (Gough & Tunmer, 1986) make categorizing readers easier. Based on this information, it is possible to project how the seven reading component will relate for the four groups of readers. The pattern of the reading components for the four groups of readers is presented in Table 2.

The good reader group will perform well on most, if not all, of the reading components (Figure 1). Because these readers will have good phonemic decoding ability, it will have a positive influence on word recognition ability. The skilled word recognition abilities of this group will increase reading fluency and increase

Table 2

Performance on the Seven Reading Components Based on the Four Major Groups of Readers from the Simple View of Reading (Gough & Tunmer, 1986).

	Good Readers	Dyslexics	Hyperlexics	Garden Variety Readers
Phonemic Decoding	Good	Poor (Causal)	Good	Poor (Causal 1)
Word Recognition	Good	Poor (Secondary)	Good	Poor (Secondary 1)
WMS	Variable	Variable	Variable	Variable
Listening Comprehension	Good	Good	Poor (Causal)	Poor (Causal 2)
Reading Fluency	Good	Poor (Secondary)	Good	Poor (Secondary 1)
Vocabulary	Good	Poor (Secondary)	Good	Poor (Secondary 1)
Reading Comprehension	Good	Poor (Secondary)	Poor (Secondary)	Poor (Secondary 1,2)

vocabulary size. Reading fluency and vocabulary size will have a positive influence on reading comprehension. Likewise, because this group has good listening comprehension, listening comprehension will also have a positive influence on

reading comprehension. Finally, WMS will facilitate in the acquisition of new vocabulary words and in the comprehension of written material.

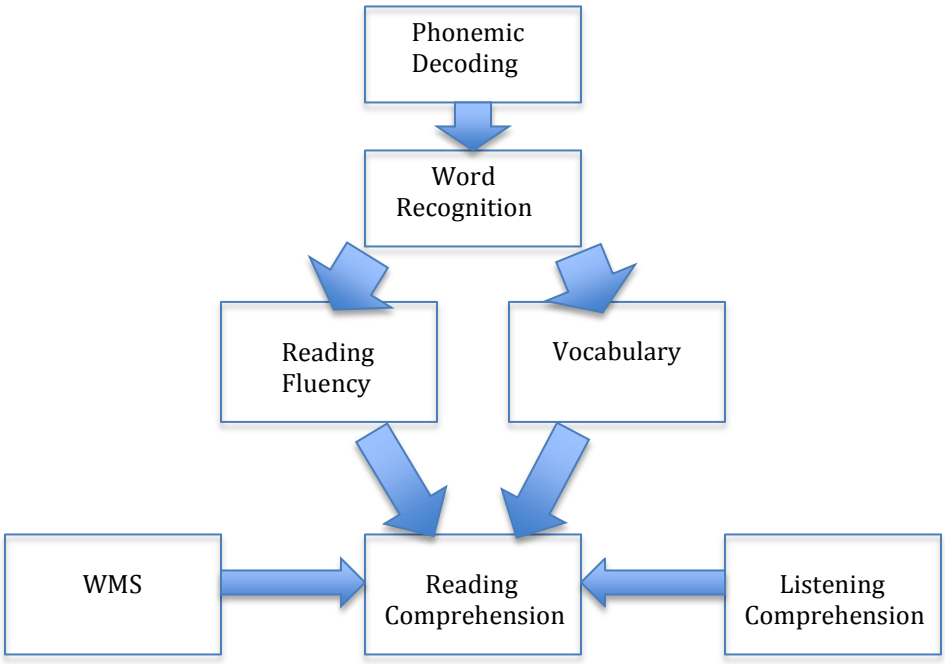


Figure 1. The Relationships between the Reading Components in Contributing to Reading Ability for Good Readers.

Unlike good readers, dyslexics have an underlying phonological problem, which will prevent them from developing an adequate phonemic decoding ability (Figure 2). Their poor phonemic decoding will have a negative effect on word recognition, which will decrease reading fluency and prevent vocabulary from increasing substantially. Due to their poor reading fluency and limited vocabulary, the reading comprehension of dyslexics will suffer. Despite these difficulties, dyslexics typically have a good listening comprehension. However, a good listening comprehension will not allow them to have a good reading ability, since they would not both good decoding and listening comprehension abilities. An efficient WM will

provide dyslexics with some benefit in their phonemic decoding, vocabulary, and reading comprehension abilities.

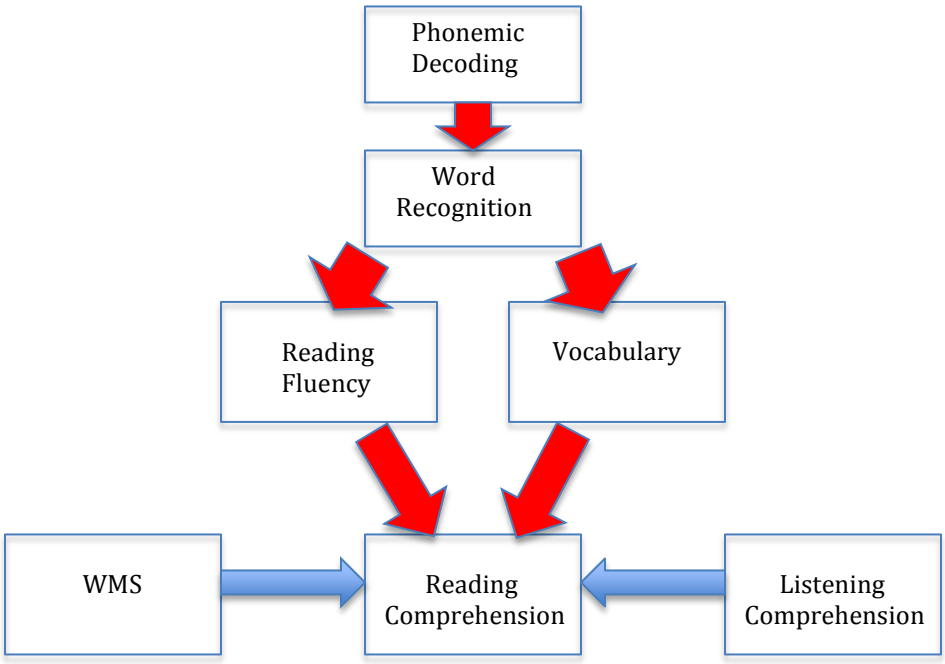


Figure 2. The Relationships between the Reading Components in Contributing to Reading Ability for Dyslexics.

Unlike dyslexics, individuals with hyperlexia or special comprehension deficit have a good phonemic decoding ability (Figure 3). Thus, their decoding ability will positively impact word recognition skills, which will increase reading fluency and vocabulary size. The high reading fluency and vocabulary skills of hyperlexics will have a positive influence on reading comprehension. Despite the success hyperlexics have in phonemic decoding and the components that rely on it, these readers have poor listening comprehension. Although a more efficient WM will help understand spoken language, their poor listening comprehension will

prevent hyperlexics from achieving good reading ability, since they would need a good listening comprehension to achieve it.

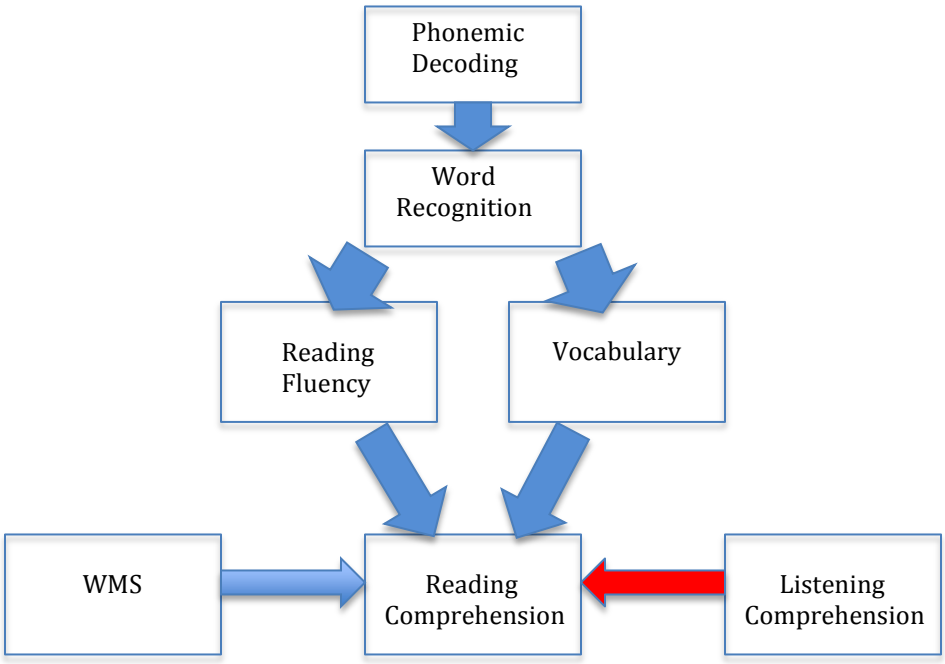


Figure 3. The Relationships between the Reading Components in Contributing to Reading Ability for Hyperlexics.

Finally, mixed or garden-variety readers have underlying problem areas in both phonemic decoding and listening comprehension (Figure 4). Because of their poor phonemic decoding, garden-variety readers have poor word recognition. Their poor word recognition decreases their reading fluency and prevents them from acquiring a large vocabulary. Their poor ability in reading fluency and vocabulary will have a negative effect on reading comprehension. Additionally, garden-variety readers have poor listening comprehension, and their poor listening comprehension will only compound the trouble their poor decoding ability has on reading comprehension. Thus, the additive nature of reading allows predictions to be made

for individuals from one of the four reading ability groups on performance on each of the reading components.

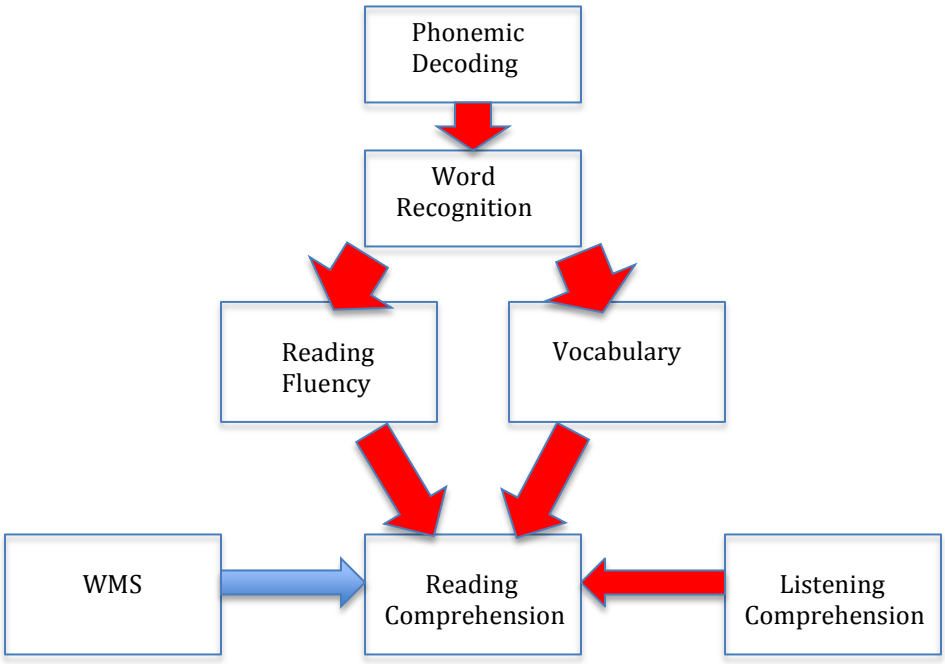


Figure 4. The Relationships between the Reading Components in Contributing to Reading Ability for Garden-Variety Readers.

Other Variables Related to Reading Ability

Besides the seven critical reading components, other variables that are not directly related to reading ability contribute to or are influenced by reading ability. Some of these variables are reading frequency, the number of books at home, gender, grade point average (GPA), and socioeconomic status (SES). These variables do not provide direct evidence of reading ability, but they are one of many factors that might influence individual differences in reading ability.

Gender has been at the heart of much research by investigating whether a difference exists between the genders in reading ability. Females have been found to

have better reading ability than do males (Logan & Johnston, 2009; Mullis, Martin, Gonzalez, & Kennedy, 2003, 2007). Additionally, females typically have more favorable attitudes towards reading than do males (Coles & Hall, 2002; Hall & Coles, 1999; Kush & Watkins, 1996; McKenna, Kear, & Ellsworth, 1995; Sainsbury & Schagen, 2004). Thus, because females are better at reading than are males, it is reasonable to expect that this relationship has the likelihood of being found in most reading research.

Reading frequency and access can provide an indication of reading ability based on the new reading opportunities sought by the individual. According to the Matthew Effect (Juel, 1988; Stanovich, 1986), good readers search out reading opportunities, because they have an easy time reading. These experiences increase reading skills and vocabulary size. However, poor readers avoid new reading opportunities due to past negative experiences in reading. Without new reading experiences, reading ability does not improve, and their vocabulary does not increase. The Matthew Effect (Juel, 1988; Stanovich, 1986) also states that the difference between good and poor readers increases over time due to the experience differential between the groups. Thus, good readers should have a higher reading frequency than poor readers (Brozko, Shiel, & Topping 2008; Donahue, Daane, & Grigg 2003; Wigfield, Guthrie, Perencevich, Klauda, McRae, & Barbosa, 2008). Similar to reading frequency, the number of books at home might also provide an indirect indication of reading ability based on the importance of reading has on the individual. The more books there are at home, the more likely the individual will read the books, providing more reading experiences. Overall, reading

frequency and the number of books owned suggests whether individuals seek out reading opportunities, and seeking out a large number of reading opportunities is one factor that alludes to good reading ability.

Socioeconomic status has been found to influence language development (Hoff, 2003; Noble, Norman, & Farah, 2005; Whitehurst, 1997). For word recognition ability, SES has a moderate to large influence on its development (White, 1982), and it also impacts decoding and reading comprehension (Bowey, 1995; Hecht, Burgess, Torgesen, Wagner, & Rashotte, 2000; Raz & Bryant, 1990). This impact of SES on reading ability derives from the reading experiences the different SES levels have, especially in the importance of reading, print exposure, and school quality (Hecht et al., 2000). Children in higher SES families typically are read to more, are taught of the importance of books, and usually attend schools with more funding and better teachers than do children in lower SES families (Raz & Bryant, 1990; Whitehurst, 1997). Higher SES families usually have more books and have better access to them than do lower SES families (R.H. Bradley, Corwyn, Pipes McAdoo, & Garcia Coll, 2001). Thus, SES has a strong influence on reading ability based on its effects on decoding, word recognition, and reading comprehension through its effects on reading experiences.

Finally, GPA is a variable that is influenced by reading ability. The National Assessment of Education Progress (2006) has suggested that individuals with average reading ability have the necessary skills for academic success. Because reading becomes more important with age through our reliance on it in knowledge acquisition, reading ability should influence indicators of academic success (Goetze

& Walker, 2004), with GPS being the most used indicator. Good readers will have an easier time grasping information from written material than will poor readers. This information could make it easier for good readers to grasp the knowledge, allowing them to perform better on tests of that knowledge than would poor readers. Thus, reading ability might have a positive influence on high school GPA.

