ABSTRACT

This study examined relationships among vocabulary breadth, vocabulary depth, and reading comprehension in adults. The focus of the study was to determine the construct of vocabulary knowledge and how these components influenced reading comprehension among Adult Basic Education (ABE) students. Participants were 71 adults who were currently enrolled in ABE programs in Massachusetts. They were asked to complete a total of 12 tasks known to measure vocabulary breadth, depth, and reading comprehension. First, we found that our assessments are reliable in testing vocabulary knowledge and reading comprehension. Moreover, results showed vocabulary knowledge consists of at least two dimensions: vocabulary breadth and vocabulary depth. Second, we also found that each component made a significant independent contribution to explain reading comprehension. Finally, the research proposed some suggestions for vocabulary instruction for ABE participants.

Testing It Right: Assessing Vocabulary Breadth and Depth

and Their Roles in Adult's Reading Comprehension

by

An H. Tran

A Thesis

Presented to the Faculty of Mount Holyoke College

in partial fulfillment of the requirements

for the degree of Bachelor of Arts

with Honors

Department of Psychology and Education

Mount Holyoke College

South Hadley, Massachusetts

ACKNOWLEDGEMENTS

I would like to express my sincere thanks to my thesis advisor, Professor Kathy Binder, for always spreading her humor and enthusiasm for research to everyone around her. Thank you for your guidance, patience and for always believing in me throughout the course of this project and for allowing me the opportunity to pursue such a rewarding experience (a.k.a to get on such a wild ride).

I would like to thank my second reader, Professor Amy Grillo, for inspiring my interest and love of education. Thank you for your valuable suggestions and comments on this thesis.

I would also like to acknowledge Professor Jessica Sidman for teaching me (almost) everything about Mathematics at the college level from matrices to eigenvalues so that I could confidently use factor analysis in my study. Thank you for serving on my honors committee.

I am indebted to Kat Tremblay, our lab manager, for always making sure that everything is organized and that every piece of data is collected, scored and coded. I am also grateful to every student in Kathy's Cognition Lab for their hard work and long hours in the lab. Thank you for your persistence and hard work.

I would like to express my gratitude to Janelle Gagnon and Cheryl Lee for always keeping me on track throughout the course of this project, for all your tips and advice as well as all the candies when we needed them most!

I would not have been able to complete this thesis without the support of my family and friends. To my friends, Lan Ha and Thu Tran, thank you for keeping me company during late

nights of writing, and for sharing food with me. To Trang Le, Son Ngo, Sieu Nguyen, and Trang Nguyen, thank you for sending me extra support and advice even though we are miles and miles apart. To Kien Nguyen, thank you for always encouraging me to explore different opportunities and cheering me up along the way.

Finally, to my family, thank you for allowing me to have this opportunity and for believing in my choices and all of my endeavors.

In short, thank you for all your _____ when I was "thesisizing".

a. love and care
b. support
c. cuteness
d. all of the above
e. other, please specify: _____

You could pick the choice that best fits into the blank.

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURE

INTRODUCTION

When we were little, we learned to read. When we grow up, we gradually read to learn. Through reading, we acquire crucial knowledge that helps us survive and advance in our communities. Therefore, literacy plays an important role in a person's life. If a person masters reading skills, he/ she will hold the most important key to long term employment and many other opportunities that may change his/ her life. Many studies have demonstrated strong relations between literacy levels and different aspects of a person's life such as economic status, and health conditions (DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004; Kutner, Greenberg, Jin, Boyle, Hsu, Dunleavy, & White, 2007; Miller, 2016). For example, results from the Program for the International Assessment of Adults Competencies (PIAAC, 2012) for countries in the Organisation for Economic Co-operation and Development (OECD) indicated that adults with a higher literacy proficiency level tended to earn higher wages than those with lower literacy skills. Among the countries participating in the PIAAC, 28% of workers with literacy proficiency at Level 1 or below (meaning that they can only read relatively short texts to identify one piece of information that is synonymous or directly related to the information given in a question) had incomes among the lowest 20% in their country (Grotlüschen, Mallows, Reder & Sabatini, 2016). Specifically, in the United States, people having literacy proficiency earn about $250 per month more than ones without literacy skills, and high proficiency (relative to low proficiency) adds over $700 to one's monthly earnings, without controlling for other measures of skills (Holzer & Lerman, 2015). This might be because lacking literacy proficiency might hinder a worker from receiving training on productive ways of working.

Beyond earnings and employment, studies have shown that low literacy skills also correlate with poor health condition (Boyes, Leitao, Claessen, Badcock, & Nayton, 2016; DeWalt et al., 2004; Schaefer, 2008). A meta-analysis study by DeWalt et al. (2004) implied that low reading ability was associated with various adverse health conditions. Consistent with the previous findings, results from all the countries surveyed in the PIAAC (2012) indicated adults with lower literacy skills were more likely to report poor health conditions. A large part of the health information available to patients (such as medical and health care brochures, results of their condition, prescription, and medication bottles) is presented in written form at a high level of literacy, which requires reading and comprehension skills at least equivalent to those expected of an 11^{th} grade high-school student (King, 2010). Thus, low literate adults might have difficulty in comprehending this information and adhering to their medical instructions. Moreover, patients are also often too embarrassed to admit to their doctors that they cannot make sense of the information given to them, which might lead to a misunderstanding or a lack of health care knowledge (King, 2010).

Most importantly, the negative effects of low literacy levels may pass on to the next generations. On average, almost 30% of adults with neither parent attending an upper secondary degree scored at or below Level 1 in the literacy assessment (OECD, 2013). Such studies suggested reading deficits might have a significant negative impact on long term employment, limit the access to health care and social services, as well as leave a pessimistic mark on future generations. Therefore, developing strong reading comprehension skills is necessary for an individual to survive and thrive in a society.

Despite the importance of reading abilities, the current statistics suggested one in six adults in the United States has weak literacy skills (at level 1), which is equivalent to about 52.4

millions of adults (OECD, 2013). The situation has aggravated since 2003, when about 30 million adults in the United States were below the basic literacy level (National Center for Education Statistics [NCES], 2003). Moreover, the United States' mean proficiency scores of 16-65 year-olds in literacy and numeracy are significantly below the average when compared with other OECD countries participating in the same survey (OECD, 2013). This revealed literacy programs for adults might have not created any significant impact, which might be due to their limited availability. Then, the question is: with such restricted availability, are these programs teaching adults in the most effective and productive possible ways? Probably not, as our knowledge of adults' reading comprehension is limited.

According to the study by Kruidenier (2002), only 70 adult reading research studies met the standards of scientific research, which is far less than the number of research efforts focusing on younger readers. Hence, adult literacy interventions might often rely on models of reading validated with children even though the ways to acquire reading comprehension may be different between adults and children. A study by Thompkins and Binder (2003) compared the reading acquisition profile of ABE participants and children who were matched on reading achievement level on different aspects such as phonological awareness, orthographic abilities, use of context, memory abilities and reading skills. The results showed that adults scored higher than children in orthographic abilities, use of context, and memory ability, while children performed better than adults on phonological awareness (Thompkins & Binder, 2003). Results from another study indicated that when facing reading difficulties, adults were less likely than children to use phonological strategies and tended to rely on visual or orthographic processes (Greenberg, Ehri & Perin, 2002). This might be because adult learners have more experience and exposure to printed words through everyday life than children do. They are also able to think more

reasonably, make inferences, and support their arguments in ways that children cannot. In addition, adults also have to juggle different responsibilities at their workplace and at home; they could not spend the same amount of time and attention for studying as children do. Thus, intervention for adults' education needs to be built based on their specific abilities as well as their needs in a restricted time frame, which demands a larger research base concentrating on reading behaviors of this particular population.

Since literacy is a broad concept defined as "understanding, evaluating, using and engaging with written text to participate in society, to achieve one's goals and to develop one's knowledge and potential", this study tried to fill some parts of that knowledge gap by focusing on one component of literacy: reading comprehension (Goodman, Finnegan, Mohadjer, Krenzke, & Hogan, 2013, p. 2). Specifically, we examined if vocabulary aids adult beginning readers in reading comprehension. Then, we evaluated which vocabulary factors affect adults' reading comprehension, and if the assessments that we were using were reliable and valid in measuring an adult's vocabulary and reading comprehension.

Vocabulary Breadth and Reading Comprehension

Vocabulary has long been considered as an important indicator of reading comprehension by researchers (Ouellette, 2006; Quinn, Wagner, Petscher, & Lopez, 2015; Tighe & Schatschneider, 2016; van Steensel, Oostdam, van Gelderen, & van Schooten, 2016). When mentioning vocabulary knowledge, people usually think about vocabulary breadth, which refers to the number of words that a person knows (Shen, 2009). More specifically, Nation (2001) divided word knowledge into three areas: form, meaning, and use. Therefore, vocabulary breadth would include the knowledge of both oral and written forms of the words, their superficial meanings, and basic uses of the words.

Until recently, vocabulary assessment often tried to examine how many words a person knows. For example, researchers and clinicians have relied on the Peabody Picture Vocabulary Test (PPVT, Dunn & Dunn, 1997) to assess children's and adults' single word lexical knowledge (Morrison, Pantkraz, & Pantzre, 2004). In this task, the experimenter shows participants four pictures and reads out a word. The participant's task is to identify the picture that best indicates the word. Another example of vocabulary assessment that only focuses on breadth is the vocabulary section of the Nelson-Denny Reading Test of Vocabulary, Comprehension, and Reading rate (Denny & Nelson, 1929). Participants are presented with a vocabulary word and asked to point out the meaning of that word from five options. A sample question is as follows:

Indispensable means:

A. uncomfortable B. costly C. durable D. essential E. timely

Despite being widely used to assess a person's vocabulary ability, these tasks only capture the most basic level of vocabulary knowledge because participants might only have a vague idea about the definition of a word to choose to the right answer. Therefore, as these methods only measure the breadth dimension of vocabulary, they have not conveyed thoroughly the complex concept of vocabulary.

Researchers have demonstrated that vocabulary might have a strong influence on reading comprehension in various populations, such as in primary and secondary school children (Ouellette & Beers, 2010; Van Gelderen et al., 2007; Verhoeven & Van Leeuwe, 2008). Specifically, the study by van Steensel, Oostdam, van Geldern, and van Schooten (2016) examined the relationships between vocabulary knowledge, meta-cognitive skill and reading comprehension in adolescents with low-literacy level in Dutch pre-vocational education. The researchers investigated if there was a difference in these relationships between Grade 7 and 9

students and between monolingual and bilingual participants. After multilevel analyses, the result implied vocabulary and meta-cognitive knowledge had a positive influence on reading comprehension consistently across grades and across monolinguals and bilinguals (van Steensel, Oostdam, van Geldern, & van Schooten, 2016). In line with these studies, Tannenbaum, Torgesen, and Wagner (2006) also claimed that in most studies, the correlations between vocabulary knowledge and reading comprehension were positive in the range from .30 to .80.

Moreover, past research on reading acquisition has established a firm foundation indicating that vocabulary breadth contributes significantly to reading comprehension. For example, Hall, Greenberg, Gores and Pae (2014) investigated expressive vocabulary and its relationship to reading skills of native English-speaking adults with reading level between third- and fifth-grade. The researchers administered the Boston Naming Test to assess participants' expressive vocabulary skills (BNT; Kaplan et al., 2001). The BNT is a confrontation naming test normed on participants ages 5 through 79. It is often used to diagnose communication disorders as well as to determine children's cognitive and academic achievements, especially in reading skills (Wolf, 1991; Wolf & Obregon, 1992). In this test, researchers presented participants with line drawings of common objects (e.g., scissors) in order of increasing difficulty and asked them to name that object. The researchers then tested participants' reading comprehension skills using the Passage Comprehension portion of the Woodcock Johnson-III which has been standardized for ages 2 to 90 (Woodcock et al., 2001). In this task, participants read sentences silently and then indicate the missing word. In this sample of adult readers with low-literacy level, the result suggested that expressive vocabulary significantly accounted for 16.4% of the variance of reading comprehension **(**Hall, Greenberg, Gores & Pae, 2014**).** In addition, a study by Tannenbaum, Torgesen, and Wagner (2006) indicated a correlation of .70 between the unit-

weighted vocabulary breadth and reading comprehension, which was higher than it had been indicated in previous studies. Furthermore, Akbarian and Alavi (2014) demonstrated in their research that vocabulary breadth contributed significantly to participants' IELTS (International English Language Testing System) and TOEFL (Test of English as a Foreign Language) reading comprehension test scores. Another study investigated the relation between vocabulary size and reading comprehension of English reading in Chinese high school students learning English as a second language; results revealed that vocabulary breadth significantly predicted a multiple-choice reading comprehension measure, which requires general understanding of the text (Miao & Kirby, 2015). Such studies suggested that vocabulary breadth might have an important influence on reading comprehension.

Vocabulary Depth and Reading Comprehension

Vocabulary knowledge has different levels, from merely having heard a word once or twice to being able to define it and use it appropriately (Beck, McKeown, & Kucan, 2002). More recently, researchers have indicated that vocabulary was not simply how many words you knew; vocabulary knowledge of each person also depends on how well he/she understands the meaning of the word. Hence, the contemporary concept of vocabulary suggests that vocabulary is a multidimensional construct with at least two main dimensions: vocabulary breadth and vocabulary depth. Vocabulary depth refers to how deeply a person understands each word. According to Proctor, Silverman, Harring, and Montecillo (2012), vocabulary depth covers such components as morphological awareness, awareness of semantic relations, and syntactic awareness. For example, the word "place" could be a noun referring to an area (Online Cambridge Dictionary, n.d.) or it may become a verb meaning put someone in a situation in the sentence "They placed him in an elementary school" (Online Cambridge Dictionary,

n.d.). Besides semantics, depth of vocabulary knowledge is also demonstrated through the morphological dimension. For example, we may derive other words by adding prefixes and suffixes to the word "place" such as: placement, displace, misplace, placed, etc.