In summary, these variables have the potential to influence reading ability. Gender differences have been found in reading ability, so gender might influence some of the reading components. SES, reading frequency, and the number of books at home provide new reading experiences to individuals, providing them with opportunities for increasing their vocabulary and honing their reading abilities. Finally, GPA has the potential of being a good reflection of reading success, since knowledge acquisition is done mostly through reading with increasing age. Although these variables probably do not have the same impact on reading ability as do the critical reading components, they do make some contribution and are worth studying.

Current Study

The current study investigated the reading abilities of incoming college freshman on the main reading components to determine the exact pattern of associations between the components and how they contribute to reading comprehension. Specifically, it sought to discover whether they demonstrate the same pattern as adults with low literacy exhibit. In particular, the current study assessed the students on their auditory working memory, phonemic decoding, word reading, expressive vocabulary, oral language comprehension, reading fluency, and

reading comprehension abilities. As seen in the literature review, each component contributes to reading success, and difficulties in any one of them will contribute to deficits in the subsequent components since they are additive. Using a cross battery approach, the participants were assessed on each critical reading component. Besides assessing for the critical reading components, the participants were asked about specific demographic variables, their reading history, and their reading habits. A path analysis was used to ascertain the specific path coefficients between the components. Finally, the path analysis for incoming college freshmen will be compared with the path analysis found for adults with low literacy derived from Mellard, Fall, and Woods (2010).

Mellard, Fall, and Woods (2010) investigated how different reading components associated with each other and contributed to the reading ability of adults with low literacy. The sample consisted of 174 adults attending a adult literacy program. These participants had a fifth grade equivalent reading comprehension and word reading abilities, less than a third grade equivalent decoding ability, and poor auditory working memory and oral language comprehension abilities. They tested a model revolving around decoding, word reading, language comprehension, working memory, speed of processing, and reading fluency.

In their study, Mellard, Fall, and Woods (2010) found an interesting pattern of contributions amongst the reading components (Figure 1). Phonemic decoding had a large effect (r = 0.84; β = 0.77) on word reading, suggesting that the degree to which the reader can decode words using their alphabetic knowledge determines

word reading. Word reading then had a large effect on both vocabulary (r = 0.60; β = 0.60) and reading fluency (r = 0.88; β = 0.77) and a moderate effect on reading comprehension (r = 0.84; β = 0.49). Accuracy and quickness in word reading positively influences whether readers can acquire new words and the speed in which they read.

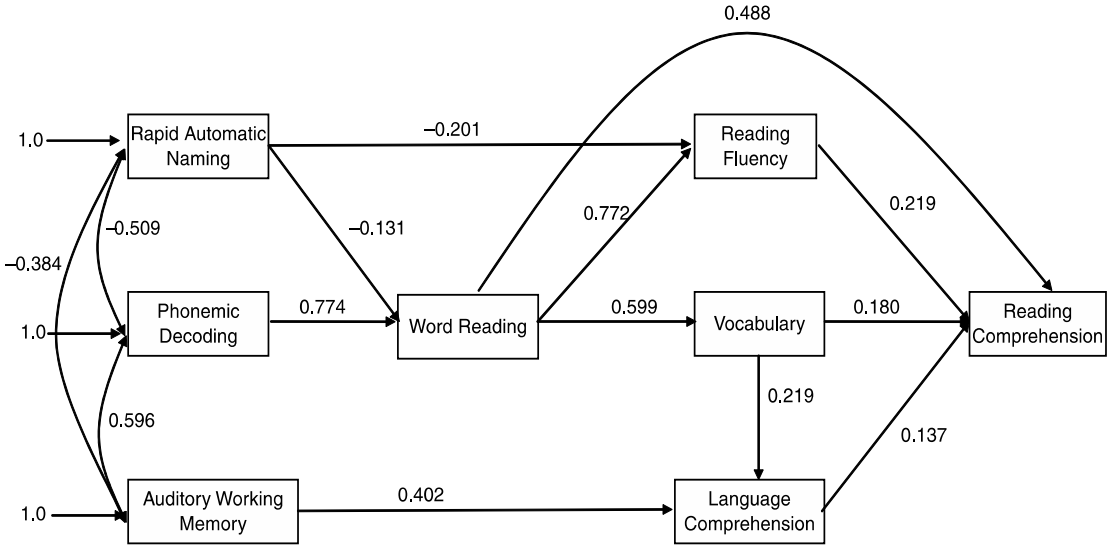


Figure 5. Path analysis found by Mellard, Fall, and Woods (2010).

Mellard, Fall, and Woods (2010) also found that vocabulary had a small effect (r = 0.41; β = 0.22) on listening comprehension, suggesting that a larger vocabulary allows for better listening comprehension. Reading fluency (r = 0.79; β = 0.22), vocabulary (r = 0.64; β = 0.18), and listening comprehension (r = 0.47; β = 0.14) all had small effects on reading comprehension. This finding indicates that for this population, reading speed, vocabulary size, and the oral language comprehension ability contribute minimally to the degree in which they comprehend what they read.

Additionally, auditory working memory (r = 0.60; β = 0.60) and rapid automatic naming (r = -0.51; β = -0.51) had moderate effects on phonemic decoding. Thus, the amount of auditory information this population can store in working memory and their speed of letter naming determine how well they use the letter-sound associations for decoding. Rapid automatic naming also had a small negative effect on word reading (r = -0.53; β = -0.13) and reading fluency (r = -0.66; β = -0.20), indicating that the faster they could name letters the worse they were in reading words and text. Finally, auditory working memory had a moderate effect (r = 0.50; β = 0.40) on language comprehension. Thus, the more oral language information readers can store in working memory, the more likely they will comprehend it (Mellard, Fall, & Woods, 2010).

Mellard, Fall, and Woods (2010) concluded that adults with low literacy do not utilize their vocabulary and language comprehension abilities for reading comprehension well (Catts et al., 2005; Cromley & Azevedo, 2007; Gough & Tunmer, 1986). Instead, they read in a similar manner as beginning readers by relying heavily on their word reading ability despite poor decoding ability, which was the main cause of their problems. This heavy reliance on word reading prevented them from associating the text strongly with vocabulary and comprehension, causing reading comprehension to suffer.

In summary, the current study used the same reading components except for rapid automatic naming, which only had a minor contribution to the remaining reading components. The incoming college freshmen were assessed on the seven reading components to determine the path analysis towards reading

comprehension. The participants were also asked questions about their educational background, demographics, reading history, and reading habits. This study should provide information on the ability of incoming college freshmen on these components, how the components contribute to reading comprehension, and whether their performance differs from that of adults with low literacy found in Mellard, Fall, and Woods (2010).

Predictions

Concerning the educational, demographic, reading history, and reading habits of the participants, there should be a number of interesting relationships. The female participants should do better overall than the male participants on the reading components. Socioeconomic status (SES) and the highest level of education achieved by the participant's mother might have some influence on the reading components due to access to books, the amount of one-to-one interaction, and educational funding to the high schools the participants attended. High school grade point average (GPA) should separate the high and low performers on the later developing components, such as vocabulary and comprehension. They should still be developing when the participants are in high school when compared to the early developing components, such as phonemic decoding and word reading, which should be well developed. Reading frequency and the number of books at home should have a relationship with vocabulary and comprehension. Finally, any diagnosis of reading problems should differentiate the participants who have been from those who have not been diagnosed with reading problems.

Most of the participants should not have any major problems on the critical reading components. A small portion of the participants might perform below average on some of the reading components. Variation in the participants' performance on each of the components should not be great. However, variance will be greater for vocabulary and comprehension components than for phonemic awareness and word reading. Thus, the variance in participant performance should increase with development.

Regarding the path analysis, the pattern of relationships should reflect the literature for normally developed reading abilities. Phonemic decoding should have a strong influence on word recognition, since it provides the foundation for word recognition. Word recognition should impact vocabulary strongly, because vocabulary acquisition depends on good word recognition ability. Word recognition should also have a strong effect on reading fluency, since reading fluency is a great indication of success in word recognition.

Working memory span (WMS) should have a strong bidirectional influence on phonemic awareness. The amount of items that can be held simultaneously should help identify and combine phonemes in words, while having to manipulate multiple phonemes simultaneously should force WMS to be large enough to accomplish it. WMS should also greatly influence listening comprehension by the necessity of holding numerous words in memory simultaneously to comprehend spoken language.

Vocabulary should also strongly impact listening comprehension by providing the word meanings necessary to comprehend spoken language. Reading

fluency should not have a large influence on reading comprehension, because it does not provide a significant contribution to reading comprehension beyond word recognition and listening comprehension. Based on the view of the Simple View of Reading (Gough & Tunmer, 1986), vocabulary and listening comprehension should have a strong impact on reading comprehension. Finally, word reading should have a strong influence on reading comprehension, since the speed in which individuals identify words has a strong influence on whether they comprehend the material.

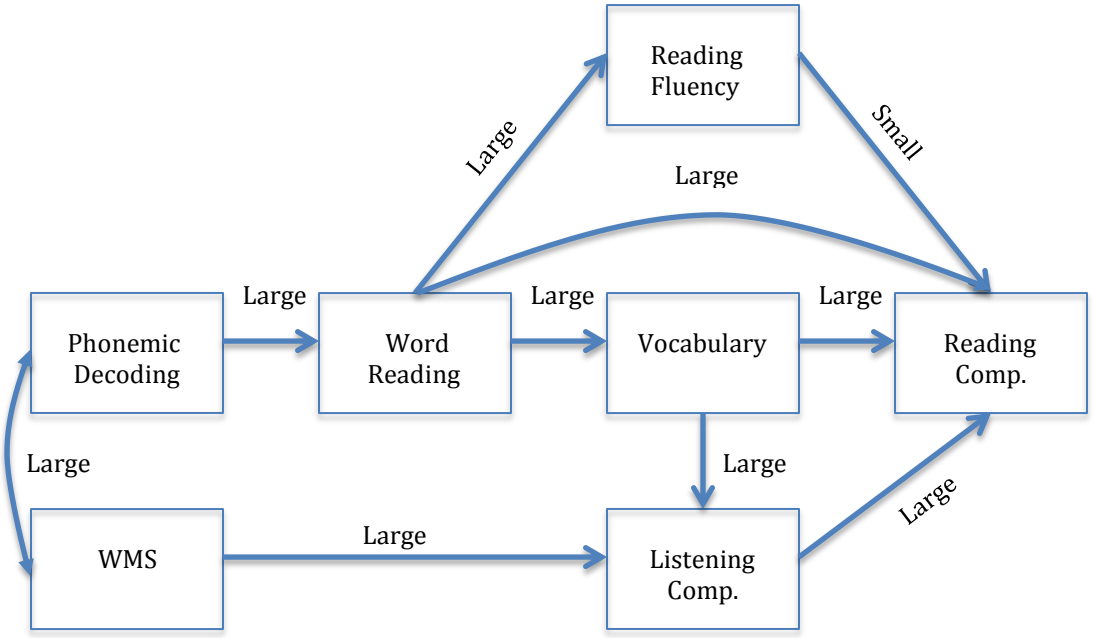
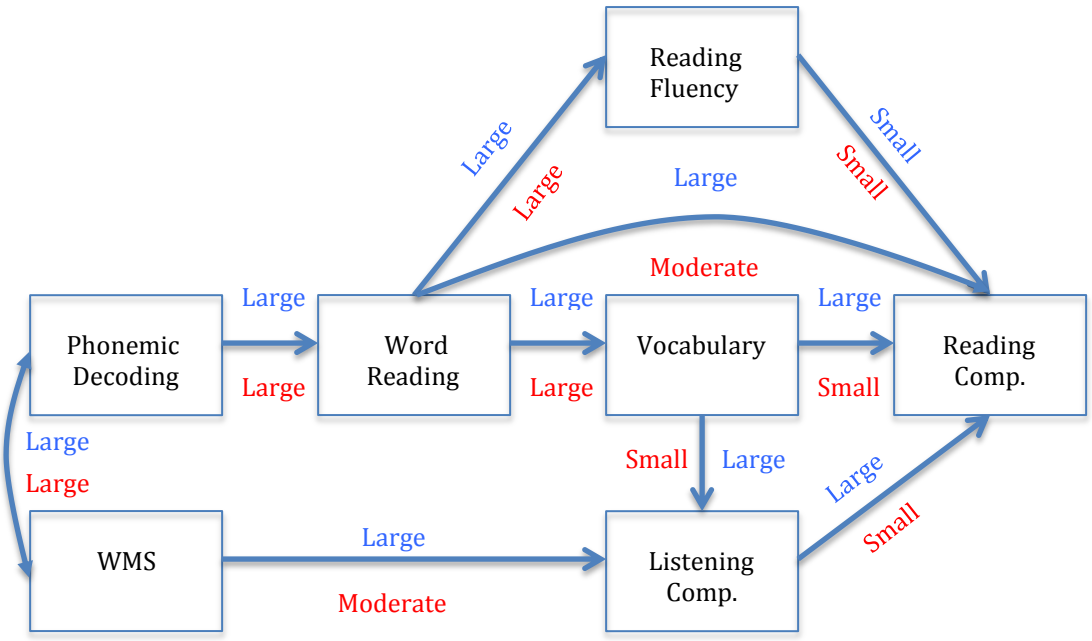


Figure 6. Figure of the Predicted Size of the Path Estimates for Incoming College Freshmen.

When comparing the path analyses between incoming college freshmen and adults with low literacy, a significant difference is expected between them. The paths between vocabulary and listening comprehension with reading comprehension should be larger for the incoming college freshmen than adults with low literacy. The incoming college freshmen should have a larger vocabulary and

better listening comprehension abilities than adults with low literacy, so they should have a greater impact on differences in comprehension performance. Additionally, due to their larger vocabulary, incoming college freshmen should have a stronger pathway between vocabulary and listening comprehension. A large vocabulary would make it easier to grasp the meaning of spoken language than would a smaller vocabulary. Similarly, word reading should have a stronger impact on reading comprehension for incoming college freshmen than for adults with low literacy. The freshmen' word recognition should be skilled enough to impact comprehension ability better than it did for adults with low literacy. WMS should have a greater influence on listening comprehension for incoming college freshmen when compared to adults with low literacy due to the better ability to retain the information in memory for word recognition. The remaining paths should be roughly similar across the groups. Thus, the triangular relationship among vocabulary, listening comprehension, and reading comprehension should contain most of the differences between incoming college freshmen and adults with low literacy.



Blue = Incoming College Freshmen
Red = Adults with Low Literacy

Figure 7. Figure of the Predicted Comparison of Path Estimates for Incoming College Freshmen Compared and Adults with Low Literacy in Mellard, Fall, and Woods (2010).

CHAPTER III

METHOD

Participants

The study included 177 incoming college freshmen students attending the University of Kansas. The participants were members of the Introductory Psychology student pool. Introductory Psychology is a required course for graduation, and most of the students taking the class were freshmen, providing access to a large sample of incoming college freshmen. Only freshmen students participated, and non-traditional students and non-native English speakers were excluded. We excluded non-traditional students because they would not be a true reflection of the reading abilities of recent high school graduates. Additionally, we used only native English speaking students because testing non-native English speakers would have produced confounds due to our testing only in English, in which they might not be as fluent as their primary language. The participants received credit counting towards the fulfillment of the research participation requirement associated with Introductory Psychology course.

To determine the appropriate sample size needed for the study, a Monte Carlo method was run. This method calculated the smallest sample size possible while retaining good power and a moderate effect sizes using simulations of 1,000 samples based on the population estimates derived from Mellard, Fall, and Woods (2010). The sample size was adjusted until the power ($1 - \beta = 0.90$) and effect size were good. The Monte Carlo method indicated that a sample size of 175 participants was best for this path model. Thus, the sample collected is adequate enough to find

significant findings while having a good effect size.

Materials

Reading Component Tasks

The Woodcock Reading Mastery Test-Revised (WRMT-R) (Woodcock, 1998) was used for measuring three abilities. For testing phonemic decoding, we used the Word Attack subtest. This subtest assesses the phonological and decoding abilities of test takers by having them pronounce non-words. We assessed word reading ability using the Word Identification subtest. This test measured sight-word recognition and phonological skills by having the participants pronounce high frequency words. The words should be familiar to the participants, and performance will indicate orthographic understanding. Finally, for reading comprehension, the participants took the Passage Comprehension subtest, in which they completed a cloze procedure. This procedure uses passages of two or three sentences in length containing a missing word, and the participants spoke the missing word based on the context. The task measures the participants' ability to generate inferences and use contextual information. The WMRT-R has an internal reliability between .87 and .98 and a concurrent validity between .79 and .92 (Woodcock, 1998). The norming information for the current version of the test is for a previous version and is not up-to-date. However, the use of the subtest scores instead of the overall scores limits the influence that the out-of-date reliability information has on the findings.

For testing expressive vocabulary, the Vocabulary subtest of the Wechsler Adult Intelligence Scale-4th Edition (WAIS-4) (Wechsler, 2008) was used. In this subtest, participants are read aloud a list of words individually. For each word, they

provide an oral description of the word's meaning. The degree of articulation indicates the depth and breadth of vocabulary. The internal validity of this test is between 0.97-0.98, and it has concurrent validity based on high correlations with the Wechsler Individual Achievement Test-Third Edition (WIAT-III; Wechsler, 2009).

For testing language comprehension, the Understanding Spoken Paragraphs subtest of the Clinical Evaluation of Language Fundamentals, Fourth Edition (Semel, Wilg, & Secord, 2003) was used. This assessment has the participants listen to a passage read aloud and answer questions about explicit and inferred material. Performance on this task suggests the degree that the participants can create the necessary inferences for integrating and comprehending spoken information. It has an internal consistency and split-half reliability coefficients between 0.70 and 0.91 and an inter-scorer reliability between 0.88 and 0.99. It also has a moderate concurrent validity with the CELF, Third Edition (Semel, Wilg, & Secord, 1995).

Finally, for auditory working memory and reading fluency, the Auditory Working Memory subtest in the Woodcock-Johnson, 3rd Edition (Woodcock, McGrew, Mather, & Schrank, 2001) was used. The auditory working memory subtest required participants to complete a working memory span assessment in which they listened to lists of words and numbers. For each list, they separate the two types of stimuli into categories and then retrieve each category in their correct order. In the reading fluency subtest, participants received a list of short sentences, and they determined whether each sentence was true or false. The participants had three minutes to do as many they could while avoiding making mistakes. These

subtests have an internal consistency above 0.80, a test-retest reliability above 0.70, and a median split-half reliability above 0.80.

Reading Survey/Questionnaire

For the reading survey/questionnaire, the participants answered questions regarding their academic, demographic, reading history, and reading habits. The reading survey/questionnaire is in Appendix B. Regarding their academics, the participants answered a question on the high school GPA upon graduation. For the demographic questions, the participants answered questions about their socioeconomic status through questions about the high school they attended and the county and state in which it was located. They were asked about their gender, the highest degree of education achieved by their mother, and the number of books in their home. The participants were also asked if they had any vision, hearing, or learning problems.

Regarding their reading history, the participants answered questions about whether they would like to improve their reading ability, whether they had any specific problem areas in reading, and what the specific problem areas were if they did. They were also asked whether they had any trouble in school, when it started if so, and whether they received any help. Finally, the participants were asked whether they thought their reading problems were preventing them from achieving their goals.

Concerning their reading habits, the participants were asked how often they read for pleasure. To gain insight as to the material they often read, they took an Author Recognition Test and a Magazine Title Recognition Test (Acheson, Wells, &

MacDonald, 2008). In the Author Recognition Test, the participants identified actual author names from a list of filler items. In the Magazine Title Recognition Test, they did the same thing except for they looked for actual magazine titles instead of author names.

Procedure

Each participant was scheduled for an individual session in a quiet environment, which will limit the amount of distractions. After signing the informed consent form describing the study, the participant answered a reading survey/questionnaire. Following the completion of the reading survey/questionnaire, the participant completed the tests related to each reading component in a random order. The entire session lasted about 45-50 minutes.

Data Collection

The data for the current study was collected by the author of this paper and a undergraduate research assistant. Both test administrators were trained using the procedure instructions provided by each of the standardized tests as well as information and instructions provided by individuals knowledgeable of the tests. The test administrator practiced the procedures until they had completely internalized the exact procedure for each test. At this point, they performed a practice run of the procedures on the other test administrator until both administrators performed it correctly. A dozen participants were used as a pilot study to ensure that the test administrators were scoring the responses similarly. The inter-rater reliability on what was scored correct and incorrect was calculated to determine scoring consistency, and this analysis indicated that the two test

administrators had an inter-rater reliability coefficient of 0.98, which suggests that the two test administrators scored almost all of the responses consistently.

To protect the identity of the participants, steps were taken to prevent any identification information be associated with the performance of the participants. Each participant was assigned a specific number that was to be placed on each of the response forms. No document contained each participant's name and their number to protect their privacy. The only document with each participant's name on it was the informed consent form, and these signed documents were stored in a locked filing cabinet. Once the documents were scored according to each test's instructions, the documents were released to the author of the paper for data entry into a secure computer file.

Statistical Analysis

The current study used two general types of statistical analysis to investigate the collected data. For both types of analyses, an alpha level of 0.05 was used to determine statistical significance. For the survey/questionnaire data, regression analysis and ANOVA were used to determine the relationships between this data and reading component performance. The type of data it provided determined the specific type of analysis used for each question on the survey/questionnaire. For the income and GPA questions, a regression analysis was used due to their continuous nature. For the remaining questions, ANOVA was used to investigate the relationships, since the data was categorical. Additionally, for analysis purposes, participants defined as having reading problems are those participants who self-reported as having been diagnosed with reading problems in school.

To determine the associations between the reading components towards influencing reading ability, a path analysis was performed using Mplus (Muthén & Muthén, 1998-2011). The path model from Mellard, Fall, and Woods (2010) was the initial model used to set the path estimates for incoming college freshmen. Besides this initial model, the best fitting model was also found for incoming college freshmen. The path estimates from the initial path model were compared with those of adults with low literacy found in Mellard, Fall, and Woods (2010). LISREL (Mels, 2006) was used to compare the path estimates from the two samples. Two models were used to compare the path estimates. The first model had fixed parameters, and the second model had free parameters. A χ^2 Difference test was used to determine whether the models were significantly different. A significantly different result would suggest that the two samples had significantly different path estimates.

CHAPTER IV

Results

Overview

The results section will first present the results of the reading survey/questionnaire for the incoming college freshmen. Performance on the seven critical reading components will then be presented. Following this section, the results of the path analysis using the path model found in Mellard, Fall, and Woods (2010). Next, the comparison between the path estimates of the incoming college freshmen and adults with low literacy using the path model found in Mellard, Fall, and Woods (2010) will be presented. The best fitting path model for incoming college freshmen will be presented. Finally, the significant relationships between the demographic information and reading component performance from the regression and ANOVA analyses will then be related.

Demographic Information

The participants' responses to the reading survey/questionnaire produced findings that differed from the comparative data. Although an equal percentage of males and females was desired, males participants accounted for only 27% of the sample. This finding could be a concern for any conclusions made concerning gender despite the fact that females are generally better readers than are males (Chiu & McBride-Chang, 2006; Smith, Smith, Gilmore, & Jameson, 2012). As expected, the average age of the participants was 18.4 years, which is within the age range of college freshmen students. The average high school GPA of the participants was 3.62, which is higher than the national average of 2.98 (National Center of

Education Statistics, 2005). The average income of the county in which the students graduated from high school was $58,317, which is above the national average of $51,914 based on the U.S. Census bureau (U.S. Census Bureau, 2011). The participants are slightly higher than desired on these characteristics, but they should still provide valuable information.

Besides the general information about the participants, information concerning other demographic variables and reading history information was collected. Half of the participants had mothers who had a bachelor's degree, while 30% of the participants had mothers who have a graduate degree. The mothers of 17% of the participants only had a high school degree, and mothers of 0.02% of the participants did not achieve high school degree. Thus, nearly 80% of the participants had mothers who had at least a bachelor's degree, which is not surprising due to the increased expectancy of high school graduates to attend university. Concerning the amount of books at home, 61% of the participants grew up in homes with multiple bookcases, while 29% of the participants had one bookcase in their homes. Small percentages of participants had one shelf of books (6.8%) or few books (3%). Again, the vast majority of the participants had easy access to books, which could be influential in reading development. Finally, most of the participants read for pleasure every day (34%) or a few times per week (42%). Smaller portions of the participants read for pleasure once a week (11%), once per couple of weeks (10%), or never (3%). Thus, over two-thirds of the participants read frequently for pleasure, and this reading frequency might facilitate reading ability through increased reading experiences.

To gauge any preference for specific reading material the participants might have had, they took an Author Identification Test and a Magazine Title Recognition Test (Acheson, Wells, & MacDonald, 2008) to gain some insight into their reading habit. The participants recognized roughly similar numbers of authors (9.73) and magazine titles (9.76), and this difference was not significant. However, they falsely recognized three times more magazine titles (1.64) than they did author names (0.51), which was significant, F (1, 352) = 41.75, $p < .001$. These findings suggest that the participants did not have preferred reading material type, but they had a harder time differentiating actual magazine names from fictitious ones. The participants were able to identify only a small number of authors and magazines, which suggests that they do not read too much despite their answers to the reading frequency question.

Several questions on the reading questionnaire focused on determining the likelihood of physical and learning difficulties in incoming college freshmen sample. Small percentages of the students had a vision (7%) or hearing (5%) difficulties. Additionally, a small percentage of the participants were diagnosed as having learning difficulties (9%). As expected, participants with physical and learning problems were present in the college freshmen population, but they were few when compared to those without any learning problems.

To gauge how the participants viewed their reading ability, several questions asked what they thought of their reading ability and in what areas they could improve it. Of the 177 participants, 82% of them thought that they could improve on their reading ability. However, only 27% of that number thought they could improve

specific reading skills. Thus, most of the participants thought their reading ability had room for improvement but was not at such a low level as to have specific areas of concern. Allowed to indicate one or more troubling reading skill, the most common reading skill targeted for improvement of those with specific concerns was reading speed (60%), closely followed by comprehension (46%). Vocabulary (27%) and word recognition (17%) were also thought to be areas of concern for the participants. Thus, most of these participants thought that they read too slowly or had difficulty comprehending the material, and few of them believed their vocabulary and word recognition abilities were problematic.

Because most of the participants thought they could improve their reading ability, it would be interesting to know how many they have been diagnosed with reading trouble, when their reading problems started, and whether they received any reading instruction. Only 15% of those students were identified as having reading problems in school, which is a lower number than the participants who had specific areas of concern in their reading. In elementary school (57%) was when most of the participants indicated when their reading difficulties started. Almost a quarter of these participants (24%) stated that their reading problems became apparent in high school, while 10% of the participants each thought it was during elementary or middle school. This finding corroborates the findings of previous research that most reading problems will arise early in reading development (Foster & Miller, 2007; Francis et al., 1996; Shaywitz et al., 1999). Despite these numbers, only 48% of these participants received supplementary reading instruction, and only 4% thought their reading problems impeded them from

achieving their goals. Thus, despite the diagnosis of reading problems, only half of these participants actually received instruction for their difficulties.

Reading Component Performance

For each task, performance was scored according to the given instructions of the subtest, and the averages and grade equivalency information was determined based on the information provided by the test makers (Table 3). Thus, performance comparisons can be made based on the typical of different age groups. For phonemic decoding, the participants had the ability roughly equivalent to that of a college senior, and on word reading, the participants performed on a level similar to that of a college junior's ability. For WMS, the participants had a WMS on par with that of a sixth grader. Regarding reading fluency, the participants could read as quickly and accurately as college seniors. Finally, for reading comprehension, the participant could make inferences and use contextual information similar to that of college juniors. For the vocabulary and listening comprehension, no information on grade-equivalencies could be found for the listening comprehension and vocabulary tasks, so it is unclear as to which age group their performance compares. In summary, with the exception of WMS, the performance of incoming college freshmen were similar to that of college-aged individuals.

Correlations

The correlations among the reading components are located in Table 3. What is most striking about these correlations is that most of them are moderate to small. Phonemic awareness had the largest correlation (r = 0.61) with its path with word recognition, while word recognition had a moderate correlation (r = 0.41) with

Table 3

Model Component Correlations, Raw Scores, Standard Scores, and Grade Equivalents (N = 177)

	Correlation Coefficient							Raw Score		Standard Score		
Variable	1	2	3	4	5	6	7	*M*	SD	*M*	SD	GE.
Word Reading	1.00							97.1	4.6	128	15	15
Phonemic Decoding	0.61	1.00						38.9	3.7	96	15	16
Listening Comp.	0.14	0.21	1.00					11.3	2.2	NA	NA	NA
Vocabulary	0.41	0.28	0.37	1.00				34.2	7.1	105	15	NA
WMS	0.38	0.42	0.16	0.26	1.00			20.9	4.2	89	15	6
Reading Fluency	0.24	0.19	0.35	0.24	0.35	1.00		84.1	11.1	108	15	15
Reading Comp.	0.34	0.35	0.31	0.57	0.27	0.32	1.00	54.2	4.6	102	15	15

vocabulary. Vocabulary also had a moderate correlation (r = 0.57) for its path with reading comprehension. These correlations correspond to the predicted pattern of associations between these reading components.

Besides these correlations, there were some other interesting correlations among the reading components. Word recognition had a very small correlation (r = 0.14) with listening comprehension, and this result suggests that these two skills are separate in their effects on reading ability. WMS also had a small correlation (r = 0.16) with listening comprehension, indicating that WMS was of small import in understanding spoken language. WMS had small correlations with both vocabulary (r = 0.26) and reading comprehension (r = 0.27), which is smaller than expected due to the positive impact that WMS has on these variables. Overall, despite the

prevalence of small and moderate correlations amongst the reading components, they were all statistically significant.