Since vocabulary depth may also be an important predictor of reading comprehension, various tasks have been developed to measure different aspects of vocabulary depth, which includes semantic, morphologic, and syntactic. Researchers have measured the semantic dimension by using the synonym task in which participants need to identify the synonym of a target word out of four options (Wiig & Secord, 1992). To test polysemy knowledge, researcher requested participants to create sentences to display different meanings of an ambiguous word (Carlo et al., 2004). For example, "ring" could mean "a wedding ring" while it could also be used as a verb in "the phone rings". For syntax, they might conduct Syntactic Knowledge Task (SKT). In this task, participants listen to a sentence that has a missing word and choose the appropriate answer from the given choices to complete the sentence. The words are verbs, pronouns, or connectives. Connectives are words that link ideas and information within and across sentences such as because, when, and if -then. To determine a person's morphological awareness, researchers examined their understanding of derivational morphemes (Carlisle, 2000). They were requested to add a prefix or suffix to the root word to fill in the blank (e.g., "help. My sister is always ____: helpful/ helping.); or they might be asked to derive different words from a root word. Another task that measures all three elements (morphology, semantics, and syntax) is the Vocabulary Depth Task (VDT; Richard, 2011). In this task, participants are presented with six sentences, each with a blank. Participants' task is to determine one target word that can fit all the blanks. An example of this task is as follows:

Target Word: Or

a. Do you want milk [ ] sugar?

b. Either you do this now [ ] you do it later, but you will do it.

c. You should try and drink three [ ] four glasses of water every day.

d. You had better study for the test, [ ] else you will fail.

e. Raining [ ] not, I am going jogging.

f. He said something [ ] other, I am not too sure.

With this test, participants need to use their morphological and syntactic awareness to adjust the target word so that it suits all the blanks. They also have to understand the word meaning in different contexts, which taps on the semantic aspect of vocabulary depth.

Many researchers have also examined the relationship between vocabulary depth and reading comprehension across various populations. A study by Oullette (2006) has investigated the effects of breadth and depth on different literacy skills in a sample of fourth grade children whose main language is English. Specifically, the researcher administered a battery of tests to determine participants' levels of nonverbal intelligence (which assess the ability to process patterns of geometric shapes), decoding, visual word recognition reading comprehension, and oral vocabulary, which includes receptive, expressive vocabulary, word definitions and synonyms. Results showed that vocabulary breadth had significant influence in decoding skills. Having a larger vocabulary size increases a person's familiarity with phonemic units, which results in decoding efficiency. Furthermore, results also indicated that both breadth and depth explained variance in word recognition because knowing more words and understanding each word well help with retrieval efficiency. Finally, the study demonstrated that only depth was a unique predictor of reading comprehension as a thorough understanding of the word meaning and its role in a context help make sense of the text.

In another research project focusing on college-skilled readers, Binder, Cote, Lee, Bessette, and Vu (2016) examined the relationships among vocabulary breadth, vocabulary depth, reading comprehension, and reading rate. They assessed these aspects by conducting the Nelson Denny Reading Test of Vocabulary, Comprehension and Reading rate to measure vocabulary size, reading rate and reading comprehension. They used the Vocabulary Depth Task (which is previously discussed) and the Word Families to determine vocabulary depth. Specifically, in the Word Families task, participants were given a root word and were asked to produce as many words as possible by adjusting affixes and suffixes. The results demonstrated that: firstly, both vocabulary breadth and depth had a significant correlation with reading comprehension and reading rate. Secondly, both breadth and depth contributed to predict reading comprehension with the contribution to explain 33% and 6% variance in reading comprehension, respectively. However, only vocabulary breadth explained unique variance in reading rate (Binder et al., 2016). This finding is consistent with the results of Ouellette (2006) previously mentioned: different dimensions of vocabulary contribute differently to various reading skills. On the one hand, possessing a large vocabulary size helps to decode words faster, which increases reading rate. On the other hand, understanding a word thoroughly aids in choosing the appropriate meaning to link words together and establishing a more coherent perception of the text, which improves reading comprehension

Moreover, a study by Qian (1999) investigated the relationships between depth and breadth of vocabulary knowledge and reading comprehension in English as a second language (ESL) students. Eighty students whose first languages had different origin than English were recruited to participate in the study. The researcher then asked them to complete three tasks to measure their vocabulary breadth, depth and reading comprehension. To determine the number

of words that participants knew, Qian administered the vocabulary size test in which participants had to match three definitions to three corresponding words out of the six given choices. After this task, data of six participants were excluded as their English vocabulary size were below 3000 high-frequency words. Then, participants' reading comprehension levels were assessed using a multiple choice reading comprehension part taken from the TOEFL test. Finally, to measure depth, participants had to complete the Depth-of-Vocabulary-Knowledge test (DVK;Read, 1989, 1993, 1994, 1995) and the Morphological Knowledge test (Qian, 1999). The result demonstrated an especially high correlation among vocabulary size, DVK, and reading comprehension scores. In the multiple regression analysis, the study implied that both vocabulary breadth and depth significantly influenced reading comprehension outcomes. Furthermore, after controlling for vocabulary size, researcher found that depth added another 11% of explained variance of reading comprehension.

Morphological Awareness - Reading Comprehension

Morphemes are the smallest units of meaning in a language, which are combined in various ways to convey meanings or to perform grammatical roles such as "kind" (a morpheme that means generous, caring), or "-ness" (a morpheme that signifies a noun). Morphological awareness refers to the conscious understanding of morphemes and the ability to decompose and manipulate them to understand word meaning (Carlisle, 2003). For example, with the word "unforgettable," readers could recognize three morphemes: "un" is a prefix meaning "not," "forget" is the root morpheme, and "able" is a suffix that turns the word into an adjective. Since the majority of English words can be comprehended by decomposing and understanding the meanings of their morphemes, readers with strong morphological skills have a better ability to decode and acquire novel word meanings (Kieffer & Lesaux, 2012). When encountering a

complex word, readers with proficient morphological skills may break it into smaller parts to decipher its meaning, thereby, increase their vocabulary knowledge.

With such essential contribution to acquiring word meaning, morphological awareness has been assessed using various tasks. For instance, the suffix choice test, used by Mahony (1994), and Tighe and Binder (2014), examines participants' ability to manipulate morphemes using pseudo words. In this task, participants are asked to select the most appropriate pseudowords to fill in the blank of a sentence. For instance, with the sentence "Our teacher taught us how to _____ long words", the participant has to choose the correct answer among four pseudo words: *jittling, jittles, jittled,* and *jittle* (Appendix F). Participants then have to pick *jittle* after the experimenter reads the sentence and answer choices aloud to participants. Another task that determines MA is the derivational morphemes task (Carlisle, 2000). This task requires participants to derive the correct words to fill in the blank, given the root words. An example item is "Farm. My uncle is a _____"; in this case, participants need to reply with the word "farmer". Base form morphology task is a reverse of the derivational morphology. In this task, participants have to fill in the blank with the root word derived from the target word given. For example, with the item "Growth. She wanted her plant to ____;", participants are expected to answer the word "grow" (Tighe & Schatschneider, 2016). All these tasks demonstrate participants' understanding of word structure as well as changes in word meaning and its grammatical role created by adding or removing morphemes of the root word.

Many studies have shown the influence of morphological awareness on reading comprehension (Bowers, Kirby, & Deacon, 2010; Carlisle & Nomanbhoy, 1993; Carlisle, 2010, 2000; Kieffer & Lesaux, 2012; Nagy, Berninger, & Abbott, 2006; Nunes et al., 2003; Singson et al., 2000; Tong, Deacon, Kirby, & Parrila, 2011). Kieffer and Lesaux (2012) reported a direct,

unique contribution of morphological awareness to reading comprehension, controlling for the contribution of reading vocabulary and word reading efficiency in a population comprising of native English speakers as well as language minority learners. Moreover, Deacon and Kirby (2004) also found in their longitudinal study of 2nd - 5th graders that morphological awareness was a significant predictor of reading after phonological awareness and intelligence were controlled. Controlling for the effect of participant's past morphological awareness before 2nd grade, morphological awareness still showed to contribute to reading comprehension, even after three years from the original measures. One explanation for this direct contribution is that morphological awareness was one component in the set of general metalinguistic skills that affect reading comprehension (Perfetti, Landi, & Oakhill, 2005). These findings suggest that morphology has a direct impact on comprehension.

Researchers have also proposed another model to explain morphological awareness' contribution to reading comprehension. In this model, morphological awareness aids reading comprehension indirectly by facilitating vocabulary growth (Fracasso, Bangs, & Binder, 2016; Keiffer & Lesaux, 2012; Nagy et al., 2006). Therefore, there might be connections between morphology and vocabulary as well as vocabulary and reading comprehension. When encountering a complex word, readers with proficient morphological skills may break it into smaller parts to decipher its meaning, thereby increasing their vocabulary knowledge. Vocabulary then contributes to reading comprehension. First, studies have found that morphology has contributed to vocabulary development (Binder & Tighe, 2012; Nagy, Berniger, & Abbott, 2006). Nagy, Berniger and Abbott (2006) found that morphological awareness made a significant contribution to reading vocabulary for students in 4/5th-, 6/7th-, and 8/9th-grade. Binder and Tighe (2012) investigated the impact of morphological awareness

on different literacy measures including vocabulary, spelling, reading comprehension and listening comprehension. The results showed that besides positively and significantly correlating with other literacy measures, morphological awareness was also the only unique predictor of vocabulary skills (Binder & Tighe, 2012). These findings also extend to Spanish-, Vietnamese-, and Filipino-speaking language minority learners as well as English speakers from diverse socio-economics background (Kieffer & Lesaux, 2012). Second, as mentioned in previous sections, both vocabulary breadth and depth have shown to be a predictor of reading comprehension. Hall, Greenberg and Laure-Gores (2014) reported that vocabulary accounted for a significant portion of the variance of reading comprehension**.** In another study, Oullette (2006) found that vocabulary depth was a unique predictor of reading comprehension as a thorough understanding of the word meaning and its role in a context helped make sense of the text. In addition, morphological awareness includes the perception of the word's structure to be able to decompose and manipulate them. Based on a word's structure, readers are not only able to understand superficial meaning of the word but also to derive new words related to the original one. Conceptually, morphological awareness adds another layer of understanding of the word; thus, morphological awareness could be a component of depth of word knowledge rather than an independent factor affecting reading comprehension. Therefore, in addition to directly influencing reading comprehension, morphological awareness also seems to help increasing comprehension ability through developing vocabulary.

Current study

This current study attempted to broaden our understanding of the relationship between vocabulary knowledge and reading comprehension in the ABEs population, which is a group of adults with low literacy levels. We focused on deconstructing the components of vocabulary

knowledge and assessed how these components influence reading comprehension in adults. Specifically, we administered a total of 12 tasks that are known to measure vocabulary breadth, depth, and reading comprehension. First, we conducted analyses to see whether these vocabulary measures of breadth and depth were reliable and valid in examining the vocabulary level of Adult Basic Education participants. We hypothesized that these measures were reliable and valid; thus, vocabulary knowledge would comprise at least two factors: vocabulary breadth and vocabulary depth. We further investigated to see which measures load the highest on the depth factor. Since morphological awareness had shown to contribute to vocabulary, we hypothesized that it might be the component that loaded the highest on the depth factor. Second, we examined if vocabulary depth measures explained variance in reading comprehension of ABE students after controlling for vocabulary breadth. We hypothesized that both components made significant independent contribution to explain reading comprehension.

METHOD

Participants

We recruited a total of 71 participants who are currently enrolled in different levels of Adult Basic Education (ABE) programs in Chicopee, Holyoke, and Springfield, Massachusetts for our study. However, we eliminated data of eight participants as they did not return to our second testing session. Therefore, the sample included a total of 63 participants ranging from 18 years old to 71 years old (M = 35.97, SD = 14.65). The participants included 50 females and 13 males. The sample included 11 African/ African American participants, 7 American participants, 24 Hispanic/Latino/Latina, and 2 Asian Participants. The remainder of participants identified as Italian, Irish, Multi-Ethnic or other. Among all participants, 43 reported English as their main language, 8 reported Spanish. The rest of participants had Italian, Russian, French or other languages as their first language. Only 57 of them could read in their first language. Thirty-five participants could speak another language and only 25 of them could read in this language. Twenty participants reported having been diagnosed with a learning disability. Participants were provided with $20 for compensation.

Materials

A total of 12 tasks were conducted to measure participants' vocabulary depth, vocabulary breadth, and reading comprehension. We administered eight tasks that are assumed to indicate vocabulary depth, two tasks that measure vocabulary breadth, and two tasks that assess reading comprehension levels.

1. Vocabulary Depth Tasks.

1.1 Word Definitions.

We used the Word Definitions part taken from Test of Word Knowledge (Wiig & Secord, 1992). In this task, the experimenter presented a word in both written and spoken forms and told participants to explain its meaning. If the meaning was ambiguous, the participant would be asked to tell more about the word. There were a total of 32 words. Each target word would be scored from 0-2, with points given for the number of semantic features, and a definition must also include the semantic category of the word. For example, if the target word was "bed", the two-point response should include at least three components such as: a piece of furniture (its category), with blankets and pillows (semantic feature), used by people for sleep (semantic feature). If participants responded with two out of three components, they would score one point. If they only answered "a piece of furniture" or gave the wrong definition, the answer was coded as 0; and NR (no response) if participant did not give any definition. The task was discontinued if the participant made 5 consecutive scores of '0' and/or 'NR.' (Appendix A).