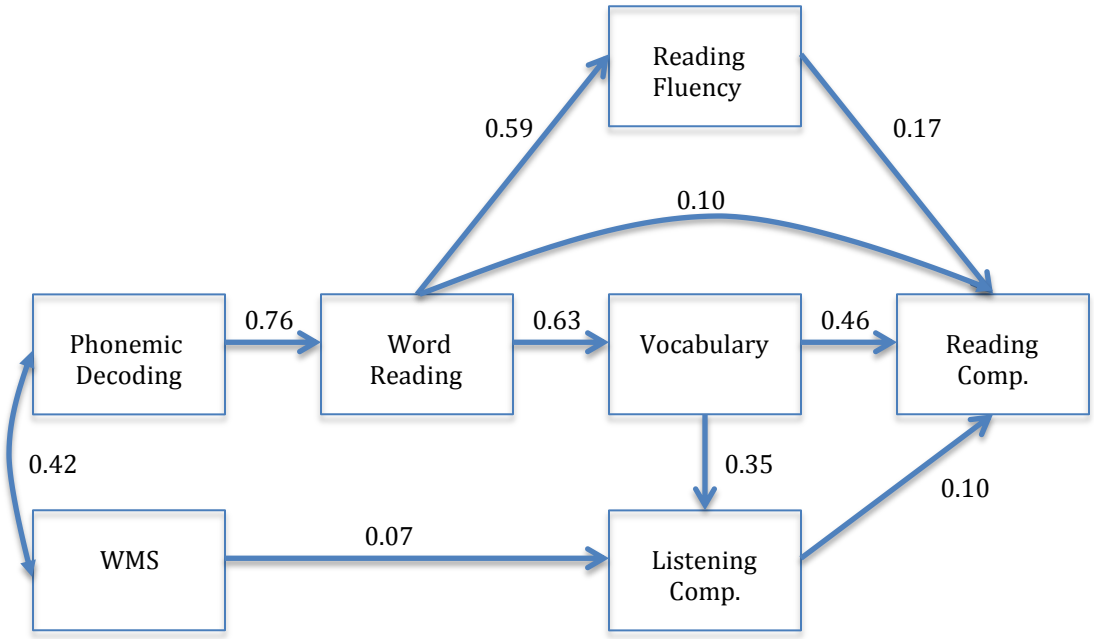
As indicated in this section, vocabulary had a moderate correlation with reading comprehension. This finding is a little troubling since the correlation between the components was slightly smaller than expected. It suggests that measurement error due to slight differences in response scoring on the vocabulary and passage comprehension tests might have cause this difference. Thus, the relationship between vocabulary and reading comprehension found in the current study might be smaller than the actual relationship between the reading components. This finding will be discussed more in the future directions portion of the discussion section.

Path Analysis

The path analysis model derived from Mellard, Fall, and Woods (2010) and adapted for the current study contained ten paths between seven reading components. After applying this model to the performance of the incoming college freshmen on the seven reading comprehension as represented in Figure 4, the model did not retain the same good fit as was found in Mellard, Fall, and Woods (2010). The path coefficients, standardized and unstandardized, are located within Table 4. This model, derived from adults with low literacy and now applied to incoming college freshmen, had only a comparative fit index of 0.90, which indicates poor model fit. The model had a root mean square error of approximation (RMSEA) of 0.11, which also suggests the model fitted the data poorly. Thus, the model that fit well for adults with low literacy fitted poorly for incoming college freshmen,

suggesting that the relationship between the reading components in contributing to reading comprehension might differ across the two groups.

Most of the pathways that were important in the path analysis from Mellard, Fall, and Woods (2010) were also important for the current sample as seen in Figure 4. The path between phonemic decoding and word reading, $\beta = 0.76$; $p < 0.001$, was strong as well as was the path between word reading and vocabulary, $\beta = 0.63$; $p < 0.001$. The path between word reading and reading fluency, $\beta = 0.59$; $p < 0.01$, and between vocabulary and reading comprehension, $\beta = 0.46$; $p < 0.001$, were also



Comparative Fit Index = 0.90; RMSEA = 0.11; 90% RMSEA Confidence Interval = 0.07-0.15; $\chi^2_{df=11} = 35.15$, $p < 0.00$

Figure 8. Mellard, Fall, and Woods (2010) Path Analysis Model for Current Study with Path Estimates.

Table 4.

Specific Effects for Reading Components from Path Analysis Model Derived from Mellard, Fall, and Woods (2010).

Pathways	Unstandardized	*SE*	Standardized
Phonemic Decoding – WMS	6.45	1.25	0.42
Phonemic Decoding – Word Reading	0.91	0.08	0.76
WMS – Listening Comprehension	0.04	0.04	0.07
Word Reading – Reading Comprehension	0.19	0.07	0.10
Word Reading – Vocabulary	0.37	0.10	0.63
Word Reading – Reading Fluency	0.45	0.18	0.59
Vocabulary – Listening Comprehension	0.11	0.02	0.35
Reading Fluency – Reading Comprehension	0.07	0.03	0.17
Vocabulary – Reading Comprehension	0.29	0.05	0.46
Listening Comprehension – Reading Comprehension	0.21	0.13	0.10

important. The path between vocabulary and listening comprehension, $\beta = 0.35$; $p < 0.001$, and between reading fluency and reading comprehension, $\beta = 0.17$; $p < 0.01$, were also moderately important. Additionally, the bidirectional pathway between phonemic decoding and WMS was moderately strong, $\beta = 0.42$; $p < 0.001$. However, three paths were not significant. The paths between WMS and listening comprehension, $\beta = 0.07$; $p = 0.35$, between language comprehension and reading comprehension, $\beta = 0.10$; $p = 0.11$, and between word reading and reading comprehension, $\beta = 0.10$; $p = 0.13$, did not reach statistical significance.

Comparison of Path Analyses

Because the path analysis for incoming college freshmen proved significant if not good fitting, two additional models were analyzed to determine whether the path analyses for adults with low literacy and college incoming freshmen

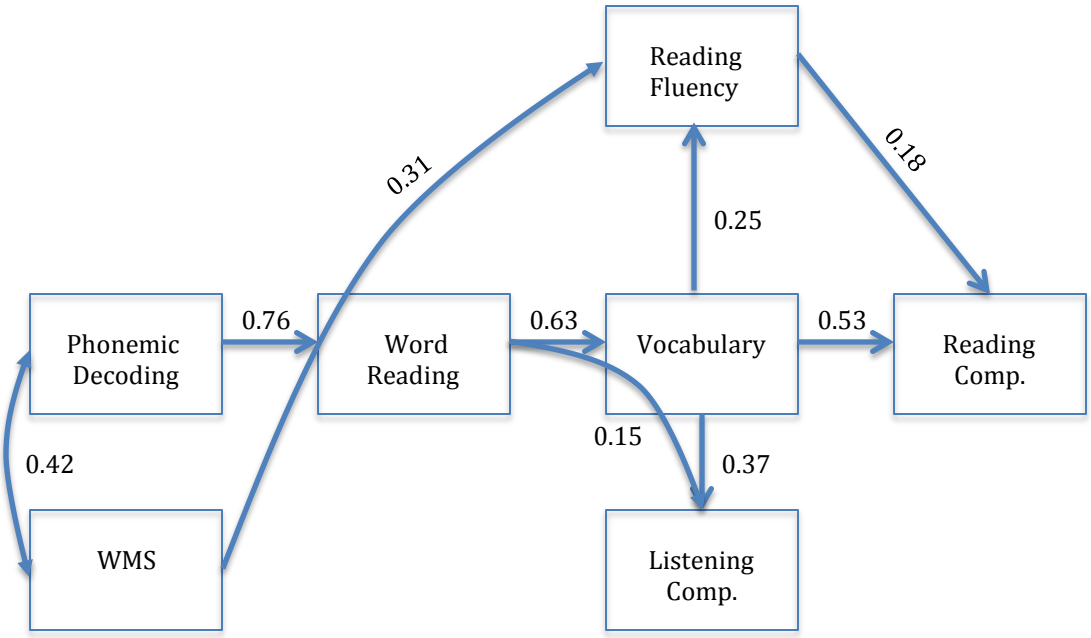
significantly differed. One model had fixed parameters across groups, while the second model had free parameters across groups. Using the covariance matrices for the adults with low literacy and incoming college freshmen, the difference between these models was significant, χ^2 Difference $_{df = 2}$ = 6.20, p = 0.05. This finding indicates that the two groups were not equal in their path estimates. Thus, the path estimates indicating the relationship among the reading components and their contribution towards reading comprehension for adults with low literacy and incoming college freshmen are different.

Best Fitting Path Model for Incoming College Freshmen

After determining the paths estimates according to the model from Mellard, Fall, and Woods (2010), different path models were tested to find the best fitting model for incoming college freshmen, since the previous path model had poor fit. The best fitting model included both direct and indirect paths as seen in Figure 5, and the standardized and unstandardized path coefficients are located in Table 5. The new model had a comparative fit index of 0.96, which suggests that the model had good fit. The model had a RMSEA of 0.06, providing further verification that the model had good fit. After comparing this model with path model derived from Mellard, Fall, and Woods (2010), the better fitting model was significantly different from the path model derived from Mellard, Fall, and Woods (2010), χ2 Difference $_{df = 1}$ = 13.73, $p < 0.001$. Thus, the new model fit the data of incoming college freshmen better than did the model for adults with low literacy found in Mellard, Fall, and Woods (2010).

Some of the same pathways found in the better fitting model for incoming college freshmen were found in both path models derived from Mellard, Fall, and Woods (2010) as seen in Figure 4. The path between phonemic decoding and word reading, $\beta = 0.76$; $p < 0.001$, was strong and significant. Similarly, the path between word reading and vocabulary had a strong and significant path estimate, $\beta = 0.63$; $p < 0.001$. The path between vocabulary and reading comprehension, $\beta = 0.53$; $p < 0.001$, was also important and significant. The paths between vocabulary and listening comprehension, $\beta = 0.37$; $p < 0.001$, and between reading fluency and reading comprehension, $\beta = 0.18$; $p < 0.01$, were moderate in strength and significant. Additionally, the bidirectional path between phonemic decoding and WMS had a moderately strong and significant path coefficient, $\beta = 0.42$; $p < 0.001$. Thus, this model had similar path estimates as the original path model.

Besides these paths that were found in all three models, three paths were significant only for incoming college freshmen. The first of these paths was between WMS and reading fluency, which was moderate in strength and significant, $\beta = 0.31$; $p < 0.001$. The second pathway was between vocabulary and reading fluency, and this pathway was small but significant, $\beta = 0.25$; $p = 0.03$. Lastly, a significant indirect path was found between word recognition and listening comprehension through vocabulary, $\beta = 0.15$; $p < 0.001$. Thus, the best fitting model for incoming college freshmen was both similar and different from the best model found for adults with low literacy in Mellard, Fall, and Woods (2010).



Comparative Fit Index = 0.96; RMSEA = 0.06; 90% RMSEA Confidence Interval = 0.01-0.11; $\chi^2_{df=12} = 21.42$, $p = 0.04$.

Figure 9. The Best Fitting Model for The Current Study with Path Estimates.

Table 5.

Special Effects for Reading Components from the Best Fitting Path Model in Current Study.

Pathways	Unstandardized	*SE*	Standardized
Phonemic Decoding – WMS	6.45	1.25	0.42
Phonemic Decoding – Word Reading	0.61	0.05	0.76
Word Reading – Vocabulary	0.41	0.06	0.63
WMS – Reading Fluency	0.81	0.07	0.31
Vocabulary – Listening Comprehension	0.11	0.07	0.37
Reading Fluency – Reading Comprehension	0.08	0.03	0.18
Vocabulary – Reading Comprehension	0.34	0.04	0.53
Vocabulary – Reading Fluency	0.16	0.07	0.25
Word Reading – Vocabulary – Listening Comprehension	0.07	0.02	0.15

Predicting Dependent Variables with Demographic Information

To investigate the predictions about the relationships between the survey/questionnaire variables and performance on the reading components, we conducted a number of analyses. Regarding SES, the relationship was marginally significant, $b = 0.14$, $t(175) = 1.82$, $p = 0.07$, between average family income and Word Attack performance. A trend indicated that as the parent's income increased, the participants were more likely to correctly pronounce non-words. Average family income also explained a marginally significant proportion of variation in Word Attack scores, $R^2 = 0.02$, $F(1, 175) = 3.30$; $p = 0.07$. This finding suggests that SES has some influence on differences in phonemic decoding, but it did not have any other relationships with the remaining reading components.

As expected, high school GPA had a moderate relationship with most of the dependent variables. Firstly, GPA significantly predicted reading comprehension, $b = 0.24$, $t(171) = 3.26$, $p = 0.01$. This finding indicates that as reading comprehension increased, the participants had better success in school. It also explained for a significant proportion of variation in passage comprehension performance, $R^2 = 0.06$, $F(1, 171) = 10.60$; $p < 0.01$. Besides reading comprehension, GPA also significantly predicted vocabulary performance, $b = 0.21$, $t(171) = 2.85$, $p < 0.01$, suggesting that GPA increased as vocabulary increased. GPA also created a significant portion of the variance in vocabulary ability, $R^2 = 0.05$, $F(1, 171) = 8.10$; $p < 0.01$. Thus, two of the higher level reading components, vocabulary and reading comprehension, had strong relationships with GPA.

In addition to vocabulary and reading comprehension, GPA significantly predicted listening comprehension, $b = 0.16$, $t(171) = 2.17$, $p = 0.03$. As listening comprehension increased, GPA also increased. Likewise, GPA contributed significantly to listening comprehension performance, $R^2 = 0.03$, $F(1, 171) = 4.71$; $p = 0.03$. Finally, GPA significantly predicted WMS, $b = 0.16$, $t(171) = 2.16$, $p = 0.03$, and reading fluency, $b = 0.22$, $t(171) = 2.88$, $p < 0.01$. This finding suggests that as WMS and reading fluency increased, GPA also increased respectively. GPA also explained significant portions of variance in both WMS, $R^2 = 0.03$, $F(1, 171) = 4.64$; $p = 0.03$, and reading fluency performance, $R^2 = 0.05$, $F(1, 171) = 8.29$; $p < 0.01$. Thus, despite the predictions that GPA should be related only to vocabulary and reading comprehension, listening comprehension, WMS, and reading fluency also were significantly related to GPA.

Besides SES and GPA, participant gender also contributed to reading component performance. A statistically significant difference was determined, $F(7, 168) = 2.39$, $p < .02$; Wilk's $\lambda = 0.91$, between gender and performance on the reading components. Gender was significantly related, $F(1, 175) = 7.62$; $p < 0.01$, with reading fluency. Female participants (M = 85.52) were significantly faster and more accurate in reading than were the male participants (M = 80.44). Additionally, a marginally significant relationship, $F(1, 175) = 3.53$; $p = 0.06$, was found between gender and phonemic decoding performance. Male participants (M = 39.71) were marginally better at pronouncing non-words than were the female participants (M = 38.55). Thus, these findings suggest that the female participants had better reading fluency, while the male participants were marginally better at phonemic decoding.