Table 1

Word definition scoring example

Score	Requirement	Example answer (Target word: bed)
2	3 components (the word's category and its semantic features)	A piece of furniture, with blankets and pillows, used by people for sleep
1	2 components	A piece of furniture, with blankets and pillows
0	1 component or wrong definition	A piece of furniture
NR	No response	

1.2 Polysemy.

A test used by Carlo et al. (2004) was conducted to examine participant's knowledge of polysemous words. The experimenter showed participants a total of six lexically ambiguous words, defined as a word with two or more possible meanings (Appendix B). Participants had to create as many sentences as possible to convey different meanings of the words. After each sentence, participants were asked if they could use the target word in a sentence in another way. Points were calculated based on the frequency of the meaning demonstrated in the sentences. Responses with the dominant meaning (most frequent meaning) were worth one point. Responses with the secondary meaning (less frequent meaning) were awarded two points. Responses with either a tertiary or quaternary meaning (least frequent meaning) were scored three points. Finally, if the participant utilizes a specific meaning more than once, the repeated meaning would not be awarded any point. For example, with the target word "ring", if a participant responded: "He gave me a wedding ring. The bell rings at the end of the lesson. The wrestler went into the ring to fight. My engagement ring has a diamond.", then their score is as follows:

- One point was awarded for the dominant meaning (most frequent) circular in shape (includes the physical ring, metal band on a finger, and the creation of a ring) for "He gave me a wedding ring".
- Two points were awarded for a secondary meaning, a resonant sound, for "The bell rings at the end of the lesson".
- Three points were awarded for a tertiary meaning, an enclosed circular area, for "The wrestler went into the ring to fight".

- Finally, participant did not gain any point for "My engagement ring has a diamond." because the meaning for ring, circular in shape (includes the physical ring, metal band on a finger, and the creation of a ring), had already been mentioned.

The participant would receive a total of six points for the target word "ring".

1.3 Semantic Category Fluency.

We conducted the semantic category fluency task developed by Tannenbaum, Torgesen, and Wagner (2006). In this test, participants were presented with eight categories (e.g. farm animals, fruits, things people drink, etc.) and instructed to list as many items in that category as possible within 10 seconds (Appendix C). Participants' scores included the total number of correct items, summed across eight categories. Tannenbaum et al. (2006) reported good reliability of .87 in their sample.

1.4 Synonyms.

The synonym section from Test of Word Knowledge (Wiig & Secord, 1992) was administered. Participants were shown a target word and asked to choose the synonym of that word from three or four given options. For instance, if the experimenter showed the word "glad" and three choices: "happy", "old", and "slow", the participant would be expected to point out "happy" as a synonyms of glad (Appendix D). All words were presented in both written and spoken forms. There were a total of 42 target words, and testing was suspended after five consecutive errors.

1.5 Morphological Awareness.

The morphological awareness was examined by three tests. The first one, Derivational Morphemes task, determined participants' knowledge of morphological structure through assessing their understanding of derivational morphemes (Carlisle, 2000). The experimenter

read the target word, followed by a sentence in which one word was replaced with the word "blank". The participant then had to derive a new word from the target word to fill in the blank. For example, if the experimenter read: "help. My sister is always _____.", the participant was expected to respond "helpful" or "helping" (Appendix E).

The second morphological awareness test was the Suffix Choice task, which involved manipulating morphemes using pseudo words (Mahony, 1994; Singson et al., 2000; Tyler & Nagy, 1989, 1990). The experimenter gave participants a printed form of the test which comprised 14 items. Each item included a sentence with a blank and four answer choices. For example, for the sentence "Our teacher taught us how to _____ long words", the participant had to choose the correct answer among four pseudo words: *jittling, jittles, jittled,* and *jittle* (Appendix F). The experimenter read the sentence and answer choices aloud to the participant to eliminate the dependence on participant's decoding ability. For both tasks, testing was terminated after six incorrect answers. Tighe and Binder (2014) reported the reliabilities of .94 and .86 for these two tasks, respectively.

The last task was the Word Families task. The experimenter presented participants with 10 root words, and requested them to write down as many derivatives of the target words as possible (e.g: root word: act, derivatives: actor, action). Each correct word participants produced was worth a point, and the total score was summed up across ten root words (Appendix G).

1.6 Target word task.

We conducted the Vocabulary Depth Task (VDT) designed by Richards (2001). In a trial, participants were given 30 sets of six sentences with a blank in each sentence. Participants had to find out a target word that can fit into all the sentences. This task aims to assess

participants' ability to apply a target word in different contexts. For each correct word, participant scored a point. An example of this task is as follows:

Target Word: Lose

A. I hear Linda is going to [ ] her job.

B. I do not want to [ ] this game.

C. To [ ] your family so young is sad.

D. I want to [ ] ten pounds, so I am exercising more.

E. Do not [ ] time in attacking your enemy.

F. Relax! Do not [ ] it.

2. Vocabulary Breadth Assessment.

Vocabulary breadth was assessed through receptive and expressive tasks. We administered the Peabody Picture Vocabulary Test-Third Edition (PPVT) as the receptive task (Dunn & Dunn, 1997). In this task, the experimenter read aloud a word while showing a participant a set of four pictures (Appendix H). The participant then pointed to the picture that conveyed the meaning of that word. Testing was discontinued when the participant made eight or more mistakes within a set. There were 12 vocabulary words in each set.

The expressive task was the Picture Vocabulary Test taken from the Woodcock Johnson. Participants had to name the picture that the experimenter showed them. The level of difficulty increased, and testing was continued until the participant made six consecutive errors (Appendix I).

3. Reading Comprehension Assessments.

We administered two tests to assess reading comprehension level. The first one was the Passage Comprehension section from the Woodcock Johnson III Achievement Test (Woodcock

et al., 2001). This test indicates the ability to utilize contextual clues to find a missing word in a sentence. For instance, with the sentence "The drums were pounding in the distance. We could _____ them.", the participant should reply that "hear" is the missing word. The sentence was presented to the participant in written form and participant responded orally (Appendix J). The experimenter continued the task until the participant had made six consecutive errors.

The second test was the Test of Sentence Reading Efficiency and Comprehension (TOSREC), which was reported to have good reliability (.93) and construct validity (.87-.89) (Wagner, Torgeson, Rashotte, & Person, 2010). The task included ninety eight items and two example items. With each item, the participant read and determined if a statement was true or false. For example, for the sentence, "A cow is an animal", the participant was expected to choose "Yes" (Appendix K). Within two minutes, the participant tried to read and answer as many items as possible.

Procedure

The experimenter started by interviewing participants to collect some demographic data including age, race, ethnicity, language, education level and basic health questions. Then all the assessments were conducted in two sessions which last between 40 - 60 minutes each with breaks as needed to minimize frustration. The process took place over two days in a room at participants' instructional sites. The experimenter delivered the tasks orally and recorded the responses.

RESULTS

We collected data from 71 participants, in which data from eight participants were omitted since they did not return to our second testing session. Therefore, we analyzed data from a total of 63 participants. The 12 variables represented scores from 10 tests of vocabulary breadth and vocabulary depth and two tests of reading comprehension. Descriptive statistics for these measures were presented in Table 2.

Table 2

Descriptive Statistic for 12 Assessments

	N	Minimum	Maximum	Mean	Std. Deviation
Passage Comprehension	63	15	38	29.79	5.156
Reading Fluency (TOSREC)	63	3	76	31.83	12.713
Word Definitions	62	5	47	25.76	11.160
Synonyms	62	1	41	27.08	9.087
Polysemy	63	4	31	16.11	6.877
Semantic Category Fluency	61	12	51	36.38	6.984
Target Word Task (VDT)	63	0	18	5.90	4.582
Derivational Morpheme	63	0	33	12.33	10.520
Word Families	63	2	31	16.14	6.488
Suffix Choice	63	0	14	6.86	4.381
Picture Vocabulary Test (PVT)	63	12	41	29.76	5.662

Peabody Picture Vocabulary Test (PPVT)	63	66	182	136.11	31.515

Cronbach's reliability

Cronbach's reliability estimates were calculated for all 12 measures. Overall, a moderate to high level of internal consistency was reported for all of the assessments (see Table 3). Out of 12 tasks, 11 tasks were found to be highly reliable ranging from $\alpha = .706$ to $\alpha = .982$. For the assessments used to measures vocabulary skills, both Picture Vocabulary Test and Peabody Picture Vocabulary Test were reported to possess high reliability of .883 and .982. Similarly, Passage Comprehension and Reading Fluency (TOSREC), which were reading comprehension tests, also had very high reliability of over .872. For the vocabulary depth assessments, Cronbach's alpha varied from $\alpha = .649$ to $\alpha = .972$. Target Word Task, Synonym and Word Definition belonged to the group that had high Cronbach's alpha values of above .848. The Semantic Category Fluency test was reported to have the lowest reliability ($\alpha = .649$) amongst all the tests. However, all alpha values were in the moderate to high range of reliability, which indicated a sufficient level of reliability for assessing adults' vocabulary knowledge and reading comprehension skills.

Table 3

Cronbach's alpha of 12 measures

	Cronbach's Alpha	N of Items
Derivational Morpheme	.972	33
Suffix Choice	.886	14

Target Word	.848	30
Synonym	.943	42
Word Definition	.913	32
Word Family	.842	10
Polysemy	.702	6
Semantic Category Fluency	.649	8
Picture Vocabulary Test (PVT)	.883	54
Peabody Picture Vocabulary Test (PPVT)	.982	204
Passage Comprehension	.872	47
Reading Fluency (TOSREC)	.965	98

Correlation analysis

Correlation analysis was used to examine the relationship among 10 vocabulary tests before we conducted factorial analysis. The results indicated all of the tasks significantly and positively correlated with one another (see Table 4). The highest correlation was the relation between Peabody Picture Vocabulary Test (PPVT) and Picture Vocabulary Test (PVT) (r = .849, $p < .001$) while the lowest was the correlation between Suffix Choice test and Semantic Fluency test (r = .289, $p < .025$). With all of the assessments significantly positively correlated, results from this correlation analysis suggested that factorial analysis could produce distinct and reliable factors. However, the Peabody Picture Vocabulary Test (PPVT) task and the Picture Vocabulary Test (PVT) had a highly positive correlation (r = .849, $p < .001$), which indicated a problem of multicollinearity for our factor analysis. Therefore, we excluded the Picture Vocabulary Test with lower reliability (α = .883) and kept the Peabody Picture Vocabulary Test (α = .982) in our factor analysis model.

Factor analysis for vocabulary assessments

We examined the factorability of nine vocabulary tests, after excluding the Picture Vocabulary Test. Several well-recognized criteria for the factorability were used. Firstly, all the tests correlated significantly and positively with one another with a range from $r = .289$ to $r = .778$, indicating reasonable factorability. Secondly, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .889 (above the recommendation of .60), which implied that our data were suitable for factor analysis. The Bartlett's test of sphericity was significant ($\chi 2 = 382.406$, $p < .001$), which implied that there were patterned relationship between the variables (see Table 5). The diagonals of the anti-image correlation matrix were all over .839, which supported the inclusion of each task in the factor analysis. Moreover, the communalities were all above .626, further confirming that each test shared some common variance with other tests. Finally, the scree plot confirmed the findings of extracting two factors (see Figure 1). Given these overall indicators, factor analysis was conducted with all nine variables.

Table 4

Correlation between 10 vocabulary measures

	Word Definitions	Synonyms	Polysemy	Semantic Fluency	Target Word VDT	Word Families	Suffix Choice	PVT Score	Peabody Score	Derivational Morph
Word Definitions	1									
Synonyms	.713**	1								
Polysemy	.617**	.638**	1							
Semantic Fluency	.598**	.490**	.436**	1						
Target Word VDT	.606**	.658**	.559**	.399**	1					
Word Families	.595**	.723**	.668**	.403**	.664**	1				
Suffix Choice	.494**	.584**	.464**	.289*	.754**	.669**	1			
PVT Score	.704**	.659**	.681**	.641**	.500**	.580**	.383**	1		
Peabody Score	.746**	.778**	.717**	.666**	.518**	.604**	.453**	.849**	1	
Derivational Morph	.596**	.713**	.608**	.422**	.704**	.640**	.668**	.562**	.615**	1

Table 5

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.889
Bartlett's Test of Sphericity	Approx. Chi-Square	382.406
	df	36
	Sig.	.000

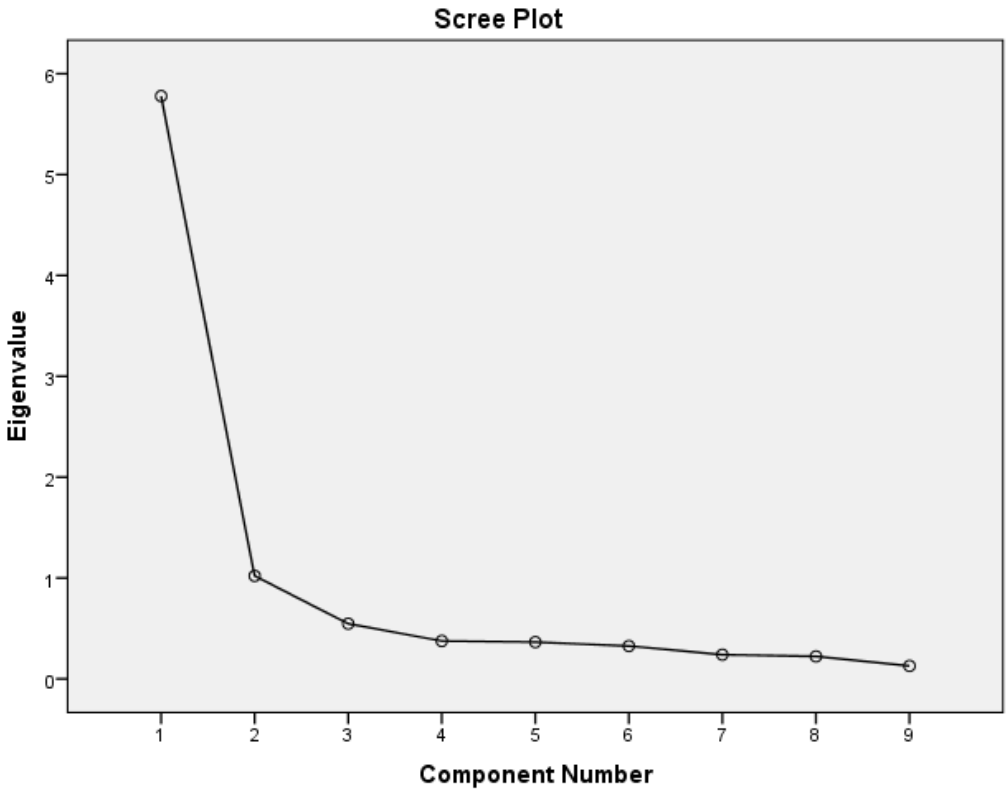


Figure 1. Scree plot of vocabulary tests factor analysis

Data were subjected to factor analysis using principle component analysis and direct oblimin rotation method. We used principle component analysis because our primary purpose was to identify common factors underlying all the tests and compute composite factor scores for the components. Direct oblimin rotation was used to allow for correlation as we suspected these factors were vocabulary breadth and depth, which positively correlated with each other.