However, because there were three times as many female participants as male participants, the generalizability of results is limited due to the small number of male participants in the sample.

Another variable that might influence reading component performance is reading frequency. Reading frequency had a marginally significant relationship with performance on the reading components, F (7, 168) = 1.43, P = 0.07; Wilk's λ = 0.79. A significant relationship, F (1, 175) = 2.80; p = 0.03, was found between reading frequency and vocabulary. Participants who read daily (M = 36.2) had significantly better vocabulary than those who read a few times a week (M= 33.9; t = 1.96; p = 0.05), less than once a week (M = 32.0; t = 2.03; p = 0.02), and never (M = 28.0; t = 2.07; p = 0.02). Reading frequency was also significantly related, F (1, 175) = 2.44; p = 0.05, with WMS. Participants who read for pleasure less than once per week had significantly poorer WMS (M = 18.3) than did participants who read daily (M = 21.4; t = 2.58; p = 0.01), a few times a week (M = 20.9; t = 2.33; p = 0.02), and once a week (M = 21.5; t = 2.17; p = 0.03). Finally, the relationship between reading frequency and passage comprehension, F (1, 175) = 2.27; p = 0.06, approached significance. The trend suggested that the more often the participants read, the better they were in passage comprehension. These findings suggest that the more reading for pleasure a participant does, the more vocabulary they acquire, the faster they read, and the better they are at comprehending written material.

Some of the variables were only related to one of the reading components. Although there was not a overall significant difference, F (7, 168) = 0.95, P = 0.54; Wilk's λ = 0.86, between mother's education and reading component performance,

the highest education level of the participant's mother was significantly related, F (1, 175) = 2.34; p = 0.05, with phonemic decoding. Participants whose mothers had either a bachelor (M = 39.5; t = 1.96; p = 0.05) or graduate degree (M = 39.3; t = 2.33; p = 0.02) were able to pronounce more non-words than did participants whose mothers only had a high school degree (M = 37.4). Thus, the work schedule for mothers with only a high school education might prevent them from have as much interaction with their children, and this lack of interaction might influence phonemic decoding.

Similar to mother's education, there was not a statistically significant overall difference between the amount of books at home and reading component performance, F (7, 168) = 1.27, P = 0.19; Wilk's λ = 0.86. However, the number of books at home was significantly related, F (1, 175) = 3.48; p = 0.02, with vocabulary performance. Participants who had one bookcase (M = 33.0; t = 2.33; p = 0.02) or multiple bookcases (M = 35.5; t = 2.05; p = 0.04) had significantly better vocabulary than did participants with only one shelf of books at home (M = 30.3). Thus, access to books at home was related with vocabulary acquisition.

As expected, the self-reported reading problems were related to reading component performance. Overall, there was a statistically significant overall relationship between reading difficulty and reading component performance, F (7, 168) = 2.76, P = 0.01; Wilk's λ = 0.90. Reading problems were significantly related, F(1, 175) = 7.76; p < 0.01, with word recognition ability. Participants with reading difficulties (M = 94.52) had poorer word recognition than did participants without reading difficulties (M = 97.45). Reading difficulty was also significantly related,

$F(1, 175) = 4.70$; $p = 0.03$, with reading comprehension. Participants with reading difficulties (M = 52.19) were poorer in passage comprehension than were the participants without reading difficulties (M = 54.47). Thus, these findings suggest that the two main problem areas that individuals with reading problems have are word recognition and reading comprehension.

Besides word recognition and reading comprehension, reading problems also had a number of marginal relationships with the reading components. There was only a marginally significant relationship, $F(1, 175) = 3.38$; $p = 0.07$, between reading difficulty and WMS, with the trend leaning towards higher WMS scores for participants without reading difficulties (M = 21.16) compared with those with reading difficulties (M = 19.38). Additionally, there was a marginally significant relationship, $F(1, 175) = 2.89$; $p = 0.09$, between reading difficulty and reading fluency. The trend suggests that participants with reading difficulties (M = 80.38) were slower and less accurate in reading than the participants without reading difficulties were (M = 84.74). Thus, reading problems might also cause deficiencies in WMS and reading fluency along with those in word recognition and reading comprehension. Only 22 participants were diagnosed with reading problems, and 16 of these participants were female. The likelihood-ratio test indicated that gender did not differ according to self-reported reading problems, $\chi^2_{df=1} = 0.15$; p = NS. Because only a small portion of the sample was diagnosed with reading problems, these findings might result from the small sample size of individuals with poor reading ability, but the findings follow the trend indicated by previous research on reading difficulties.

Finally, there was a significant reading difficulty by reading frequency interaction on reading fluency, F (4, 166) = 2.57; p = 0.04, as seen in Figure 2. For participants with reading difficulties, participants who read a few times per week (M = 90.6) were significantly faster in reading and were more accurate than were the participants who read daily, M = 75.9; t = 2.17; p = 0.03. For those without reading difficulties, participants who read a few times per week (M = 85.6) read significantly faster and more accurately than did the participants who read less than once per week, M = 78.9; t = 2.17; p = 0.03. The small sample size of participants with reading problems could have influenced these findings. Regarding the reading difficulties group, only 10 participants were in the reading every day group, and 5 participants were in the reading a few times per week group. Six participants were in the reading once a week, every other week, and never groups combined. This small sample makes it difficult to generalize these findings of participants with reading problems who read less were faster and more accurate readers than did those who read more.

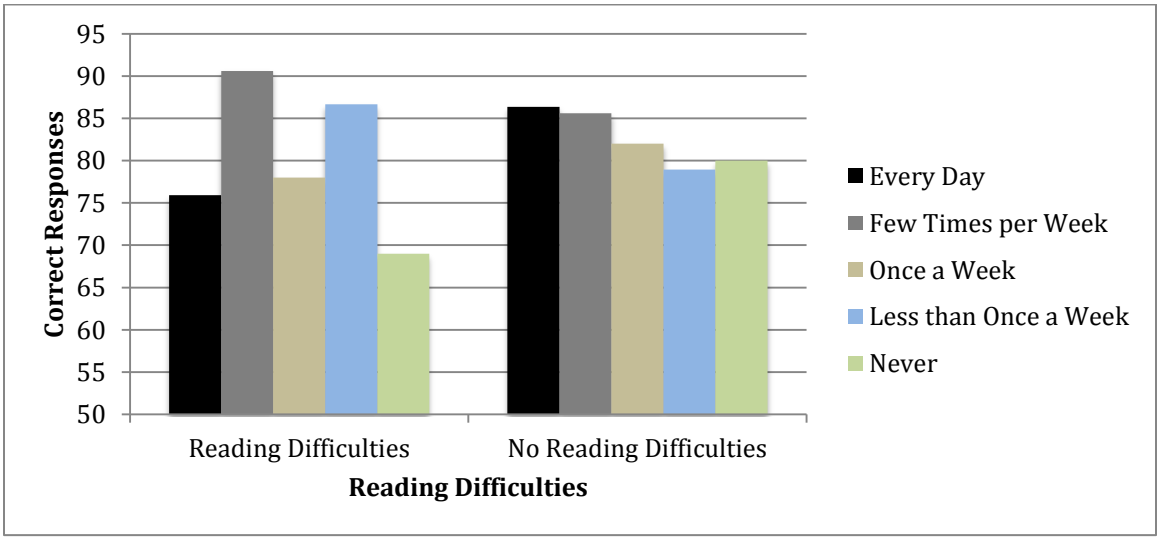


Figure 2. Interaction between Reading Problems and Frequency on Reading Fluency.

Additionally, gender and the education of the participant's mother significantly interacted with WMS, F (2, 168) = 2.90; p = 0.05, as seen in Figure 3. No significant differences were noted in WMS for the female participants across the different levels of mother's education. For the male participants, the participants with mother's who went to college (M = 22.62) had significantly larger WMS than those whose mothers who went to graduate school, M = 19.58, t = 2.05, p = 0.04, and had a marginally larger WMS than those whose mothers only went to high school, M = 20.2 t = 1.81, p = 0.07. However, only a quarter of the participants were male. There were no male participants who had mothers with less than high school degree. Ten participants had mothers with a high school degree, 26 participants had mothers with a college degree, and 12 participants had mothers with a graduate degree. Since the difference was with only the male participants, it is difficult to generalize these findings to the overall population, especially when there were no significant findings for the female participants.

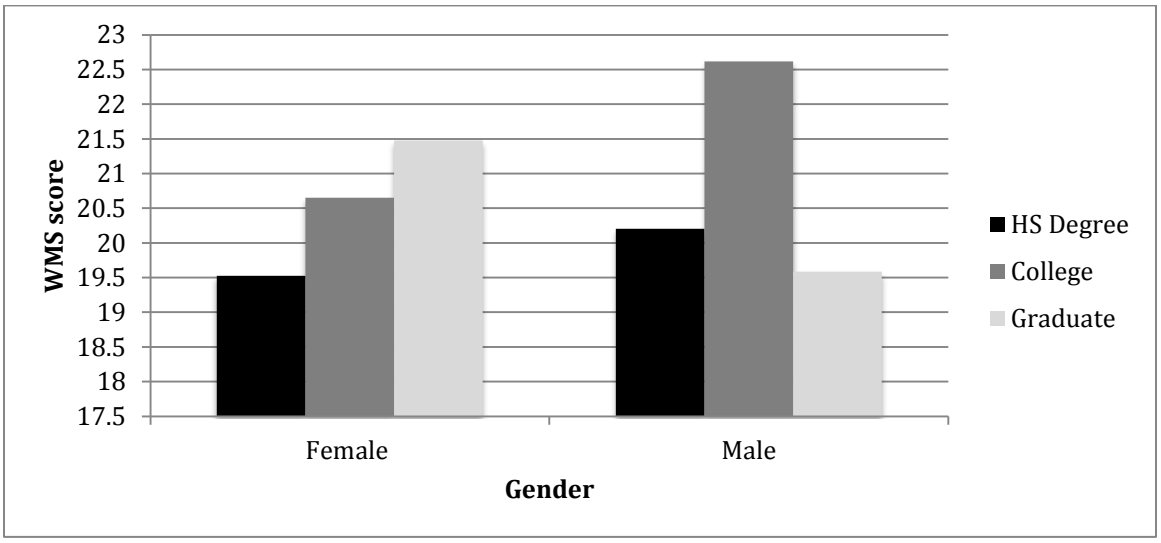


Figure 3. Interaction between Gender and Mother's Education on WMS.

CHAPTER V

Discussion

The current study had three goals. The first goal was to determine how performance on the tasks measuring these components relates with each other and contribute to reading comprehension in terms of the path model found in Mellard, Fall, and Woods (2010) and the best fitting model for incoming college freshmen. The second goal sought to compare the resulting path analysis for this sample of incoming college freshmen with the path analysis derived from a sample of adults with low literacy in Mellard, Fall, and Woods (2010). The last goal was to investigate the skills of incoming college freshman on seven critical reading components and whether they were predicted by any academic, demographic, and reading variables.

Critical Reading Components

For the most part, the participants did very well on the tasks measuring the reading components. For phonemic decoding, word reading, reading fluency, and reading comprehension, they had college equivalent skills. However, for WMS, the participants only had a sixth grade ability. For the most part, the participants were not deficient in any of the critical reading skills and, in fact, did quite well on the reading components. Thus, despite the percentage of students having reading difficulties in and outside of school, the fact that the vast majority of the sample did not have serious reading problems is indicative that most incoming college freshmen have at least normal abilities on the reading components.

The sixth grade equivalency for WMS is interesting, because WMS is critical for most of the higher level reading components. It begs to question if this sample of

incoming college freshmen do not have a large WMS, why are they quite skilled in the higher level reading components, such as vocabulary and reading comprehension? Vocabulary and reading comprehension should suffer if WMS was in fact small. A reason for this performance might revolve around the working memory task. The task measuring WMS had the participants separate a list of words and numbers into their respective types, recall the words, and then recall the numbers. This is a difficult task due to the different stimuli types, which do not associate well with each other as do the stimuli types individually. Thus, it would be harder to perform very well on this task than on tasks using either words or numbers.

Path Analysis Comparison between Reader Groups

The current study compared the path analysis of Mellard, Fall, and Woods (2010) derived from a sample of adults with low literacy to the same model using a sample of incoming college freshmen. The analysis indicated the path model did not fit the incoming college freshmen as well as it did the adults with low literacy, and the path analyses between the two samples were significantly different. The differences between the groups on the different paths will be discussed in the upcoming paragraphs. The most important pathways between incoming college freshmen and adults with low literacy for the current study will be discussed first, followed by the remaining pathways.

Critical Pathways among Reading Components

The pathway that provides the foundation for the later developing reading components is the pathway between phonemic decoding and word recognition.

Despite the significant differences among the path analyses, the influence of phonemic decoding on word recognition was roughly the same for incoming college freshmen and adults with low literacy (Table 6). Phonemic decoding provides the basis for the development of word recognition. Without phonemic decoding, word recognition cannot develop. Adults with low literacy have poor phonemic decoding, and their poor phonemic decoding will negatively affect word recognition. Incoming college freshmen have a well-developed phonemic decoding ability, which will positively influence word recognition. Thus, phonemic decoding will always have a strong influence on word recognition, regardless of decoding ability. Thus, phonemic decoding has a strong influence on word recognition for both incoming college freshmen and adults with low literacy.

Table 6

Comparing the Pathway between Phonemic Decoding and Word Recognition across Groups.

	Incoming College Freshmen	Adults with Low Literacy	Pathways
Phonemic Decoding	Good	Poor (Causal)	No Difference Across Groups ICF = 0.76 ALL = 0.77
Word Recognition	Good	Poor (Secondary)	

Similar to the pathway between phonemic decoding and word recognition, the pathway between word recognition and vocabulary was similar for adults with low literacy and incoming college freshmen (Table 7). Word recognition ability made a similar contribution on vocabulary for adults with low literacy as it did with college freshmen. This finding suggests no significant difference between the two

groups on this pathway. Because individuals acquire vocabulary mostly through reading than through direct instruction, the ability to recognize words will have a large impact on vocabulary size. Adults with low literacy have poor word recognition, and their poor word recognition will hinder them from increasing their vocabulary. On the other hand, incoming college freshmen have good word recognition, which will allow them to increase their vocabulary. However, due to the slightly smaller vocabulary-reading comprehension correlation coefficient, there is a potential that the current study has some measurement error in the scoring of the vocabulary and reading comprehension tests by the test administrators. This difference would suggest that vocabulary scores are either smaller than or more spread out than they actual are. Word Recognition might then have a smaller impact on vocabulary due to its smaller or more dispersed scores. Thus, it is unclear whether the contribution made by word recognition on vocabulary is actually larger than was found. Despite this uncertainty, word recognition should still have a strong influence vocabulary, regardless of reading ability.

Table 7

Comparing the Pathway between Word Recognition and Vocabulary across Groups.