With an eigenvalue cut-off of 1.0, the initial eigen values suggested that there were two significant factors that together explained a total variance of 75.54 %. Specifically, the initial eigen values showed that the first factor explained 64.20% of the variance, while the second factor added another 11.34% of the variance (see Table 6).

The pattern matrix presented the factor loadings after rotation. Results from the pattern matrix indicated that there were two factors constructing vocabulary, which were vocabulary depth and vocabulary breadth (factor 1 and factor 2, respectively). During our analysis, Synonym was eliminated because it had a primary factor loading of .56 on vocabulary depth and a cross loading of .43 on vocabulary breadth. Similarly, we also excluded Polysemy since it only had moderate primary loading of .53 and a cross loading of .37 (above .30).

Table 6

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	5.778	64.203	64.203	5.778	64.203	64.203	4.943
2	1.021	11.340	75.542	1.021	11.340	75.542	4.434
3	.547	6.074	81.616				
4	.375	4.167	85.783				
5	.364	4.047	89.830				
6	.326	3.617	93.447				
7	.239	2.661	96.108				
8	.222	2.472	98.579				
9	.128	1.421	100.000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Table 7

Final Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	4.471	63.877	63.877	4.471	63.877	63.877	3.951
2	1.009	14.414	78.291	1.009	14.414	78.291	3.296
3	.393	5.619	83.911				
4	.359	5.129	89.039				
5	.326	4.658	93.697				
6	.243	3.467	97.164				
7	.199	2.836	100.000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

We conducted principle component factor analysis of the remaining seven vocabulary tests, with direct oblimin rotations, with the two factors explaining 78.29 % of the variance. All assessments had primary loadings over .68. The factor loading matrix for this final solution is presented in Table 8. Four assessments, including Suffix Choice, Target Word Task, Word Families, and Derivational Morphemes loaded on vocabulary depth (factor 1) with loading over .75. Peabody Picture Vocabulary Test, Semantic Fluency, and Word Definition loaded on vocabulary breadth (factor 2) with loading over .68.

Table 8

Pattern Matrix Loading

	Component	
	1	2
Suffix_Choice	.988	-.162
Target_Word_VDT	.876	.036
Word_Families	.751	.160
D_Morph	.746	.183
Semantic_Fluency	-.138	.963
Peabody_Score	.192	.792
Word_Definitions	.298	.682

Extraction Method: Principal Component Analysis.

Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Composite scores were created for each of the two factors using the multiple regression approach. We also conducted a correlation analysis before putting them into the hierarchical regression model (see Table 9). The result indicated that vocabulary breadth and depth are significantly and positively correlated with each other (r = .51, p < .001).

Table 9

Correlations

		Vocabulary Depth Factor	Vocabulary Breadth Factor
Vocabulary Depth Factor	Pearson Correlation	1	.512**
	Sig. (2-tailed)		.000
	N	60	60
Vocabulary Breadth Factor	Pearson Correlation	.512**	1
	Sig. (2-tailed)	.000	
	N	60	60

**. Correlation is significant at the 0.01 level (2-tailed).

Factor analysis for reading comprehension assessments

Similar to all the vocabulary tests, we used factor analysis to reduce reading comprehension measures to one component, and then created composite score for it before using the score for the hierarchical regression. We examined the factorability of two reading comprehension tests, the Reading Fluency (TOSREC) and Passage Comprehension. The tests had a significant and positive correlation (r =.69, p < 0.01). The Bartlett's test of sphericity was significant (χ^2 = 40.2, p < .001), and the Kaiser-Meyer-Olkin (KMO) measure of sampling

adequacy was .50, which was acceptable for factor analysis (see Table 10). Moreover, the communalities were all above .84, suggesting that these assessments shared some common variance with each other.

Table 10

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.500
Bartlett's Test of Sphericity	Approx. Chi-Square	40.200
	Df	1
	Sig.	.000

Given these indicators, we conducted the principle component analysis and direct oblimin rotation method. The initial eigen values showed that there was one significant factor that together explained a total variance of 84.83 % (see Table 11).

Table 11

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.697	84.837	84.837	1.697	84.837	84.837
2	.303	15.163	100.000			

Extraction Method: Principal Component Analysis.

The component matrix indicated that both Reading Fluency and Passage Comprehension, each loaded .92 on this reading factor. Finally, we created a composite score for the reading comprehension factor using multiple regression approach.

Table 12

Component Matrix

	Component 1
Reading_Fluency_Score	.921
Passage_Comp_Score	.921

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Regression analysis

Hierarchical multiple regression analysis was conducted to examine whether vocabulary breadth and vocabulary depth significantly predicted participants' reading comprehension. A two stage hierarchical multiple regression was run with Reading Comprehension Factor as the dependent variable. Vocabulary Breath Factor was entered at stage one of the regression to control for the influence of vocabulary breadth knowledge. Vocabulary Depth Factor was entered at stage two of the regression to identify if vocabulary depth contributed additional variance to explain reading comprehension beyond the effect of vocabulary breadth. The hierarchical multiple regression revealed that at stage one, Vocabulary Breadth contributed significantly to the regression model, $F(1, 58) = 55.391$, $p < .001$ with an R^2 of .488, which implied that vocabulary breadth accounted for 48.8% of the variation in reading comprehension. Introducing the Vocabulary Depth Factor variable explained an additional 24.0% of variation in

Reading Comprehension Factor and this change in R^2 was significant, $F(2,57) = 76.310$, $p < .001$. Together the two independent variables accounted for = 71.9% of the variance in Reading Comprehension Factor. The β coefficients for both of the predictors were significant (vocabulary breadth: $\beta = .407$, $t = 5.064$, $p < .001$; vocabulary depth: $\beta = .570$, $t = 7.087$, $p < .001$.

Table 13

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.699[a]	.488	.480	.71156746	.488	55.391	1	58	.000	
2	.853[b]	.728	.719	.52334686	.240	50.221	1	57	.000	1.793

a. Predictors: (Constant), REGR factor score 2 for analysis 5

b. Predictors: (Constant), REGR factor score 2 for analysis 5, REGR factor score 1 for analysis 5

c. Dependent Variable: REGR factor score 1 for analysis 2

Table 14

ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	28.046	1	28.046	55.391	.000[b]
	Residual	29.367	58	.506		
	Total	57.413	59			
2	Regression	41.801	2	20.901	76.310	.000[c]
	Residual	15.612	57	.274		
	Total	57.413	59			

a. Dependent Variable: REGR factor score 1 for analysis 2

b. Predictors: (Constant), REGR factor score 2 for analysis 5

c. Predictors: (Constant), REGR factor score 2 for analysis 5, REGR factor score 1 for analysis 5

Table 15

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta	T	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.014	.092		.155	.878	-.170	.198					
	Vocabulary Breadth Factor	.697	.094	.699	7.443	.000	.510	.885	.699	.699	.699	1.000	1.000
2	(Constant)	.004	.068		.053	.958	-.132	.139					
	Vocabulary Breadth Factor	.406	.080	.407	5.064	.000	.246	.567	.699	.557	.350	.738	1.355
	Vocabulary Depth Factor	.560	.079	.570	7.087	.000	.402	.719	.778	.684	.489	.738	1.355

a. Dependent Variable: REGR factor score 1 for analysis 2

DISCUSSION

Although a vast amount of research has investigated the relationship between vocabulary and reading comprehension, very few of them concentrated on this relationship in the adult beginning reader population. Therefore, the purpose of this study was to examine the relationship between vocabulary breadth, vocabulary depth and reading comprehension, as well as to determine whether the commonly used assessments are valid and reliable in assessing vocabulary and reading comprehension skills in adult basic education students. Specifically, we focused on deconstructing the components of vocabulary knowledge and assessed how these components are related to reading comprehension in adults. To examine both questions, participants were given a set of 12 tasks assessing their vocabulary breadth, vocabulary depth, and reading comprehension. First, we hypothesized that our tests would be reliable and valid in assessing vocabulary and reading comprehension skills in the adult beginning reader population. Second, if all the tests were valid, the factor analysis would extract two factors: vocabulary breadth and depth.

Vocabulary Knowledge and Reading Comprehension Assessments Reliability

To assess reliability, 12 tests were subjected to Cronbach's alpha measure. In conjunction with previous research, the results indicated that all the tests were moderately or highly reliable to be used for the adult beginning reader population (Carlo et al., 2004; Ouellette, 2006; Proctor et al. 2012; Tannenbaum et al., 2006). Specifically, since the assessments had

internal consistency, if students respond correctly to an item, they are also likely to provide correct responses to other similar items.

For the assessments that were used to measure vocabulary breadth, both Picture Vocabulary Test and Peabody Picture Vocabulary Test were reported to possess high reliability of over .883, which are similar to their Cronbach's alpha values reported by the examiner's manual (Dunn & Dunn, 1997). Similarly, Passage Comprehension and Reading Fluency (TOSREC), which were reading comprehension tests, also had very high Cronbach's alpha values. These results of our sample are consistent with the psychometric properties of these tests in other population. For example, Passage Comprehension was reported to have $\alpha = .94$ to .96 in Grades 6 to 8 population (Denton et al., 2011). In the same study, TOSREC was also found to be more strongly related to reading comprehension in Grades 6 to 8 than any other silent fluency measure evaluated. It was clear that these assessments were highly reliable since they were well-established standardized tests that had been widely used to measure vocabulary knowledge and reading comprehension of people with an age range of between 2 and 90 years.

For the vocabulary depth assessments, except for Semantic Category Fluency, all the assessments were reported to have high value of Cronbach's alpha, which was in line with the results of other researchers in their population (Carlo et al., 2004; Ouellette, 2006; Proctor et al. 2012; Tannenbaum et al., 2006). In our adult beginning readers population, the Semantic Category Fluency test was reported to have a moderate Cronbach's alpha of .649, which is much lower to the result of .870 in the sample reported by Tannenbaum et al. (2006). This lower Cronbach's alpha value might be due to the small number of items (eight) in this test. The alpha is dependent not only on the magnitude of the correlations among items, but also on the number

of items in the test. Therefore, if the number of items in the assessment is too small, its reliability might be underestimated (Tavakol & Dennick, 2011).

Overall, the results from Cronbach's alpha reliability test supported the part in our first hypothesis that the assessments used in this study were reliable in testing adult beginning readers' vocabulary knowledge and reading comprehension level.

Vocabulary Knowledge and Reading Comprehension Assessments Validity

To examine the validity of our assessments, we attempted to extract the underlying common factors of ten vocabulary tests and two reading comprehension tests. After data were subjected to factor analysis, we found two underlying factors among ten vocabulary tests: vocabulary breadth and vocabulary depth, which is consistent with findings from past literature about the construct of vocabulary knowledge (Binder et al., 2016; Nurweni & Read, 1999; Oullette, 2006; Qian, 2000). Our results indicated that Suffix Choice, Target Word Task, Word Families, and Derivational Morphemes loaded on vocabulary depth. For the breadth factor, in addition to Peabody Picture Vocabulary Test, vocabulary breadth was also loaded by Semantic Category Fluency, and Word Definition tests. Different from our initial prediction, Polysemy and Synonym tasks were shown to assess not only vocabulary depth but also vocabulary breadth. Thus, out of 10 vocabulary knowledge tests, only six tests including Suffix Choice, Target Word Task, Word Families, Derivational Morpheme, Picture Vocabulary Test and Peabody Picture Vocabulary Test supported part of our hypothesis that they measure what researchers have been using them for.