	Incoming College Freshmen	Adults with Low Literacy	Pathways
Word Recognition	Good	Poor (Secondary)	No Difference Across Groups ICF = 0.63 ALL = 0.60
Vocabulary	Good	Poor (Secondary)	

Despite the importance of the word recognition-vocabulary pathway, it is not the only path for increasing vocabulary for adults with low literacy. They can still

increase their vocabulary using the contextual information. The meanings of words they do know can provide an indication of the meaning of the sentence, which will allow adults with low literacy to infer the new word meaning. However, adults with low literacy might infer a slightly different meaning than the word actual has, or they might infer something totally different if they have an erroneous word meaning. Despite the errors that arise from this method, it is the best method to use with the word recognition problems typically encountered by adults with low literacy.

Unlike the last two pathways, the pathway between word recognition and reading fluency was larger for adults with low literacy than it was for incoming college freshmen (Table 8). A reason for this difference might relate to the word recognition ability of the two groups. Adults with low literacy have poor word recognition. This deficiency will slow down reading fluency, because reading fluency is a direct reflection of word recognition ability. If word recognition suffers, reading fluency will subsequently suffer. On the other hand, incoming college freshmen are skilled at word recognition. Thus, their word recognition positively influences reading fluency. However, due to the high word recognition ability of incoming college freshmen, word recognition will not have as strong an impact on reading fluency as it will for adults with low literacy, whose word recognition problems will have a strong negative effect on reading fluency. In summary, word recognition will have a strong impact on reading fluency if word recognition is poor. Skilled word recognition will still have a strong effect on reading fluency, but it will be smaller than the effect poor word recognition has on reading fluency.

Table 8

Comparing the Pathway between Word Recognition and Reading Fluency across Groups.

	Incoming College Freshmen	Adults with Low Literacy	Pathways
Word Recognition	Good	Poor (Secondary)	Larger for Adults with Low Literacy ICF = 0.59 ALL = 0.77
Reading Fluency	Good	Poor (Secondary)	

Similar to the path between word recognition and reading fluency, the pathway between word reading and reading comprehension was a lot larger for adults with low literacy than it was for incoming college freshmen (Table 9). Word recognition has a large positive influence on vocabulary size, and vocabulary subsequently has a larger positive influence on reading comprehension. If word recognition is poor, vocabulary will probably be small as well, which will negatively affect reading comprehension. In this case, word recognition should have a large influence on reading comprehension since it is the main cause for the poor vocabulary. If word recognition is good, vocabulary will be large and have a large influence on reading comprehension. The effect of word recognition on reading comprehension would be small. This pattern was found in the current study. Adults with low literacy had poor word recognition ability, and their poor word recognition had a stronger effect on reading comprehension than did their vocabulary. However, incoming college freshmen had good word recognition, allowing vocabulary to have a large influence on reading comprehension and making the pathway between word recognition and reading comprehension to be small. Word recognition has an

indirect effect on reading comprehension through vocabulary for good readers. Thus, the pathway between word recognition and reading comprehension was only significant for adults with low literacy.

Table 9

Comparing the Pathway between Word Recognition and Reading Comprehension across Groups.

	Incoming College Freshmen	Adults with Low Literacy	Pathways
Word Recognition	Good	Poor (Secondary)	Larger for Adults with Low Literacy ICF = 0.10 ALL = 0.49
Reading Comprehension	Good	Poor (Secondary)	

Because the pathway between word recognition and reading comprehension was smaller for incoming college freshmen, the pathway between vocabulary and reading comprehension was a lot larger for incoming college freshmen than it was for adults with low literacy (Table 10). Incoming college freshmen have a larger and more diverse vocabulary due to their well-developed word recognition skills than do adults with literacy, and the contribution of vocabulary on reading comprehension might be even larger than reported due to the potential measurement error in scoring.

A larger vocabulary makes it easier for the incoming freshmen to ascertain word meanings and integrate the information together in a coherent mental representation. The coherent mental representation would positively affect reading comprehension. Adults with low literacy have a small vocabulary due to their word recognition deficiencies. A smaller and less diverse vocabulary will not be able

provide the meaning for every word, which will slow down reading. This slowing down of reading will make it more difficult to integrate the information adequately in memory, and poor comprehension would be the result. Thus, good readers typically have a strong pathway between vocabulary and reading comprehension due to their good word recognition. Poor readers have strong pathway between word recognition and reading comprehension, because their poor word recognition prevents them from increasing their vocabulary substantially. The poor vocabulary of poor readers has a small impact on reading comprehension when compared to the effect their word recognition has on it.

Table 10

Comparing the Pathway between Vocabulary and Reading Comprehension across Groups.

	Incoming College Freshmen	Adults with Low Literacy	Pathways
Vocabulary	Good	Poor (Secondary)	Larger for Incoming College Freshmen ICF = 0.46 ALL = 0.18
Reading Comprehension	Good	Poor (Secondary)	

Similar to previous pathways, the pathway between reading fluency and reading comprehension was similar for both incoming college freshmen and adults with low literacy (Table 11). Because the groups did not differ largely on the impact of reading fluency has on reading comprehension, this finding suggests two different possibilities. One possibility is that adults with low literacy were able to circumvent their word recognition deficiencies enough to attain a similar level of reading

fluency to incoming college freshmen. This finding seems unlikely due to the poor word recognition of adults with low literacy. If anything, adults with low literacy should have poor reading fluency. The other possibility is that reading fluency does not make a large contribution to reading comprehension. The latter one is the more logical of the two possibilities, since reading fluency does not significantly account for differences in reading comprehension performance beyond those accounted for by word recognition (Adlof, Catts, & Little, 2006). Thus, there might be a low ceiling level in which reading fluency independently contributes to reading comprehension, regardless of reading ability.

Table 11

Comparing the Pathway between Reading Fluency and Reading Comprehension across Groups.

	Incoming College Freshmen	Adults with Low Literacy	Pathways
Reading Fluency	Good	Poor (Secondary)	No Difference Across Groups ICF = 0.17 ALL = 0.22
Reading Comprehension	Good	Poor (Secondary)	

Remaining Pathways between Reading Components

The remaining pathways are important for reading ability to occur, but they were not as important when comparing incoming college freshmen with adults with low literacy. Firstly, the bidirectional path between phonemic decoding and WMS was larger for the adults with low literacy than it was for the incoming college freshmen (Table 12). This finding indicates a stronger relationship between phonemic decoding and WMS for adults with low literacy than it was for the

incoming college freshmen. This difference could be due to the incoming college freshmen having better phonemic awareness than did the adults with low literacy, so they did not need a more efficient WMS to manipulate phonemes. The extra WM space would be allocated to other reading components. On the other hand, adults with low literacy have poor phonemic awareness, so they would need as much WM space as possible for identifying and manipulating the phonemes. With a small WM, individuals with poor phonemic decoding would not have the space for phonemic manipulation, which would cause phonemic decoding difficulties. Thus, the path between phonemic decoding and WMS was much more important for the adults with low literacy than it was for incoming college freshmen.

Table 12

Comparing the Bidirectional Pathway between Phonemic Decoding and AWMS across Groups.

	Incoming College Freshmen	Adults with Low Literacy	Pathways
Phonemic Decoding	Good	Poor (Causal)	Larger for Adults with Low Literacy ICF = 0.42 ALL = 0.60
AWMS	Moderate	Moderate	

Along with the phonemic decoding and WMS pathway, the pathway between WMS and listening comprehension was a lot stronger for adults with low literacy than it was for incoming college freshmen (Table 13). Incoming college freshmen are skilled at word recognition, so they need less time to identify spoken or written words. Because of this quickness, their WMs are never taxed enough during listening comprehension to require an efficient WMS, so WM would contribute little

in listening comprehension. However, adults with low literacy need an efficient WMS for listening comprehension, because they have much difficulty in word recognition. Thus, the more efficient WM would allow them extra space for identifying the words and comprehending the spoken language. Without this extra efficiency, adults with low literacy would have much difficulty in recognizing and understanding spoken language. For these reasons, the pathway between WMS and listening comprehension was much more important and larger for adults with low literacy than it is for incoming college freshmen.

Table 13

Comparing the Pathway between AWMS and Listening Comprehension across Groups.

	Incoming College Freshmen	Adults with Low Literacy	Pathways
AWMS	Moderate	Moderate	Larger for Adults with Low Literacy ICF = 0.07 ALL = 0.40
Listening Comprehension	Good	Moderate	

Unlike the previous few pathways, the pathway between vocabulary and listening comprehension was larger for incoming college freshmen than it was for adults with low literacy (Table 14). Because of the skilled word recognition ability incoming college freshmen exhibit, their vocabulary is very good. Due to its large size, vocabulary would have a great impact on listening comprehension due to large number of word meanings from which to choose. When individuals have this many options, it makes it easier to understand spoken language. On the other hand, adults with low literacy have poor word recognition and vocabulary abilities. Without a large sample of words to choose from in their vocabulary, it makes it more difficult

to understand spoken language. Thus, vocabulary has a stronger influence on listening comprehension for incoming college freshmen because of the advanced nature of their vocabulary when compared to that of adults with low literacy.

Table 14

Comparing the Pathway between Vocabulary and Listening Comprehension across Groups.

	Incoming College Freshmen	Adults with Low Literacy	Pathways
Vocabulary	Good	Poor (Secondary)	Larger for Incoming College Freshmen ICF = 0.35 ALL = 0.22
Listening Comprehension	Good	Moderate	

The pathway between listening comprehension and reading comprehension was similar across the groups (Table 15), but it was not significant for incoming college freshmen. This finding is strange, because listening comprehension should have its largest impact on reading comprehension after decoding has been mastered according the Simple View of Reading (Gough & Tunmer, 1986). By the time incoming college freshmen have entered college, their word recognition ability should have been well developed. Thus, listening comprehension should have a large impact on reading comprehension. Mellard, Fall, and Woods (2010) postulated that the reason listening comprehension had a small influence on reading comprehension in adults with low literacy was due to deficient word reading ability. However, the incoming college freshmen in the current study had great word recognition skills. Thus, it appears that listening comprehension does not contribute

much to reading comprehension of incoming college freshmen beyond the impact of vocabulary and reading fluency.

Table 15

Comparing the Pathway between Listening and Reading Comprehension across Groups.

	Incoming College Freshmen	Adults with Low Literacy	Pathways
Listening Comprehension	Good	Moderate	Larger for Adults with Low Literacy ICF = 0.10 ALL = 0.14
Reading Comprehension	Good	Poor (Secondary)	

Best Fitting Model for Incoming College Freshmen

A path model that fit well for incoming college freshmen was found using the measured reading components. The best fitting path model included some of the same pathways included on the original path model derived from Mellard, Fall, and Woods (2010). However, there were new pathways added to it to account for the freshmen data, and there were pathways that were strong and significant in the original model that became small and non-significant in the best fitting model. The current section will describe why the pathways between the reading components in the best fitting model were significant and how it differed from the model derived from Mellard, Fall, and Woods (2010) for the same sample.

The pathways that were similar in the path model derived from Mellard, Fall, and Woods (2010) and the best fitting model for incoming college freshmen are important regardless reading group. Phonemic decoding still made a large contribution to word recognition ability. Because phonemic decoding is crucial for

the development of word recognition, phonemic decoding will always be influential in word recognition. Similarly, word recognition ability had a large and significant influence on vocabulary ability, since most vocabulary is acquired through reading, which relies on adequate word recognition for optimal performance. Likewise, vocabulary had a large effect on reading comprehension ability. This finding further indicates that individual differences in reading comprehension ability can be accounted for by differences in vocabulary.

Like reading comprehension, vocabulary also positively contributes to listening comprehension, but it has a smaller influence on listening comprehension than it did reading comprehension. Reading fluency still made a small contribution on reading comprehension, suggesting that reading fluency has a small independent influence on reading comprehension. Vocabulary allows readers to retrieve from memory the meanings of spoken words, allowing for better listening comprehension. Finally, phonemic decoding and WMS significantly contribute to each other. A more efficient WMS facilitates phonemic decoding by providing space for phonemic manipulation, while good phonemic decoding allows the WM resources to be allocated to other reading components. In summary, these six pathways were significant in contributing to the reading ability of both adults with low literacy and incoming college freshmen.

Despite the large correspondence across the best fitting model for incoming college freshmen and the application of the best fitting model for adults with low literacy (Mellard, Fall, & Woods, 2010) onto incoming college freshmen, a number of differences were noted between the models. A path that was large and significant in

the original model was the word recognition and reading fluency pathway. However, this pathway was not significant in the best fitting model for incoming college freshmen. The inclusion of a pathway between WMS and reading fluency, which was both moderate in strength and significant, caused the path coefficient between word recognition and reading fluency pathway to become small and insignificant. Because the path model had better fit, the WMS and reading fluency pathway was kept in the model while the pathway between word recognition and reading fluency was removed. Thus, for incoming college freshmen, WMS accounts for differences in reading fluency more than did word recognition.

This finding of WMS having a more significant influence on reading fluency makes sense when considering the nature of reading fluency. Reading fluency is often assessed with the reading of entire sentences, paragraphs, and texts as quickly and accurately as possible. It does not pertain just the reading of words, as in a word list which sometimes the fluency task, because it would cover only a small aspect of it. For this reason, WMS would make a significant contribution on reading fluency due to its ability to store text information in memory efficiently in memory (Cooke, Halleran, & O'Brien, 1998; Graesser, Singer, & Trabasso, 1994). For this reason, WMS can influence reading fluency by affecting the integration of information in a mental representation. For integration to occur, the information necessary for comprehension to occur must be continually rotated in WM. A more efficient WM will allow fewer rotations of the information to occur before the information is integrated in memory, which would allow readers move onto subsequent information at a quicker pace. A less efficient WM would require a large number of

rotations in memory before the integration of the information occurs. This delay will slow down reading fluency. Thus, one way in which WMS can influence reading fluency is through its impact on the integration of information in memory.

Besides its effects on integration, WMS can also influence the speed of inference generation by allowing the reader to store more information simultaneously (Daneman & Carpenter, 1980; Just & Carpenter, 1992; Singer et al., 1992; Singer & Ritchot, 1996). The quicker inferences are made, the sooner a reader understands the meaning of the current sentence in relation to the other sentences in a text. A more efficient WMS would facilitate inference generation by retaining the information crucial for making inferences in memory, which allows the reader to process sentences at a fast pace. On the other hand, a less efficient WMS would hinder inference generation by retaining only a small portion of the information in memory simultaneously, forcing the reader to wait until a number of cycles to have been completed for them to have the information necessary to make the inferences. This delay in inference generation would slow down reading speed. Thus, WM can contribute to reading fluency not only in the integration of information in memory but also through facilitating inference generation.

Another pathway that only appeared in the best fitting model for incoming college freshmen was the pathway between vocabulary and reading fluency. The importance of vocabulary on reading fluency is similar to the influence that WMS has on reading fluency. A larger vocabulary will allow for the quicker processing of text information. The meaning of words can quickly be retrieved from memory, which will facilitate information integration and inference generation. Integration

and inference generation would not have to wait for the use of context information to ascertain word meanings, allowing them be performed quickly. This facilitation would then increase reading fluency. A smaller vocabulary will cause text processing to slow down, which will cause inference generation and the integration of information to take longer. Reading fluency would slow down as the result of this delay. Similar to the original model, vocabulary might even have a larger impact on reading fluency than found due to the potential measurement error in scoring on the vocabulary test. If there was any measurement error in the scoring of the vocabulary and reading comprehension tests by the test administrators as indicated by the slightly smaller vocabulary-reading comprehension correlation coefficient, then vocabulary scores might be smaller or more distributed than they actually are. Thus, vocabulary would have a smaller impact on reading fluency due to the smaller or more distributed values than it actually has. Overall, for incoming college freshmen, vocabulary significantly contributes to reading fluency.