One surprising finding in our study was that the Semantic Category Fluency and Word Definition tests, which were usually thought to measure vocabulary depth, loaded highly on vocabulary breadth (Tannenbaum et al., 2006). One possible explanation could be due to the

testing and scoring procedures. For Semantic Category Fluency, participants are asked to name as many words as possible in a given category within 10 seconds. Since our categories are familiar to participants (e.g. ways to travel, farm animals, and things to drink), participants only need to understand the basic meaning of the words to list them under a category. Thus, while the task is designed to assess participants' depth knowledge of each category, it might actually ask participants how many words they know under a category, which might tap on the breadth aspect rather than vocabulary depth. In addition, participants' score is the total amount of correct words listed without taking into account the difficulty levels of the words. A participant who earns high score by listing more words with high-frequency might not understand the category as well as the one that produces less, but listing less common words. For Word Definition, participants were asked to explain the meaning of the words to the experimenter. Participants' scores were determined based on a scale from 0 - 2. Since the range of the scale was small, it might not be able to differentiate the depth aspect of word understanding among participants. Therefore, researchers could consider adjusting Semantic Category Fluency and Word Definition tests to address these problems. Some suggestions are discussed in the future direction section.

Additionally, the results showed that Suffix Choice, Target Word Task, Word Families, and Derivational Morphemes loaded on vocabulary depth. This supported the idea that vocabulary depth consists of different components including morphological awareness, semantic relations and syntactic awareness (Proctor et al., 2012). Moreover, our findings revealed that all three morphological awareness tasks highly loaded on vocabulary depth, which further emphasizes the important contribution of morphological awareness to the depth of vocabulary as presented in past literature (Fracassco, Bangs, and Binder, 2016; Keiffer & Lesaux, 2012; To, Tighe & Binder, 2016). In their study, Fracasso, Bangs, and Binder (2016) found that

morphological awareness was a unique predictor of spelling ability, vocabulary, and listening comprehension. One explanation may be that by understanding the morphological structure of a word, readers could manipulate suffixes, and affixes to derive different word meanings, which adds another layer of understanding the word. Our finding also supports the idea of an indirect relationship between morphological awareness and reading comprehension (Fracasso, Bangs, & Binder, 2016; Keiffer & Lesaux, 2012; Nagy et al., 2006). Morphological awareness indirectly contributes to reading comprehension through vocabulary. When encountering a complex word, readers with proficient morphological skills may break it into smaller parts to decipher its meaning, thereby, increasing their vocabulary knowledge. Vocabulary then contributes to reading comprehension.

For reading comprehension, we were able extract a reading comprehension factor, which implied that both Passage Comprehension and Reading Fluency were valid in measuring reading comprehension. This result was clear to understand since both of the tests were straightforward in testing participants' understanding of written text. Passage Comprehension task requires participants to supply a missing word to sentences and then paragraphs of increasing complexity. For Reading Fluency, participants read some sentences to determine whether they are true or false. Therefore, participants have to use their vocabulary to construct meaning and make sense of the context to produce the correct answers and complete the tasks.

Overall, we were able to demonstrate that vocabulary knowledge might comprise of two components: vocabulary breadth and vocabulary depth. While both vocabulary breadth assessments showed to only measure breadth aspect, out of eight tests that researchers had been using to measure vocabulary depth, only four tests including Suffix Choice, Target Word Task, Word Families, Derivational Morphemes showed that they measure only the depth aspect of

vocabulary. Polysemy and Synonym tasks were reported to tap on both vocabulary breadth and depth. Contrary to our initial thought, Semantic Category Fluency and Word Definition seemed to assess vocabulary breadth instead of vocabulary depth. Finally, we found that morphological awareness loaded highest on the depth factor, which supported our hypothesis.

Relationship among Vocabulary Breadth, Vocabulary Depth and Reading Comprehension

Several studies have investigated the relationship among vocabulary breadth, depth and reading comprehension. Hall, Greenberg, Gores and Pae (2014) suggested in their study that expressive vocabulary accounted for a significant portion of the variance of reading comprehension in adult readers with low-literacy level. Akbarian and Alavi (2014) also demonstrated that vocabulary breadth contributed significantly to participants' IELTS and TOEFL reading comprehension test scores in their sample. In line with these studies, our finding indicated that vocabulary breadth significantly explain variance in reading comprehension (Carlisle, 2000; Nelson & Stage, 2007; Oullette, 2006). After adding vocabulary depth to the regression model, the results demonstrated that vocabulary depth measures explain another 24% variance in reading comprehension of ABE learners after controlling for vocabulary breadth. These findings support our second hypothesis that both components make significant independent contribution to explain reading comprehension in the adult beginning reader population. Moreover, they also agree with other studies and add to past literature by extending the significant contribution of both vocabulary breadth and depth to reading comprehension to the adult beginning reader population (Binder et al., 2016; Nation & Snowling, 2004; Qian, 1999). While knowing more words (vocabulary breadth) helps readers decode and process words more efficiently, understanding more about each individual word (vocabulary depth)

assists readers in making sense of the whole text, thereby aiding reading comprehension (Binder et al., 2016).

Implications

Our study suggests that similar to other populations, in our adult basic education sample, breadth and depth are essential components of vocabulary, and both of them have a predictive relationship with reading comprehension level. Therefore, it is essential to help students build both of these aspects of vocabulary knowledge. In their study, Coyne, Kapp and McCoach (2007) suggested two approaches to teach vocabulary breadth and depth depending on the goal of instruction. If the goal is to simply introduce students to new word meanings, then embedded instruction may be adequate (Coyne, Kapp & McCoach, 2007). When students encounter target words in a text, teachers may explicitly present the word definition to them. Specifically, McKeown (1993) noted that presenting dictionary definitions might not be an effective way to learn word meanings since learners may interpret the meaning incorrectly. Thus, this study recommended that teachers might give a student-friendly definition by providing the word's typical use and explaining its meaning in everyday language. For example, the dictionary definition for "apathetic" is "showing no interest or energy and unwilling to take action, especially over something important" (Online Cambridge Dictionary, n.d.). The word's typical use is to describe a person who is lacking interest to something important. One way to explain its meaning in everyday language would be describes a person who is not interested in or does not care about something enough to do it. With this approach, adults struggling readers might develop initial representations of a word's definition that would later facilitate the understanding of the same word when that word is encountered again (Coyne, Kapp & McCoach, 2007). For instance, if a teacher defined "pen" as a tool used for writing or drawing

with ink, then students might be able to infer the meaning of "pen" in the sentence "I could pen a poem everyday" as to use a pen to write a poem because "pen a poem" relates to the function of a pen, which is used for writing.

However, only providing direct and embedded instruction is not sufficient since students might not be able to understand meanings of the same word in a different context. With the same word "pen", if students encounter the sentence "The dog is in the pen", they might not be able to relate the meaning of pen (a writing tool) to understand "pen" (a small enclosure to keep animals) in the novel context. Thus, besides instruction to expand ABE students' number of words in their lexicon, teachers and instructors may also reinforce the depth of students' vocabulary knowledge by various teaching practices. Stahl and Nagy (2006) proposed that teachers may consider utilizing synonyms and antonyms, providing examples and non-examples to enhance vocabulary depth while at the same time, to help students compare and understand the similarities and differences between the novel words and known words. Besides coordinating activities about matching synonyms, teachers may include an in-depth discussion of word meanings by describing how these synonyms are similar and different and in what contexts each word could be used (Steele & Mills, 2011). For example, "greedy" means "wanting a lot more food, money, etc. than you need", whereas "selfish" implies wanting and caring about what you want and need without any thought for the needs of other people" (Online Cambridge Dictionary, n.d.). Exposing students to various examples may further help students understand word meanings more deeply. Moreover, Coyne, Kapp and McCoach (2007) suggested that teachers should apply extended instruction, which is defined as explicit teaching that combines both word definition and its contexts, multiple exposures to target words in different contexts, and encourages deep processing of word meanings. Furthermore, students could only achieve

reliable improvement in reading comprehension through teachers' word instruction only if the teacher follows by presenting multiple encounters that provide a variety of information about the instructed words. With limited class time, vocabulary instruction from teachers can maintain multiple, rich encounters for only a small number of words; thus, student must have additional opportunities to be exposed to large number of words regularly (Nagy & Herman, 1987). Therefore, encouraging students to read outside the classroom also benefits their depth of vocabulary since students only gain this kind of exposure when they continue to read frequently. This is essential because the time ABE students spend in the classroom is limited.

Nagy and Anderson (1984) estimated that for English, about 60% of the novel words students encounter in texts could be understood by manipulating morphological structure and their use in a sentence. Thus, if a child could recognize the root of a word, it would be more feasible to infer the word definition as a result of understanding the root word's (Bowers & Kirby, 2009; Mahony, Singson, & Mann, 2000). With adult learners, this pattern may also have a great effect, which is suggested in the current study since morphological awareness seems to load highly on vocabulary depth. This implication was in line with past research that age seemed to strengthen the contribution morphological awareness to reading comprehension (Nagy et al., 2006; Singson et al., 2000). Therefore, applying morphological awareness into vocabulary instruction can support adult struggling readers. In their research, Bowers and Kirby (2009) introduced a wide but deep approach to morphological instruction. They designed a "word matrix" including a root word and different affixes and suffixes to provide learners with the visualization of how manipulating affixes and suffixes could modify the root word meaning and orthography (see Appendix L). With this method, teachers focus on some of the derivations, and encourage students to practice connecting these morphemes to create new words. For example,

with the target word “heal”, teachers may provide an example of heal + ing = healing or un + heal + thy = unhealthy and let students create different formulas for other suffixes and affixes (healed, healer, healthier, and unhealed). This instruction presents learners with the efficient and active way to process the root word “heal” while it also offers a glimpse of a larger number of words deriving from this root word, which could benefit students in decomposing new words to figure out their meanings. In addition, researchers also recommended to start with familiar or obvious morphemes with constant meaning and spellings such as “un-”, “-tive” and “-able” before moving to more complicated ones (as cited in Herman, Gilbert Cote, Reilly, & Binder, 2013, p.10). In addition, Carlisle and Stone (2005) described the role of uninstructed experiences with morphology on lexical representations by concluding that "frequent encounters with a base word (by itself or combined with affixes in words) reinforce the mental representation of the morphemes in those words, and access to memory for the morphemes speeds identification of words containing those morphemes" (p. 43). Therefore, despite which types of instruction used, reinforcing students’ exposure to target words cannot be neglected.

Finally, as these instructions were tailored to adults’ reading profile, they might indeed help adults read more efficiently. However, it might be difficult to accomplish, especially with an adult basic education population because of the attendance and retention issues. Thus, moving forwards, researchers may need to examine these strategies for further improvement.

Limitations and Future Studies

One limitation of this study is that we could only analyze data from 63 participants in our factor analysis for 10 variables. Although some researchers suggested the subjects-to-variables ratio of above five is sufficient, others recommended a ratio of 10:1 (as cited in Garson, 2008; as cited in MacCallum, Widaman, Zhang & Hong, 1999). Thus, our factor analysis might have low

stability since our sample did not satisfy the 10:1 ratio. Therefore, future research may increase the number of participants to eliminate this issue.

Although we were able to determine the predictive relationship between vocabulary breadth, depth and reading comprehension in our diverse ABE sample, we did not have a sufficient number of participants to make a comparison of this relationship between native English speakers and non-native English speakers. Most of the research in past literature investigated vocabulary knowledge and reading comprehension in children, adolescent or adults whose first languages are not English. These populations are not as familiar with the language as native speakers are; thus, they may depend mostly on their vocabulary knowledge to understand the texts. Thus, interventions targeting non-native English readers might not be appropriate for native English struggling readers. A study by Binder et al. (2014) showed that vocabulary depth contributed to reading comprehension in a group of proficient college readers who are native English speakers. However, the comparison of reading profile between native and non-native English readers at lower literacy level needs to be investigated. Thus, future studies might focus on adult beginning readers who are native English speakers to determine the importance of vocabulary breadth and depth in this population as well as to compare reading behaviors between these populations.

Moreover, developing more accurate assessments for determining the vocabulary knowledge of ABE learners is necessary. Through the results of this study, we suggest future researchers to improve the internal consistency of the Semantic Fluency Category test by increasing the number of items or adjusting the scoring procedure. For Word Definition, researchers may consider widen the range of the scoring scale so that it could differentiate the depth levels of participants. After developing more accurate assessments to capture the concept

of vocabulary depth, researchers might further investigate how each component of vocabulary depth (semantics, morphology, and syntax) is related to reading comprehension. In general, compared to vocabulary breadth, vocabulary depth is a relatively novel concept. Thus, assessments still need to be developed to measure this dimension of vocabulary. Although the construction of assessments is an intricate and time consuming endeavor, it is crucial for all types of vocabulary learning research.

Appendix A

Word Definitions

Write the student's response verbatim in the space provided. Refer to Appendix A in the *Examiner's Manual* during Administration. Circle "2" for a 3-component response. Circle "1" for a 2- component response. Circle "0" for a 1-component response or an incorrect response. Circle "NR" for no response or refusal to respond.

Carrier Phrase: Tell me what you can about _____.

Level 1 Core Subtest: Ages 5-8	Level 2 Core Subtest: Ages 8-17
Demonstration: zoo a. place/park b. where animals are kept c. for people to see	Demonstration: mustache a. hair b. that grows on face c. above upper lip
Trial: bed a. piece of furniture/thing b. used by people/animals c. for sleep or rest d. mattress/sheets/blankets/pillows e. placed on top of a support	Trial: refrigerator a. box/room/appliance/thing b. with a cooling system/that cools c. food or other things d. so they don't spoil

Scoring: 3 Component Response = 2 2 Component Response = 1 1 Component/Incorrect Response = 0	
Start: 5 -11 Years	
Stimulus	Response

1. **magician**		2	1	0	NR
2. **envelope**		2	1	0	NR
3. **teacher**		2	1	0	NR
4. **scarf**		2	1	0	NR
5. **bus**		2	1	0	NR
6. **friend**		2	1	0	NR
7. **broom**		2	1	0	NR

Appendix B

Polysemy Task

Score Sheet for Polysemy Task

Move on to the next word after 30 seconds.