Because vocabulary significantly influences listening comprehension, it is logical to think that word recognition might also influence listening comprehension based on its contribution to vocabulary. In the best fitting model, there was a significant indirect pathway between word recognition and listening comprehension through vocabulary. Word recognition significantly contributes to listening comprehension by allowing individuals to acquire new vocabulary, which would then make it easier for them to understand spoken language. Word recognition did not have a significant direct influence on listening comprehension, further demonstrating that word recognition influences listening comprehension

through vocabulary. Good word recognition will increase the size of vocabulary, and this large vocabulary would then facilitate listening comprehension. Poor word recognition would make it more difficult to acquire new vocabulary, causing it to be small. The small vocabulary would make it more difficult to understand spoken language. Thus, it is through word recognition's influence on vocabulary size does it impact listening comprehension.

In summary, the best-fitting model and the model derived from Mellard, Fall, and Woods (2010) using incoming college were significantly different. The pathway between word recognition and reading fluency was no longer significant in the best-fitting model, and WMS and vocabulary became more important in determining reading fluency. Additionally, word recognition made an indirect contribution to listening comprehension through its influence on vocabulary. Despite these differences, the crucial pathways towards good reading ability were strong and important for each model. The differences between path models arose in only those pathways that play a lesser role in determining reading ability than do the crucial pathways.

Demographic and Reading Component Relationships

The next section will describe the significant relationships that were found between the reading components and the answers from the reading survey/questionnaire. These findings mostly dealt with reading problems, GPA, reading frequency, books at home, and mother's education. These relationships were interesting in that they provide some indication of the effect that non-reading variables have on reading ability.

Participants with reading problems

For the current sample of incoming college freshmen, 22 participants reported on the reading survey/questionnaire that their schools diagnosed them as having reading problems. This amount is interesting despite the fact that the vast majority of the participants thought they could improve their reading abilities. Most of the participants identified with reading problems had this diagnosis made in elementary school, further indicating that reading problems tend to arise early in reading development (Foster & Miller, 2007; Francis et al., 1996; Shaywitz et al., 1999). Reading problems are additive in that most of them start with difficulties in phonemic decoding and word recognition, which causes later developing reading skills that depend on these early skills to lag behind students without reading problems.

The findings from the current study also provide support by the finding of a significant relationship between word recognition and reading comprehension. Incoming college freshmen who had reading problems tended to have more difficulty in identifying and pronouncing words than did individuals who did not have reading problems. Previous research (Fletcher et al., 1994; Stanovich & Siegel, 1994) has also found that most individuals with reading problems tended to have poor word reading ability. Poor word recognition would then have a negative consequence on reading comprehension by slowing down reading and consuming a lot of resources, leaving fewer resources for integrating information into a mental representation. In the current study, participants who had word reading problems also had reading comprehension difficulties, demonstrating the pattern just

mentioned (LaBerge & Samuels, 1974; Lesgold & Perfetti, 1978). Thus, problems in early reading skills will carry over into problems in later developing reading skills.

Besides word recognition and reading comprehension, reading fluency and WMS also had marginal relationships with reading problems. If individuals have poor word recognition, then they will have difficulty reading a text quickly and accurately, which has been demonstrated as a great indicator of word recognition success in previous research (Adlof, Catts, and Little, 2006). The current study provided some corroboration for this by evidencing a trend towards which individuals with reading problems had poor reading fluency. WMS might also influence word recognition and reading fluency by determining the amount of space in which readers have for manipulating information. The less WMS is available, the fewer potential matches for printed words can be stored simultaneously in memory, causing word recognition to slow down. If word recognition slows down, then reading fluency must also slow down since it relies heavily on word recognition ability (Allington, 1983; Kame'enui & Simmons, 2001; Kuhn, 2004; Samuels, Ediger, & Fautsch-Patridge, 2005; Torgesen & Burgess, 1998). The current study found a marginal relationship, trending in this direction. Although we did not find significant relationships between these variables, previous research has suggested that they should exist.

Interestingly, reading problems did not have a relationship with vocabulary. This result makes sense when one considers the multiple ways in which one can acquire new words while reading. The main method in which individuals with word recognition problems can acquire new words is through the use of contextual

information (Chall, 1994; Davidson & Strucker, 2002; Stanovich, 1986). Because word recognition is so slow for these readers, it does not occur before the contextual information becomes active. This delay allows them to ascertain word meaning, thereby providing a method for increasing vocabulary. However, this method is not without drawbacks, since poor readers sometimes infer the incorrect meaning from context. This outcome makes sense with the reading comprehension problems they exhibit. Overall, this process provides a good example of the flexibility that individuals can evidence in reading development; alternative pathways allow poor readers to circumvent problem areas and achieve some skill level.

What was surprising was that not all of the participants diagnosed with reading problems in school received additional reading instruction. It does not bode well for the students or the education system if they are measuring the reading ability of the students and diagnosing them with reading problems without making sure that those with reading problems receive the necessary instruction for improving their reading ability. Failing to provide this instruction will only increase the gap between the reading ability of these students and those without reading problems (Juel, 1988; Stanovich, 1986). Reading is a complex and additive process with later reading components developing on the foundation produced by the earlier reading components. When the foundation is deficient due to difficulties in phonemic decoding and word identification, reading fluency, vocabulary, and reading comprehension will fall short of expectations.

However, a good sign that these problems are not completely detrimental to the student's education is that only 4% of them believed that their reading problems prevented them from achieving their goals. Previous research (Bruck, 1998; Jackson & Doellinger, 2002; Jackson, 2005; Wilson & Lesaux, 2001) has continually demonstrated that students with poor reading ability are not necessarily poor students doomed to failure. Although they might have lower ability on some of the critical reading skills, these students can rely on other factors, such as the context, to aid comprehension (Chall, 1994; Davidson & Strucker, 2002; Stanovich, 1986). This explains why students with poor reading ability can go to college, even though they have difficulty attaining the same success as those students without reading problems (Jackson, 2005).

GPA

Despite the participant's high average high school GPA, GPA had a number of significant relationships with later developing reading components. GPA was related to all the reading components with the exception of phonemic decoding and word reading. The lack of a significant relationship between these two reading skills and GPA makes sense by the fact that these skills are already well developed by the time the students reach high school. GPA should have its greatest impact on vocabulary and reading comprehension while also being related to WMS, reading fluency, and listening comprehension.

Although it is impossible to predict the directionality of this relationship based only on this regression analysis, the fact that they are related provides some corroborating information about these relationships. Starting with one of the earlier

reading components, students with a small WMS are able to retain only a small portion of information in WM at a single time, preventing them from fully integrating information in a mental representation. Without a complete mental representation, the students have difficulty comprehending spoken and text information completely, preventing GPA from increasing. On the other hand, students with a larger WMS can store a large amount of information in WM at one time, enabling them to encode and integrate the information in long-term memory (Cooke, Halleran, & O'Brien, 1998; Graesser, Singer, & Trabasso, 1994; Hasher & Zacks, 1988; Rosen & Engle, 1997, 1998). They would be able to retrieve the information in school, and thereby increase GPA as a result of their better retrieval of information.

Reading fluency and listening comprehension would follow a similar pattern as WMS. Students with good reading fluency would read words quickly and accurately. Better reading fluency provides them with more processing time for the higher-level reading skills of vocabulary and reading comprehension. Ultimately, reading fluency has an indirect relationship with GPA through this facilitation of vocabulary and reading comprehension. On the other hand, students with poor reading fluency take longer to read and are less accurate at it, which will cause them to expend more resources on word recognition. The few leftover resources would then go to vocabulary and reading comprehension, negatively affecting GPA (Fuchs, Fuchs, & Maxwell, 1988; Jenkins et al., 2003; Lovett, 1987; Rupley, Willson, & Nichols, 1998; Swanson & Trahan, 1996). Thus, individuals with better reading fluency will have higher GPAs will individuals with slower reading fluency.

Similarly, listening comprehension has an intuitive relationship with GPA. Students with good listening comprehension will be better at taking notes and following lectures, and these notes and topical understanding will increase the probability of doing well in their classes. However, students with poor listening comprehension will be unable to follow the course of the lecture, getting only small amount of information out of it (Curtis, 1980; Hoover & Gough, 1990; Sticht, 1979; Vellutino et al., 1991; Vellutino, Scanlon, & Tanzman, 1994; Vellutino et al., 2007). The lack of the critical lecture information will then make it more difficult for these students to do well in the class, negatively affecting their GPA. In summary, listening comprehension allows students to understand the lecture information better, which can lead to better class performance and a higher GPA.

Corresponding with past research, vocabulary and reading comprehension had a strong relationship with GPA despite the possible measurement error related with vocabulary scores. A large vocabulary would allow students to understand the word meanings in text, while a small vocabulary would make it more difficult for students to understand word meanings (Baddeley et al., 1985; Calvo, Estevez, & Dowens, 2003; Estevez & Calvo, 2000; Ouellette, 2006). Because reading comprehension depends on adequate vocabulary, reading comprehension ability should follow the same pattern. Students with good reading comprehension integrate information efficiently in memory with prior topic knowledge, allowing them to understand well the material. This information would also be available for future retrieval, facilitating increases in GPA. However, students with poor comprehension only encode and integrate a smaller portion of the information with

prior topical knowledge in memory, which will hinder comprehension and future retrieval (Cain & Oakhill, 1999; Long, Oppy, & Seely, 1997). Thus, vocabulary and reading comprehension both combine to affect GPA.

Reading Frequency

The Matthew Effect (Juel, 1988; Stanovich, 1986) states that the difference between good and poor readers will increase over time. The reason for this difference is that individuals with poor reading ability will avoid reading due to their reading difficulties. This avoidance will hinder any growth in vocabulary and reading comprehension. On the hand, unhampered by any negative experiences or problems with reading, individuals with good reading ability will strive for new reading opportunities, which will increase vocabulary and sharpen comprehension skills. Thus, the ability of poor readers will remain stagnant or have minimal growth, while the ability of good readers will continue to increase with more reading experiences. The amount of time reading should provide an indication of, if not whether a person is a good reader, at least whether the person has any hesitancy in seeking out personal reading opportunities.

The findings from the current study indicate some interesting findings between reading frequency and the reading components. As indicated by research on the Matthew Effect (Juel, 1988; Stanovich, 1986), individuals who read more often tend to have better vocabulary than those who do not. Only a small fraction of the words individuals learn during a year comes from direct instruction. The vast majority of word acquisition comes through reading (Hayes & Ahrens, 1988; Nagy & Anderson, 1984; Nagy & Herman, 1987; Stanovich, 1986). Thus, the more a person

reads, the more vocabulary one should acquire. Although these findings do not definitively demonstrate this process, they do indicate the presence of the relationship between reading frequency and vocabulary.

Similarly, if reading frequency has been shown to influence vocabulary, it will nevertheless influence reading comprehension through increased text exposure. The findings suggest a marginal relationship between reading fluency, trending toward better comprehension with more frequent reading. Previous research has also verified this relationship in experimental settings (Brozko, Shiel, & Topping 2008; Donahue, Daane, & Grigg 2003; Wigfield, Guthrie, Perencevich, Klauda, McRae, & Barbosa, 2008). Thus, the more often individuals read, the more skilled they becoming in comprehending text information.

Finally, the findings demonstrate an interesting relationship between reading frequency and WMS. The trend suggested that individuals with larger WMS tend to read more frequently. They accomplish this by holding more information in memory for encoding and integration, leading to better comprehension. With a larger WMS, individuals have a higher probability of comprehending textual information efficiently, and this increase in comprehension allows them to read more frequently by making it more rewarding. A smaller WMS decreases the probability of comprehending information efficiently, making reading a lot more difficult and less rewarding (Cooke, Halleran, & O'Brien, 1998; Graesser, Singer, & Trabasso, 1994; Hasher & Zacks, 1988; Rosen & Engle, 1997, 1998). This difficulty then makes these individuals more hesitant about seeking out new reading

opportunities (Juel, 1988; Stanovich, 1986). Overall, WMS has an indirect relationship with reading frequency through its effects on reading comprehension.

Providing some verification of the Matthew effect (Juel, 1988; Stanovich, 1986), a significant interaction was found between reading problems and reading frequency on reading fluency. Poor readers who read during the week tended to have faster reading times than did poor readers who read daily. On the face of it, this finding does not make much sense, and it could be a result of the small sample of individuals with reading problems. On the other hand, good readers show a pattern that makes sense; good readers who read more often will often read faster than good readers who read less often. Greater reading experience will allow for growth in word recognition ability, which will speed up the pace of reading. Thus, poor readers tend to show an inverse relationship with reading frequency, while good readers tend to show a direct relationship with reading frequency. Overall, reading frequency has some interesting relationships with vocabulary, comprehension, WMS, and reading fluency.

Books at Home

Another variable that might be influential on the reading components is the amount books located at home. The current study found a significant relationship between the amount books at home and vocabulary ability. More specifically, individuals who had one or more bookcases at home tended to have better vocabulary than individuals with fewer books. As with reading frequency, the more books available, the more likely will individuals acquire more words, substantially increasing vocabulary beyond levels typically associated with only direct

instruction. When fewer books are in the home, individuals have fewer opportunities to read, and without these opportunities, vocabulary will not increase substantially (Juel, 1988; Stanovich, 1986). In summary, vocabulary depends on having frequent exposure to reading materials, and the more books available to individuals, a greater chance exists for improving vocabulary.

Highest Education Level Achieved by Mother

Besides reading problems, GPA, and reading frequency, the highest education level of the participant's mother also had relationships with one of the reading components. The mother's education level had a relationship with phonemic decoding. Individuals whose mothers achieved a high level of education tended to have high phonemic decoding ability. This relationship might concern the amount of time the mothers had in reading to their children. Mothers who had achieved a lower education level might be forced to work more than one job to support their families, making the mother's education an indicator of SES. The SES of the parents might limit the number of conversations between mother and child, the amount of time the mother has reading to her children, and the value placed on reading. Because children need to hear constant speech to develop phonemic awareness (Ferguson, 1986; Studdert-Kennedy, 1986; Suomi, 1993; Walley, 1993), this shortage of conversations or one-on-one time might prevent them from adequately detecting the individual phonemes. However, children of mother's who have achieved a higher educational level will have more conversations and one-on-one time with their mothers, who have more flexibility in their schedule. These conversations would facilitate the development of phonemic awareness in the

children. Despite this speculation about the relationship between phonemic awareness and mother's education level, future research would need to be conducted to verify this speculation.

Future Directions

The current study can provide the impetus for future research questions. There is a question revolving around whether other variables might be included in the model that might significantly contribute to reading ability for incoming college freshmen. Another question revolves around whether new tests of the reading components would change the strength of the pathways. Finally, other questions can expand on the current findings into the reading abilities of incoming college freshmen. Overall, there are a number of interesting studies that can be conducted originating from the current study.