Ring	
Place	
Settle	
Pitch	
Back	
Check	

Appendix C

Semantic Category Fluency

Participant ID#: _____

Semantic Category Fluency Test Directions & Scoring Sheet

Created by Tannenbaum, Torgesen, & Wagner (2006)

This is an oral task. The experimenter counts the number of correct answers as the participant responds. Make hash marks (i.e., 𝍸 = 5) in the space under each category to keep track of the number of correct answers given in the allotted time. Note: Dr. Tannenbaum does not have a copy of the task or more details than are provided in the 2006 paper.

Read the following directions:

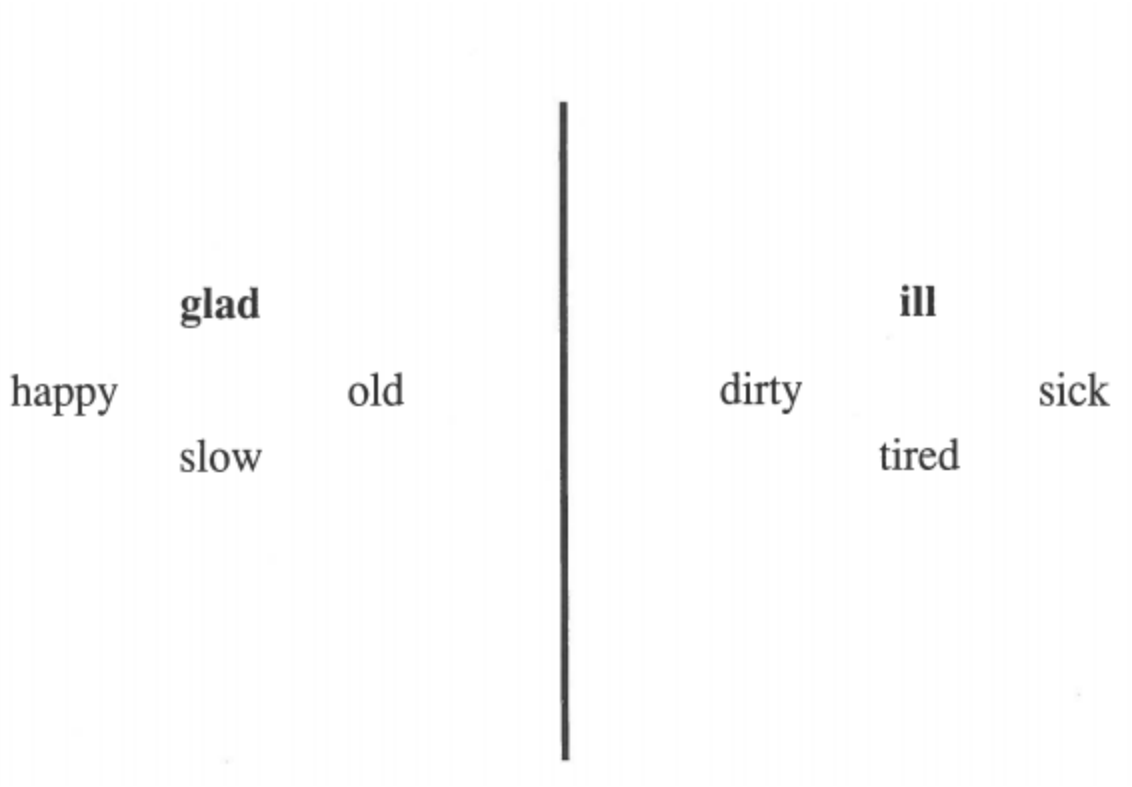
"Name as many items as possible from the categories I give you. You will have 10 seconds to respond to each category."

Category	Total # of correct responses
Farm animals	
Fruits	
Clothes you wear	
Items of furniture	
Things that take you places (i.e., ways to travel)	
Things used at school	

Appendix D

Synonym

Trial items :



Appendix E

Derivational Morpheme Task

Trial items:

a. **“farm. My uncle is a __blank__.”** [farmer]
b. **“help. My sister is always __blank__.”** [helpful or helping]

Test items. The experimenter will say “blank” where the spaces are.

1. **“warm. He chose the jacket for its _____.”** [warmth]
2. **“teach. He was a very good _____.”** [teacher]
3. **“permit.** (to allow) **Father refused to give _____.”** [permission]
4. **“profit. Selling lemonade in summer is _____.”** [profitable]
5. **“appear. He cared about his _____.”** [appearance]
6. **“express. ‘OK’ is a common _____.”** [expression]
7. **“four. The cyclist came in _____.”** [fourth]
8. **“remark. The speed of the car was _____.”** [remarkable]
9. **“protect. She wore glasses for _____.”** [protection]
10. **“perform. Tonight is the last _____.”** [performance]
11. **“expand. The company planned an _____.”** [expansion]
12. **“revise. This paper is his second _____.”** [revision]
13. **“reason. Her argument was quite _____.”** [reasonable]
14. **“major. He won the vote by a _____.”** [majority]
15. **“deep. The lake was well known for its _____.”** [depth]
16. **“equal. Boys and girls are treated with _____.”** [equality]
17. **“long. They measured the ladder’s _____.”** [length]
18. **“adventure. The trip sounded _____.”** [adventurous]

19. **“absorb. She chose the sponge for its _____.”** [absorption/absorbency]

20. **“active. He tired after so much _____.”** [activity]

21. **“swim. She was a strong _____.”** [swimmer]

22. **“human. The kind man was known for his _____.”** [humanity]

23. **“wash. Put the laundry in the _____.”** [washer]

24. **“humor. The story was quite _____.”** [humorous]

25. **“assist. The teacher will give you _____.”** [assistance]

26. **“mystery. The dark glasses made the man look _____.”** [mysterious]

27. **“produce. The play was a grand _____.”** [production]

28. **“glory. The view from the hill top was _____.”** [glorious]

29. **“vision. During the winter, the woman tried to _____ herself on a sunny beach.”** [visualize/envision]

30. **“excess. The boy’s parents did not want him to eat _____ amounts of sugary foods.”** [excessive]

31. **“brave. The girl showed _____ when she rescued the cat from the tree.”** [bravery]

32. **“collide. The cars slowed down because they did not want to have a _____.”** [collision]

33. **“injure. The athlete suffered from an _____ after her fall.”** [injury]

Appendix F

Suffix Choice Task

1. Our teacher taught us how to _____ long words.

a) jittling b) jittles c) jittled d) jittle

2. _____ makes me happy.

a) blopness b) bloply c) blopish d) blopable

3. The _____ boy plays soccer.

a) tweagness b) tweagish c) tweagment d) tweagtion

4. The girl dances _____.

a) spridderish b) spriddered c) spridderly d) spridding

5. I could feel the _____.

a) froodly b) froodful c) frooden d) froodness

6. What a completely ____ idea.

a) tribacious b) tribicism c) tribacize d) tribation

7. I admire her _____.

a) sufilive b) sufilify c) sufilation d) sufilize

8. Where do they _____ the money?

a) curfamic b) curfamity c) curfamate d) curfamation

9. Please _____.

a) scriptial b) scriptize c) scriptist d) scriptious

10. The meeting was very_____.

a) lorialize b) lorial c) lorialism d) lorify

11. I just heard a _____ story.

a) dantment b) dantive c) danticism d) dandify

12. Dr. Smith is a famous _____.

a) cicarist b) cicarize c) cicarify d) cicarial

13. Can you _____ both sides?

a) romify b) romity c) romious d) romative

14. He has too much _____.

a) brinable b) brinicity c) brinify d) brinicious

Appendix G

Word Families Task Scoring Sheet

Please read the following out loud to the participant and write all of their answers in the space provided (even answers that you know are not real words). Move onto the next word after 30 seconds or when the participant has stopped providing new answers.

"Please tell me as many words as you can that include the word…"

	Number
Act:	
Friend:	
Intense:	
Establish:	
Poet:	
Depend:	
Manage:	
Regular:	
Endure:	
Excite:	
Total number of correct responses:	

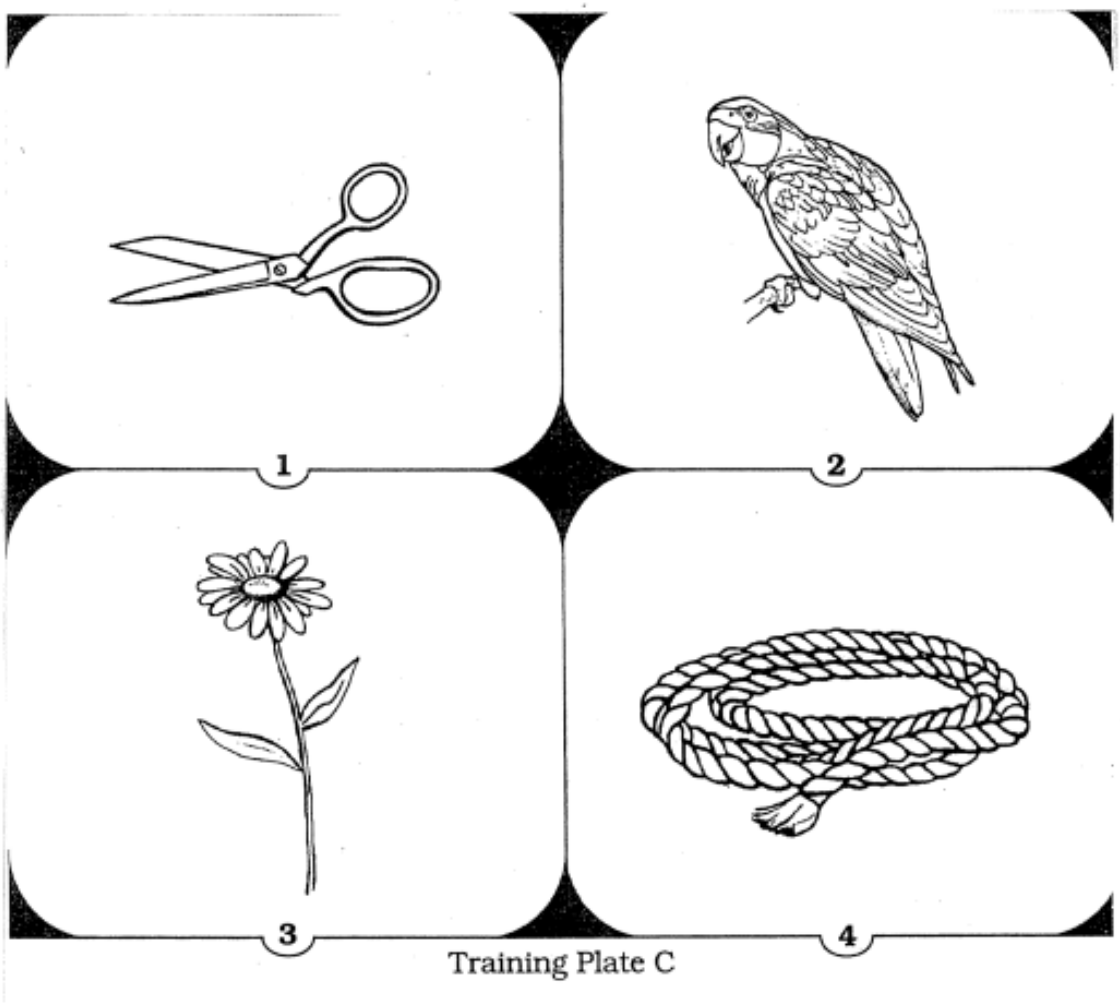
Appendix H

Peabody Picture Vocabulary Test

Read the following directions:

"The next task involves your knowledge of vocabulary. I'm going to show you 4 pictures. They're marked 1, 2, 3 and 4. I'm going to read a word and you'll have to tell me which picture, 1, 2, 3 or 4, best describes that word."

Training plate C: **flower** (picture #3)



Training Plate C

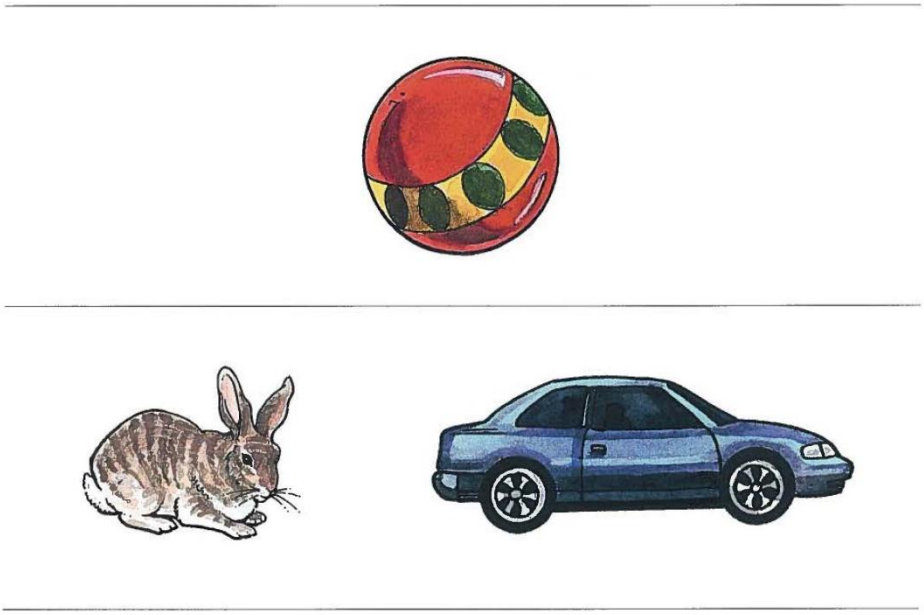
Appendix I

Picture Vocabulary Test

Read the following direction:

"Now I'm going to show you some pictures and I'd like you tell me what those pictures are."