The first question concerns whether any additional components would account for the reading ability of incoming college. The main additional component that could be included is rapid naming ability, which is the ability to name pictures, objects, or symbols. The Component Model of Reading (Aaron, 1997; Joshi, 1999) suggests that besides the interaction of decoding and listening comprehension abilities, rapid naming ability also makes an additional contribution to reading ability. Rapid naming difficulty causes problems word recognition, reading fluency, and reading comprehension (Sabatini, 2002; Wolf & Bowers, 1999). The Rapid Automatized Naming and Rapid Alternating Stimulus Tests (Wolf & Denckla, 2005) could potentially be a good test to measure rapid naming ability. Thus, rapid naming ability can be included into the model with paths to word recognition, reading

fluency, vocabulary, and reading comprehension components, potentially increasing the model fit.

The second question revolves around whether the tests used to measure the reading components are ideal for this population. The participants in the current study had a WMS equivalent to that of sixth graders. There are at least two reasons for this poor performance. One reason is that the WM task used in the current study, the AWMS subtest from the Woodcock-Johnson, Third Edition (Woodcock, McGrew, Mather, & Schrank, 2001), might have been too difficult for the participants. Because this is a standardized test that has been normed, this conclusion seems unlikely. A more likely conclusion is that the participants were not motivated to perform well on the task, especially when it is a difficult task. The participants would do as well as they could when it was easy, but when it got more difficult, their motivation to perform well decreased. This decrease of motivation will definitely occur when the participants are not completely invested in their performance due to the lack of negative consequences related to poor performance. Thus, the WMS task in the current study was difficult, and the participants would be motivated to perform well until it became too difficult and they became frustrated.

It would be interesting to see if other WM tasks would produce similar results. The Wechsler Memory Scale, Fourth Edition (Wechsler, 2009) might be a good standardized test to use for measuring working memory since it does not alternate between stimuli types. On the other hand, reliable cognitive WM tasks, such as the reading span task (Daneman & Carpenter, 1980), might prove more beneficial in its relation to reading. In this task, readers are asked to read a group of

sentences, while trying to remember the last word of each sentence. Another variation of this task would be to remember a list of words while reading a group of sentences. These three tasks might produce better responses, and they also might allow for stronger paths between WM and reading components previous research has shown to be impacted by it, such as vocabulary and reading comprehension, to be found.

Besides investigating whether different WM tasks would cause differences in the path model, different types of vocabulary tests might also determine further the influence of vocabulary on reading ability. The vocabulary test used in the current study tested the expressive vocabulary of the students. In this task, the students were told a word, and they provided a definition of the word. It might be harder for the students to verbalize the meaning of words, making it more difficult to determine exact vocabulary level students have. Because expressive vocabulary relies on receptive vocabulary for performance, it would be interesting to see if receptive vocabulary would produce a stronger correlation with and make a stronger contribution on reading comprehension than did the expressive vocabulary test. The Peabody Picture Vocabulary Test, Fourth Edition (Dunn & Dunn, 2007) could be used instead of the expressive vocabulary task, because it asks students to point to a picture that represents the meaning of a spoken word. Thus, variations in the type of vocabulary task might increase the relationship vocabulary has on reading comprehension, reading fluency, and listening comprehension.

Using a receptive vocabulary task in a future study might also shed some light on whether the slightly smaller vocabulary and reading comprehension

correlation was due to the expressive vocabulary task or due to measurement error. Verbally describing words they are not normally asked to describe could make it more difficult for the participants to provide the correct word meanings. Additionally, the vocabulary and passage comprehension test instructions provided specific words that are to be considered correct and incorrect, leaving little interpretation to the test administrator as to whether responses are correct. The test administrators explicitly follow the provided instructions by only counting responses correct based on only the choices provided by the test. The slightly lower correlation between vocabulary and reading comprehension might relate more to the participants having a slightly harder time providing oral word meanings than variation in response scoring. Despite having a slightly lower correlation with reading comprehension, vocabulary still made a strong contribution on reading comprehension ability. Although it will not be conclusive, using a receptive vocabulary test might help determine the cause of the slightly lower correlation between vocabulary and reading comprehension.

A future study needs to replicate the current findings to ensure that the findings were not due only to the sample selected. Besides verifying the validity of the path model, cross-validation would provide the foundation from which the path model for incoming college freshmen can be applied in testing incoming college freshmen on their reading abilities. Before this application can happen, it is crucial that this path model be compared among samples of good and poor readers from this population. If this study provides information that the two groups differ, the group differences can be used in developing a quick screening measure that would

identify poor readers early in their college education. The reading components that might be included in this short screening measure are word recognition and vocabulary, because of their importance in determining the reading ability of incoming college freshmen. This screening measure would be quick and relatively inexpensive while allowing for the efficient identification of poor readers.

Another potential future study would investigate whether the path model for incoming college freshmen changes as they progress in their education. With more exposure to class requirements and professor's demands, college freshmen might learn more efficient ways of reading text and focusing on the important information crucial for comprehension. Thus, a study could measure the reading abilities of students in the four academic years to determine whether there are significant differences in the path models for each year. If this study provides interesting information regarding the relationships among the reading components for different academic years, a longitudinal study could then investigate more thoroughly the changes that occur throughout a student's time at the university. Overall, a number of future studies can be conducted that would expand on the current findings.

In summary, future study can expand and improve upon the current findings about the reading ability of incoming college freshmen. Including rapid naming ability in the path model and linking it with word recognition and the subsequent reading components that depend on it might be the missing element to attaining good model fit. Additionally, it would be interesting to determine whether using another WM task would result in different findings and whether it would have

larger influences on vocabulary and reading comprehension. Using a receptive vocabulary rather than an expressive vocabulary test might allow vocabulary to have a higher correlation with other reading components, which would result in a strong influence on those components. Future studies can investigate whether there are differences in the path model for incoming college freshmen between good and poor readers with the hope of developing a short screening measure of reading ability. Additionally, a study could also investigate whether any changes occur in the path model throughout a student's academic career at the university. Although the current study is a good start in investigating the best path model for incoming college freshmen, there are knowledge gaps to resolve.

Conclusions

The current study had a number of interesting findings. For the current sample, only a small percentage of the participants were diagnosed with reading problems though most of them believed they could improve their reading ability. Additionally, reading problems, GPA, and reading frequency all had a number of significant relationships with the reading components. Reading problems mostly related word recognition, while GPA and reading frequency related to the higher-order reading components.

Incoming college freshmen are skilled on most of the critical reading components with the only exception being WM. Concerning the path analysis, incoming college freshmen had strong relationships between reading components that have been demonstrated in previous research. The stronger relationships were between phonemic decoding and word recognition, between word recognition and

vocabulary, between word recognition and reading fluency, and between vocabulary and reading comprehension. However, the best fitting model for incoming college freshmen does not include a word recognition and reading fluency pathway. It did have the remaining pathways in the model in addition to pathways between WMS and reading fluency, between vocabulary and reading fluency, and between word recognition and listening comprehension through vocabulary. Overall, the same pathways are crucial in reading ability of incoming college freshmen for both models.

Finally, the path analysis for incoming college freshmen was significantly different from the path analysis for adults with low literacy found by Mellard, Fall, and Woods (2010). For adults with low literacy, the paths with phonemic decoding, word reading, and WMS were stronger than those of incoming college freshmen. These are the same skills they have the greatest trouble with during reading. For incoming college freshmen, the paths concerning the higher-level components, specifically vocabulary and reading comprehension, were stronger than those of adults with low literacy. Thus, the current study corroborated previous findings that adults with low literacy have greater trouble in the early developing reading components than do incoming college freshmen, who are more skilled at the later developing reading components.

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Appendix A

Reading and Academic Survey/Questionnaire

Participant #: _____

Please answer these questions as truthfully as possible. Please do not put your name on this survey/questionnaire. This will help to protect your identity and to keep your responses anonymous.

What is your age? _____

What high school did you attend? _____

In what county did you attend high school? _____

In what state did you attend high school? _____

What was your high school GPA upon graduation? _____

What was your score on the Critical Reading portion of the SAT? _____

What was your overall SAT score? _____

What is your gender?

1. Female.
2. Male.

What is the highest level of education for your Mother?

1. Less than high school.
2. Some high school.
3. High school.
4. College
5. Graduate Degree

What was the number of books in the home in which you grow up?

1. Few.
2. One shelf
3. One bookcase
4. Multiple bookcases

Do you have difficulty seeing print regardless of glasses or contact lenses?

1. Yes.
2. No.

Do you have difficulty hearing other people?

1. Yes.
2. No.

Have you been diagnosed with a learning disability?

1. Yes.
2. No.

How often do you read during a week?

1. Every day.
2. A few times a week.
3. Once a week.
4. Less than once a week.
5. Never.

Would you like to improve your reading ability?

1. Yes.
2. No.

If yes, do you have any specific problem areas in your reading of which you are aware?

1. Yes.
2. No.

If yes, what are the problem areas?

1. Word recognition.
2. Reading Speed.
3. Vocabulary.
4. Comprehension.

Have you had any trouble reading in school?

1. Yes.
2. No.

If yes, when did it start?

1. Preschool.
2. Elementary school.
3. Middle school.
4. High School.

Have you ever received help reading in school?

1. Yes.
2. No.

Do you think that your reading ability is hindering you from achieving their goals?

1. Yes.
2. No.

Below is a list of names. Some of them are authors of books, and some of them are not. Please put a check mark next to the ones that you know for sure are authors. Only check only those names about which you are absolutely certain.

___Patrick Banville
___Kristen Steinke
___Ernest Hemingway
___Clive Cussler
___Hiroyuki Oshita
___Kurt Vonnegut
___Anne McCaffrey
___Elinor Harring
___Sue Grafton
___Lisa Woodward
___David Harper Townsend
___Anna Tsing
___T.C. Boyle
___Jonathan Kellerman
___Cameron McGrath
___F. Scott Fitzgerald
___A.C. Kelly
___Peter Flaegerty
___Kazuo Ishiguro
___Jane Smiley
___James Patterson
___Martha Farah
___Craig DeLord
___Nora Ephron
___Ann Beattie
___Stewart Simon
___Danielle Steel
___Dick Francis
___Ted Mantel
___I.K. Nachbar
___Judith Krantz
___Thomas Pynchon
___Wayne Fillback

___Harry Coltheart
___Gary Curwen
___Herman Wouk
___Geoffrey Pritchett
___Ray Bradbury
___Jay Peter Holmes
___Christina Johnson
___Jean M. Auel
___Judith Stanley
___Gloria McCumber
___James Joyce
___Robert Ludlum
___Larry Applegate
___Keith Cartwright
___Jackie Collins
___Umberto Eco
___David Ashley
___Jack London
___Seth Bakis
___Padraig O'seaghdha
___E.B. White
___Giles Mallon
___Raymond Chandler
___Isabel Allende
___Amy Graham
___Marion Coles Snow
___George Orwell
___Maya Angelou
___Bernard Malamud
___John Grisham
___Erich Fagles
___Walter Dorris
___Gabriel Garcia Marquez

___Virginia Woolf
___John Landau
___Toni Morrison
___Harriet Troudeau
___Roswell Strong
___J.R.R. Tolkien
___Margaret Atwood
___Seamus Huneven
___Harper Lee
___Chris Schwartz
___Walter LeMour
___Alice Walker
___Elizabeth Engle
___T.S. Elliot
___Marvin Benoit
___Joyce Carol Oates
___Jessica Ann Lewis
___Nelson Demille
___Arturo Garcia Perez
___S.L. Holloway
___John Irving
___Stephen Houston
___Marcus Lecherou
___Valerie Cooper
___Tom Clancy
___Vladimir Nabokov
___Pamela Lovejoy
___Vikram Roy
___Saul Bellow
___Stephen King
___Elizabeth May Kenyon
___Frederick Mundow

___Tony Hillerman
___Amy R. Baskin
___James Clavell
___Salmon Rushdie
___Maryann Phillips
___Scott Alexander
___Ayn Rand
___Alex D. Miles
___Margaret Mitchell
___Leslie Kraus
___Ralph Ellison
___Sidney Sheldon
___ Brian Herbert
___Sue Hammond
___Jared Gibbons
___Michael Ondaatje
___Thomas Wolfe
___Jeremy Weissman
___Willa Cather
___J.D. Salinger
___ Antonia Cialdini
___ Lisa Hong Chan
___Samuel Beckett
___Beatrice Dobkin
___Wally Lamb
___Katherine Kreutz
___James Michener
___William Faulkner
___Isaac Asimov
___Lindsay Carter
___Paul Theroux
___Francine Preston

Below is a list of names. Some of them are real magazines, and some of them are not. Please put a check mark next to the ones that you know for sure are magazines. Check only those Titles about which you are absolutely certain.

___Hot Rod
___Male
___Harper's Magazine
___Buff
___Guitar Player
___Women's Day
___Choices

___Mountain Bike
___Driver
___Scientist
___U.S. News & World Report
___Ultimate Audio
___Premiere

___Cat Life
___Home Computer
___Men's Fitness
___Organic Gardening
___Flex
___Money
___Muscle Mania

___Spin
___Atlantic Monthly
___Jet
___XL
___Ebony
___Mahogany
___Online
___Men's Life

___Consumer's Digest
___Investigate
___Outdoor Life
___Fashion Bible
___Exploration

___Men's Health
___InStyle
___Pet World
___U.S. Nation
___Sand Trap
___Working Mother
___Maxim

___Business Week
___Alternative Fitness
___The Source
___Bait n' Tackle

___Men's Journal
___Playground

___Cat Fancy
___You
___Yachter
___Estate Gardener
___Alternative
___Food & Wine
___Zoom

___Car World
___Self
___Gossip
___Vegetarian
___Modern Woman
___Music Review
___Sculpt
___Psychology Weekly
___Golf World
___Celebrity
___Discover
___Psychology Today
___Easy Eats

___Bon Appetit
___Gourmet Express
___Hunter
___Gourmet
___Biography
___Stuff
___U.S. Citizen

___Gardener
___Wired
___Car & Driver
___Tuned In

___Modern Bride
___Camper's Guide

___The Progressive
___Cigar Aficionado
___Nation News
___State of the Union
___Ski Magazine
___Entrepreneur Now
___Wildlife Conservation
___Yoga Journal
___Mr. Fixit
___Constitution
___Technology
___Boating World
___Details
___Water Sports
___Ski & Pole

___Family Circle
___Country Living
___The Scene
___Motor Trend

___Healthy Habits
___Outdoor Adventure
___Popular Science
___Science News
___Delicious
___Hunting
___Good Housekeeping
___Chica
___Backpacker
___Let's Read!
___Field & Stream

___Vibe
___Ladies Home Journal
___Mechanics
___Capitalist
___Redbook
___Black Enterprise
___Home Cooked
___Fortune
___Cook Veggie

___Market Today
___Smithsonian
___Game Pro
___City Living
___Popular Mechanics
___Rosie
___Science and You
___PC World

___Connected
___Career Mom
___World InDepth
___Groupie