Trial items:



Correct answers: ball, rabbit, car

Appendix J

Passage Comprehension from the Woodcock Johnson III Achievement Test

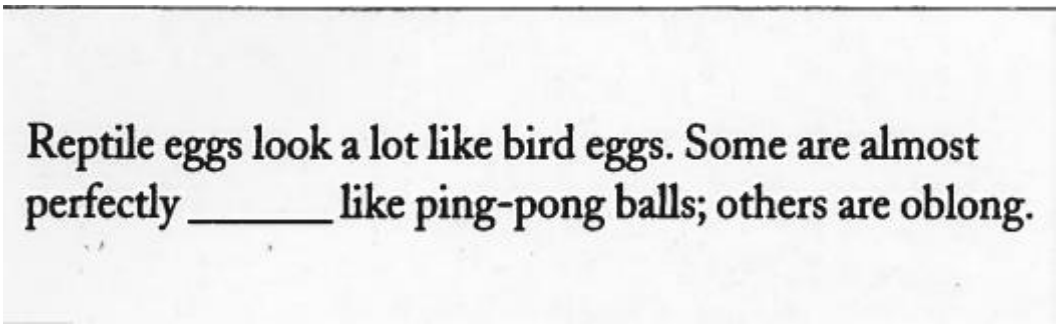
Experimenter: **"Now I'm going to show you some pictures and some sentences about those pictures. There is one word missing from each sentence and I need you to tell me what that word is. I'll read each sentence out loud so you can follow along and then you can tell me the one word that is missing."** Point to the picture on the participant's page and say, **"Look at this picture. The sentence says, 'the house is bigger than the [blank].' Based on this picture** (point to the picture)**, what word belongs in the blank?"**

Item with a picture:

The house is bigger than the _____.

Correct: Answers along the lines of man, woman, person, boy, child, lady, mom

Item without a picture:



Reptile eggs look a lot like bird eggs. Some are almost perfectly _____ like ping-pong balls; others are oblong.

Correct: round(ed), circular, shaped

Incorrect: alike, different, eggs, oval, look, small, white

Appendix K

TOSREC

Test Items

1. A bird can fly. ..... Y N
2. Cats have five legs. ..... Y N
3. Some people have long hair. ..... Y N
4. People have teeth. ..... Y N
5. The sky is always brown and yellow. Y N
6. A clock tells time. ..... Y N
7. The color of grass is red. ..... Y N
8. A school bus has a driver. ..... Y N
9. People like to drink gum. ..... Y N
10. A butterfly has ten wings. ..... Y N
11. A train goes on the road. ..... Y N
12. A banana is to eat. ..... Y N
13. Summer is a season of the year. ..... Y N
14. Ants are very big. ..... Y N
15. A fire is cold. ..... Y N
16. A bus has wings. ..... Y N
17. The color of milk is pink. ..... Y N
18. A flower grows in the sky. ..... Y N
19. A dog may bark at a cat. ..... Y N
20. A room in a house has walls. ..... Y N
21. Golf is a game that some people like to play. ..... Y N
22. June is the month after March. ..... Y N
23. Most dogs can fly over the tops of mountains. ..... Y N
24. Some people like to go swimming on hot days. ..... Y N
25. Most windows are made of glass. ..... Y N
26. A pen is for writing. ..... Y N
27. Monkeys live in fish tanks. ..... Y N
28. An insect may live under a rock. ..... Y N
29. A shoe goes on your head. ..... Y N
30. A frog may swim in a pond. ..... Y N
31. A beach by the ocean may have sand. Y N
32. May is the last day of the week. ..... Y N
33. People sit on their hands at the dinner table. ..... Y N
34. You can see only one color in a rainbow. ..... Y N
35. Cars have four wheels. ..... Y N
36. The sun is smaller than an orange. ..... Y N
37. A bird may build a nest. ..... Y N
38. All mountains are very flat on top. ..... Y N
39. You can drink milk through a straw. .... Y N
40. A map is used to help you find phone numbers. ..... Y N

Go to the next page →

TOSREC Scoring Sheet

Test 2 Reading Fluency

Basal: Item 1
Time Limit: 2 Minutes

Score 1, 0

Time: _____ Minutes _____ Seconds

☐ Number Correct (0-98)

☐ Number Incorrect (0-98)

If not using a stopwatch, record the start and end times in the box below

End Time: _____ Minutes _____ Seconds

-Start Time: _____ Minutes _____ Seconds

= Time: _____ Minutes _____ Seconds

To use the Hand-scoring table, compute Total Points below.

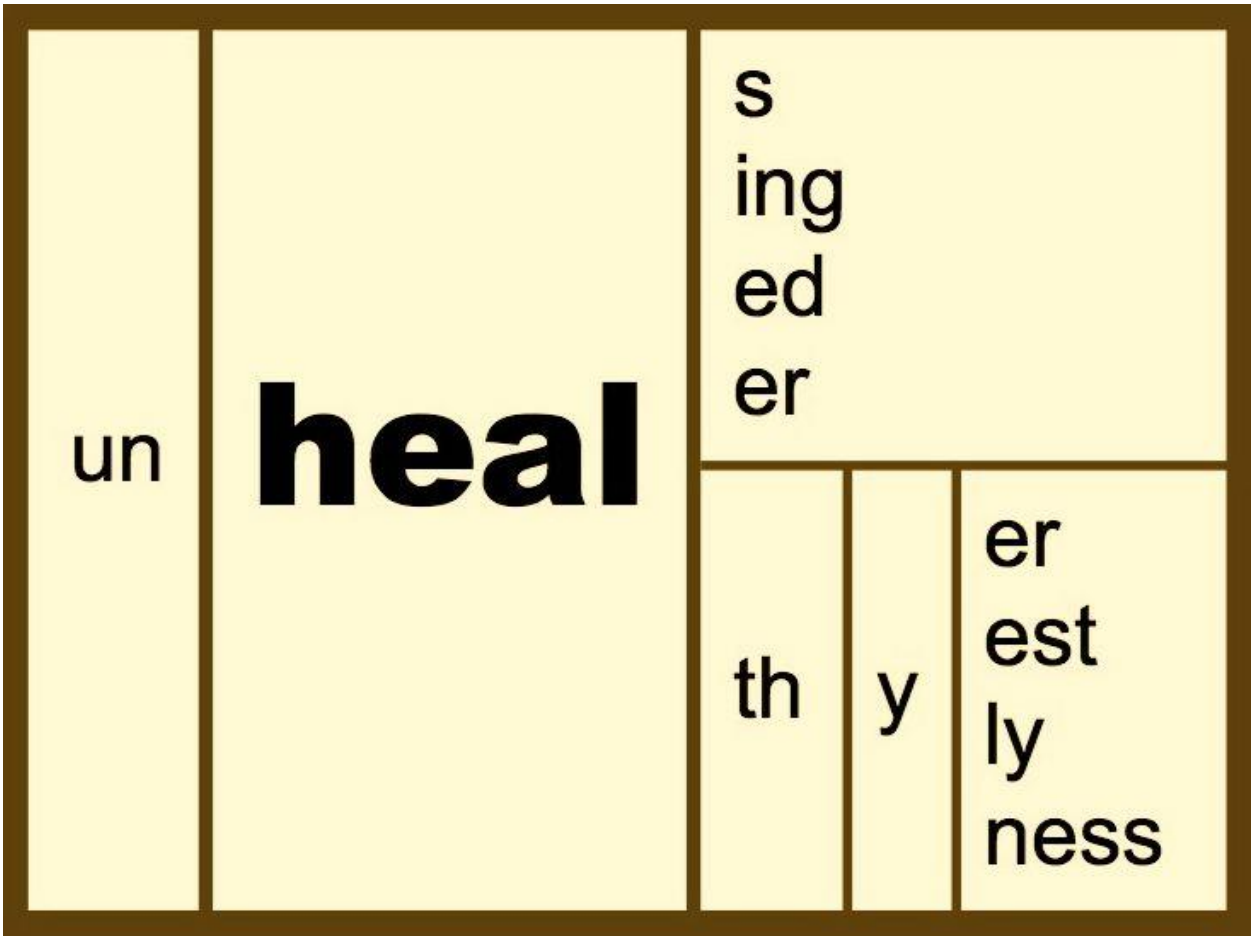
_____ Number Correct - _____ Number Incorrect = _____ Total Points (0-98)

Test 2 Reading Fluency
Scoring Table
Encircle Row for the Total Points

Total Points	*AE (Est)**	*GE (Est)**	Total Points	*AE (Est)**	*GE (Est)**
0	<5-10	<K.7	44	10-5	5.0
1	6-0	K.8	45	10-7	5.2
2	6-3	1.0	46	10-9	5.4
3	6-5	1.1	47	11-0	5.6
4	6-6	1.2	48	11-2	5.8
5	6-7	1.3	49	11-4	6.0
6	6-8	1.4	50	11-7	6.2
7	6-9	1.5	51	11-10	6.4
8	6-10	1.6	52	12-0	6.7
9	6-11	1.6	53	12-3	6.9
10	7-0	1.7	54	12-6	7.1
11	7-1	1.8	55	12-9	7.4
12	7-2	1.8	56	12-11	7.6
13	7-3	1.9	57	13-2	7.9
14	7-3	2.0	58	13-5	8.1
15	7-4	2.0	59	13-8	8.4
16	7-5	2.1	60	14-0	8.7
17	7-6	2.1	61	14-3	8.9
18	7-7	2.2	62	14-6	9.2
19	7-8	2.3	63	14-9	9.4
20	7-8	2.4	64	15-0	9.7
21	7-9	2.5	65	15-4	9.9
22	7-10	2.6	66	15-7	10.2
23	7-11	2.6	67	15-10	10.4
24	8-0	2.7	68	16-2	10.7
25	8-1	2.8	69	16-5	10.9
26	8-2	2.9	70	16-9	11.2
27	8-3	3.0	71	17-1	11.4
28	8-4	3.1	72	17-5	11.7
29	8-5	3.1	73	17-9	11.9
30	8-6	3.2	74	18-1	12.2
31	8-8	3.2	75	18-6	12.5
32	8-9	3.4	76	18-11	12.7
33	8-10	3.5	77	19	13.0
34	9-0	3.6	78	19	13.2
35	9-1	3.7	79	20	13.4
36	9-3	3.8	80	21	13.8
37	9-4	3.9	81	22	14.1
38	9-6	4.1	82	>23	14.6
39	9-7	4.2	83	>23	15.1
40	9-9	4.4	84	>23	15.9
41	9-11	4.5	85	>23	17.2
42	10-1	4.7	>85	>23	>18
43	10-3	4.8			

Appendix L

Word Matrix



REFERENCES

Abadzi, H. (1996). Does Age Diminish the Ability to Learn Fluent Reading? *Educational Psychology Review, 8*(4), 373-395. Retrieved from http://www.jstor.org/stable/23359445

Alavi, S. M., & Akbarian, I. (2013). Comparing the Contribution of Vocabulary Breadth to IELTS and TOEFL Reading Subtests. *Porta Linguarum: revista internacional de didáctica de las lenguas extranjeras, 20*, 135-151.

Beck, I.L., McKeown, M.G., & Kucan, L. (2002). *Bringing words to life*. New York, NY: The Guilford Press.

Binder, K. S., Cote, N. G., Lee, C., Bessette, E., and Vu, H. (2016) Beyond breadth: the contributions of vocabulary depth to reading comprehension among skilled readers. *Journal of Research in Reading*, doi: 10.1111/1467-9817.12069.

Bowers, P. N., Kirby, J. R., & Deacon, S. H. (2010). The effects of morphological instruction on literacy skills: A systematic review of the literature. *Review of Educational Research, 80*(2), 144-179. doi: 10.3102/0034654309359353

Boyes, M. E., Leitao, S., Claessen, M., Badcock, N. A., and Nayton, M. (2016) Why Are Reading Difficulties Associated with Mental Health Problems?. Dyslexia, 22: 263–266. doi: 10.1002/dys.1531.

Carlisle, J. F. (2000). Awareness of the structure and meaning of morphologically complex words: Impact on reading. *Reading & Writing, 12*(3), 169-190.

Carlisle, J. F. (2003). Morphology matters in learning to read: A commentary. *Reading Psychology*, 24. 291–332.

Carlisle, J. F., & Nomanbhoy, D. M. (1993). Phonological and morphological awareness in first graders. *Applied Psycholinguistics, 14*(2), 177-195. doi: 10.1017/S0142716400009541

Carlisle, J. F., & Stone, C. A. (2005). Exploring the role of morphemes in word reading. Reading Research Quarterly, 40, 428–449.

Carlo, M. S., August, D., Barry, M., Snow, C. E., Cheryl, D., David N., L., & ... Claire E., W. (2004). Closing the Gap: Addressing the Vocabulary needs of English-Language Learners in Bilingual and mainstream classrooms. *Reading Research Quarterly*, *39*, 188-215.

Coyne, M., McCoach, D., & Kapp, S. (2007). Vocabulary intervention for kindergarten students: Comparing extended instruction to embedded instruction and incidental exposure. *Learning Disability Quarterly, 30*(2), 74–88. (ERIC Document Reproduction Service No. EJ786232). Retrieved August 18, 2009, from ERIC database.

Deacon S. H., Kirby J. R. (2004). Morphological awareness: Just "more phonological"? The roles of morphological and phonological awareness in reading development. *Applied Psycholinguistics*, 25, 223–238.

Denton, C. A., Barth, A. E., Fletcher, J. M., Wexler, J., Vaughn, S., Cirino, P. T., … Francis, D. J. (2011). The Relations Among Oral and Silent Reading Fluency and Comprehension in Middle School: Implications for Identification and Instruction of Students With Reading Difficulties. *Scientific Studies of Reading : The Official Journal of the Society for the Scientific Study of Reading*, *15*(2), 109–135. http://doi.org/10.1080/10888431003623546

DeWalt, D.A., Berkman, N.D., Sheridan, S., Lohr, K.N., & Pignone, M.P. (2004). Literacy and health outcomes. *Journal of General Internal Medicine, 19,* 1228-1239.

Dunn, L. M. & Dunn, L. M. (1997). *Peabody Picture Vocabulary Test*, 3rd edition. Circle Pines, MN: American Guidance Service.

Fracasso, L. E., Bangs, K., & Binder, K. S. (2016). The Contributions of Phonological and Morphological Awareness to Literacy Skills in the Adult Basic Education Population. *Journal of Learning Disabilities*, 49(2), 140-151.

Garson, D. G. (2008). ***Factor Analysis: Statnotes***. Retrieved March 22, 2008, from North Carolina State University Public Administration Program, http://www2.chass.ncsu.edu/garson/pa765/factor.htm.

Goodman, M., Finnegan, R., Mohadjer, L., Krenzke, T., and Hogan, J. (2013). *Literacy, Numeracy, and Problem Solving in Technology-Rich Environments Among U.S. Adults: Results from the Program for the International Assessment of Adult Competencies 2012: First Look* (NCES 2014-008). U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved [date] from http://nces.ed.gov/pubsearch.

Greenberg, D., Ehri, L. C., & Perin, D. (2002). Do adult literacy students make the same word-reading and spelling errors as children matched for word-reading age? *Scientific Studies of Reading, 6*(3), 221-244.

Grotlüschen, A., et al. (2016), "Adults with Low Proficiency in Literacy or Numeracy", ***OECD Education Working Papers***, No. 131, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/5jm0v44bnmnx-en

Hall, R., Greenberg, D., Gore, J. L., & Pae, H. K. (2014). The Relationship Between Expressive Vocabulary Knowledge and Reading Skills for Adult Struggling Readers. *Journal of Research in Reading, 37*(Suppl 1), 87–100. http://doi.org/10.1111/j.1467-9817.2012.01537.x

Herman, J., Cote, N. G., Reilly, L., & Binder, K. S. (2013). Literacy Skill Differences between Adult Native English and Native Spanish Speakers. *Journal of Research and Practice for Adult Literacy, Secondary, and Basic Education*, *2*(3), 147–.

Holzer H. J. and Lerman R. I. (2015). *Cognitive Skills in the U.S. Labor Market: For Whom Do They Matter?* Retrieved 05/02/2017, from static1.squarespace.com

King, A. (2010). Poor health literacy: A 'hidden' risk factor. , *Nature Reviews Cardiology* **7**, 473-474. doi:10.1038/nrcardio.2010.122. Retrieved May 02, 2017, from http://www.nature.com/nrcardio/journal/v7/n9/full/nrcardio.2010.122.html

Kieffer, M. J. and Lesaux, N. K. (2012), Direct and Indirect Roles of Morphological Awareness in the English Reading Comprehension of Native English, Spanish, Filipino, and Vietnamese Speakers. Language Learning, 62: 1170–1204. doi:10.1111/j.1467-9922.2012.00722.x

Kutner M., Greenberg E., Baer J. (2005). National Assessment of Adult Literacy (NAAL): A first look at the literacy of America's adults in the 21st century. U.S. Department of Education; Washington, DC: National Center for Education Statistics; 2005. (NCES 2006-470) http://nces.ed.gov/NAAL/PDF/2006470.PDF. Retrieved on October 27, 2008.

Kutner M., Greenberg E., Jin Y., Boyle B., Hsu Y., Dunleavy E., White S. (2007) Literacy in everyday life: Results from the 2003 National Assessment of Adult Literacy. U.S. Department of Education; Washington, DC: National Center for Education Statistics. (NCES 2007–480) http://nces.ed.gov/Pubs2007/2007480.pdf. Retrieved on October 27, 2008.

Kruidenier J. (2002) Research-based Principles of Adult Basic Education Reading Instruction. Washington, DC: National Institute for Literacy; 2002.

MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). *Sample size in factor analysis*. Psychological Methods, 4, 84-99.

Mahony D. L. (1994). Using sensitivity to word structure to explain variance in high school and college level reading ability. *Reading and Writing: An Interdisciplinary Journal*, *6*, 19-44.

Miao Li, & Kirby, J. R. (2015). The effects of vocabulary breadth and depth on English reading. *Applied Linguistics*, *36*(5), 611-634.

Miller, T. A. (2016). Health literacy and adherence to medical treatment in chronic and acute illness: A meta-analysis. *Patient education and counseling*, 99(7), 1079-86. doi: 10.1016/j.pec.2016.01.020.

Nagy, W. E., & Anderson, R. C. (1984). How many words are there in printed school English? *Reading Research Quarterly*, **19**, 304–330.

Nagy, W., Berninger, V., & Abbott, R. (2006). Contributions of morphology beyond phonology to literacy outcomes of upper elementary and middle-school students. *Journal of Educational Psychology*, *98*(1), 134-147.

Nagy, W. & Herman, P. (1987). Breadth and Depth of Vocabulary Knowledge: Implications for Acquisition and Instruction. In McKeown M. G., & Curtis M. E. (Eds.), The nature of vocabulary acquisition (pp. 19–35). New York, NY: Psychology Press.

Nation, I. S. (2001). *Learning vocabulary in another language*. Ernst Klett Sprachen.

National Center for Education Statistics. National Assessment of Adult Literacy. Washington DC: US Department of Education; 2003.

Nelson, J. R., & Stage, S. A. (2007). Fostering the Development of Vocabulary Knowledge and Reading Comprehension Though Contextually-Based Multiple Meaning Vocabulary Instruction. Education and Treatment of Children, (1). 1.

Nunes, T., Bryant, P., & Olsson, J. (2003). Learning morphological and phonological spelling rules: An intervention study. *Scientific Studies of Reading, 7*(3), 289-307. doi:10.1207/S1532799XSSR0703_6

Nurweni, A. J. (1998, November 30). The English Vocabulary Knowledge of Indonesian University Students. Retrieved May 03, 2017, from https://eric.ed.gov/?id=EJ577545

OECD (2013), *Time for the U.S. to Reskill? : What the Survey of Adult Skills Says*, OECD Skills Studies, OECD Publishing. http://dx.doi.org/10.1787/9789264204904-en

Ouellette, G. (2006). What's meaning got to do with it: The role of vocabulary in word reading and reading comprehension. *Journal of Educational Psychology, 98*(3), 554-566. doi:10.1037/0022-0663.98.3.554

Ouellette, G., & Beers, A. (n.d). A not-so-simple view of reading: how oral vocabulary and visual-word recognition complicate the story. *Reading And Writing*, 23(2), 189-208.

Ouellette, G., & Shaw, E. (2014). Oral vocabulary and reading comprehension: An intricate affair. *L'Année psychologique, 114*, 623-645. doi:10.4074/S0003503314004023.

Pankratz, M., Morrison, A., & Plante, E. (2004). Difference in standard scores of adults on the Peabody Picture Vocabulary Test (Revised and Third Edition). *Journal of Speech, Language, and Hearing Research, 47*, 714-718.

Perfetti, C. A., Landi, N. and Oakhill, J. (2005) The Acquisition of Reading Comprehension Skill, in The Science of Reading: A Handbook (eds M. J. Snowling and C. Hulme), Blackwell Publishing Ltd, Oxford, UK. doi: 10.1002/9780470757642.ch13

Place. (n.d.). In *Online Cambridge Dictionary*. Retrieved from http://dictionary.cambridge.org/us/dictionary/english/place

Proctor, C. P., Silverman, R. D., Harring, J. R., & Montecillo, C. (2012). The Role of Vocabulary Depth in Predicting Reading Comprehension among English Monolingual and Spanish-English Bilingual Children in Elementary School. *Reading and Writing: An Interdisciplinary Journal, 25*(7), 1635-1664.

Qian, D.D (1999). Assessing the Roles of Depth and Breadth of Vocabulary Knowledge in Reading Comprehension. *The Canadian Modern Language Review, 56*(2), 282-307.

Quinn, J. M., Wagner, R. K., Petscher, Y., & Lopez, D. (2015). Developmental relations between vocabulary knowledge and reading comprehension: A latent change score modeling study. *Child Development, 86*(1), 159-175. doi:10.1111/cdev.12292

Richard, J.P.J. (2011). Does size matter? The relationship between vocabulary breadth and depth. *Sophia International Review*, 33, 107-120.

Schaefer, C. T. (2008). Integrated review of health literacy interventions. *Orthopaedic Nursing*, *27*(5), 302-317.

Shen, Z. (2009). The roles of depth and breadth of vocabulary knowledge in EFL reading performance. *Asian Social Science, 4*(12), 135.

Singson, M., Mahony, D. & Mann, V. (2000). The relation between reading ability and morphological skills: Evidence from derivational suffixes. *Reading and Writing: An Interdisciplinary Journal ,12*, 219-252. doi:10.1023/A:1008196330239

Stahl, S., & Nagy, W. (2006). *Teaching word meanings.* Mahwah, NJ: Lawrence Erlbaum Associates.

Steele, S. C., & Mills, M. T. (2011). Vocabulary Intervention for School-age Children with Language Impairment: A Review of Evidence and Good Practice. *Child Language Teaching and Therapy*, *27*(3), 354–370. http://doi.org/10.1177/0265659011412247

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, *2*, 53–55. http://doi.org/10.5116/ijme.4dfb.8dfd

Tannenbaum, K.R., Torgesen, J.K. & Wagner, R.K. (2006). Relationships between word knowledge and reading comprehension in third grade children. *Scientific Studies of Reading, 10,* 281-298.

Thompkins, A. C., & Binder, K. S. (2003). A comparison of the factors affecting reading performance of functionally illiterate adults and children matched by reading level. *Reading Research Quarterly*, *38*(2), 236-258. doi:10.1598/RRQ.38.2.4

Tighe, E. L., & Binder, K. S. (2014). An investigation of morphological awareness and processing in adults with low literacy. *Applied Psycholinguistics*. Advance online publication. doi:10.1017/S0142716413000222

Tighe, E. L., & Schatschneider, C. (2016). Modeling the Relations Among Morphological Awareness Dimensions, Vocabulary Knowledge, and Reading Comprehension in Adult Basic Education Students. *Frontiers in Psychology*, *7*, 86. http://doi.org/10.3389/fpsyg.2016.00086

To, N. L., Tighe, E. L., & Binder, K. S. (2016). Investigating morphological awareness and the processing of transparent and opaque words in adults with low literacy skills and in skilled readers. *Journal of Research in Reading*, *39*(2), 171–188. http://doi.org/10.1111/1467-9817.12036

Tong, X., Deacon, S. H., Kirby, J. R., Cain, K., & Parrila, R. (2011). Morphological awareness: A key to understanding poor reading comprehension in english. *Journal of Educational Psychology, 103*(3), 523-534. doi: 10.1037/a0023495

Tyler, A., & Nagy, W. E. (1989). The acquisition of English derivational morphology. *Journal of Memory and Language, 28,* 649–667.

Tyler, A., & Nagy, W. E. (1990). Use of derivational morphology during reading. *Cognition, 36,* 17–34.

van Gelderen, A., Schoonen, R., de Glopper, K., Stoel, R. D., & Hulstijn, J. (2007). Development of adolescent reading comprehension in language 1 and language 2: a longitudinal analysis of constituent components. *Journal Of Educational Psychology,* (3), 477.

van Steensel, R., Oostdam, R., van Gelderen, A., & van Schooten, E. (2016). The role of word decoding, vocabulary knowledge and meta-cognitive knowledge in monolingual and bilingual low-achieving adolescents' reading comprehension. *Journal Of Research In Reading, 39*(3), 312-329. doi:10.1111/1467-9817.12042.

Verhoeven, L., & Van Leeuwe, J. (n.d). Prediction of the development of reading comprehension: A longitudinal study. *Applied Cognitive Psychology*, 22(3), 407-423.

Wagner, R.K., Torgesen, J.K., Rashotte, C.A., & Pearson, N.A. (2010). *Test of silent reading efficiency and comprehension*. Austin, TX; Pro-ED, Inc.

Wiig, E.H. & Secord, W.A. (1992). *Test of Word Knowledge.* San Antonio, TX: The Psych Corporation.

Wolf M. (1991) The word-retrieval hypothesis and developmental dyslexia. *Learning and Individual Differences*. 3(3):205–223. doi: 10.1016/1041-6080(91)90008-O

Wolf M, Obregon M. (1992) Early naming deficits, developmental dyslexia and a specific deficit hypothesis. *Brain and Language*. 42:219–247. doi: 10.1016/0093-934X(92)90099-Z.

Woodcock, R. W., Dr., McGrew, K. S., Dr., & Mather, N., Dr. (2001) *The Woodcock-Johnson Test of Achievement-Third Edition*. Itasca, IL: Riverside Publishing.