

EXAMINING INCIDENTAL VOCABULARY ACQUISITION BY  
PERSON- AND ITEM-LEVEL FACTORS IN SECONDARY STUDENTS

by

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## ABSTRACT

Vocabulary knowledge is central to the process of reading comprehension (Cromely & Azevedo, 2007; Stahl & Nagy, 2005; Stanovich, 1986). The majority of our vocabulary knowledge is postulated to come from the process of incidental vocabulary acquisition (IVA) while reading (Nagy & Anderson, 1984). Prior studies have estimated an average probability of acquisition of 15% (Swanborn & de Glopper, 2000). Differential rates of acquisition for struggling readers have been demonstrated (Herman, 1985). Rates of acquisition may be influenced by manipulating the frequency of exposure during reading and the presence of morphologically complex words in a text. Morphologically complex words may be more easily acquired because the reader is familiar with some morphemes in the word and uses this knowledge to assist in determining the meaning of an unknown word containing any known morpheme (McBride-Chang, Wagner, Muse, Chow, & Shu, 2005). Multi-level item response crossed-random effects modeling statistical techniques allow a closer investigation into the person and word level factors that influence IVA which may provide clarification of which item-level factors (i.e., the number of contextual exposures and morphological complexity) and person-level factors (i.e., reading comprehension, vocabulary knowledge, basic reading skills, working memory, print exposure, and morphological awareness and analysis) (Cho, Partchev, & De Boeck, 2012). This study examined the influence of number of contextual exposures and morphological complexity of words as text level factors and the influence of general reading ability, vocabulary knowledge, working memory, and morphological awareness as person-level factors in a sample of 9<sup>th</sup> and 10<sup>th</sup> grade students ( $n = 78$ ). Significant

findings for item-level factors of exposure and person-level factors of reading comprehension, morphological awareness, and vocabulary were found as well as interactions between the number of exposures and reading comprehension ability.

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## CHAPTER ONE

### INTRODUCTION

Vocabulary knowledge is central to the process of reading comprehension. Vocabulary knowledge is an intrinsic component of reading comprehension theories (e.g., Gernsbacher, 1990; Kintsch, 1988; Tunmer & Chapman, 2012). This relationship has been examined in multiple studies (e.g., Cromely & Azevedo, 2007; Kendeou, Savage, & van den Broek, 2009; Stahl & Nagy, 2005; Stanovich, 1986; Tannenbaum, Torgesen, & Wagner, 2009), and vocabulary knowledge has repeatedly been demonstrated to influence comprehension (Elleman, Lindo, Morphy, & Compton, 2009). The importance of vocabulary knowledge in reading comprehension increases over the course of a student's education ultimately accounting for more variance in reading comprehension than either decoding or background knowledge by the time students reach high school (Cromley and Azevedo, 2007). While vocabulary knowledge is not a sufficient condition for reading comprehension, it is a necessary component of the comprehension processing. Vocabulary knowledge acts as a governor for comprehension processes when vocabulary knowledge is inadequate (Perfetti, 2007; Perfetti & Stafura, 2014).

Vocabulary knowledge is a multi-dimensional construct which is often construed as a multi-nodal network in the connectionist model of vocabulary growth (Adams, 1990; Atchison, 2012; Stahl, 1990; Schwanenflugel, Stahl, & McFalls, 1997; Vemeer, 2001). This network represents vocabulary breadth and depth. Vocabulary breadth is size of vocabulary represented in this network model by the number of nodes present, and

vocabulary depth is the completeness of vocabulary knowledge of individual words represented by the number of connections each node possesses. Vocabulary knowledge is an unconstrained skill that develops incrementally and continues to improve both in breadth and depth over the course of one's lifetime (Paris, Carpenter, Paris, & Hamilton, 2005). Word knowledge varies along the continuum with lack of knowledge or even awareness of the word's existence towards one extreme and fully fleshed-out word representation, including aspects of word knowledge such as formal definition, contextual occurrence, frequent collocates, and syntactic information (Beck, McKeown, & Kucan, 2002; Vemmer, 2001). As unknown words are initially encountered, partial word knowledge is obtained. Orthographic information and perhaps some semantic meaning may be ascertained depending on the richness of the context (Stahl, 1990). With repeated exposures, more complete word knowledge is formed; stronger or more abundant nodal network connections are formed, which represent many aspects of word knowledge: syntax, semantics, phonology, orthography, related words, associated contexts, and connotative information (Schwanenflugel et al., 1997).

### **The Nature of Vocabulary Growth**

It has been argued that growth in vocabulary knowledge occurs in a relatively predictable pattern (Biemiller, Rosenstein, Sparks, Landauer, & Foltz, 2014). Young children begin uttering their first words around 12 months of age and adding to their vocabulary at approximately one word per week until they possess approximately 50 -100 words in their mental lexicon (O'Grady, 2005). Once this breadth of vocabulary knowledge is achieved, children experience a dramatic increase in word acquisition of

approximately 10 words per day (O'Grady, 2005). This rate of growth continues, and children typically enter into formal education with an approximate vocabulary of 3000 words (Vemeeer, 2001). Of course, the vocabulary acquired up to the point of formal reading instruction is largely, if not completely, acquired through listening. Once children are in the school environment, reading becomes an important source of new vocabulary growth, and the vocabulary growth rate surges again to approximately 20 words per day or 3000 words per year (Nagy, Anderson, & Herman, 1987; O'Grady, 2005). Fast mapping is one mechanism for this rapid expansion in vocabulary knowledge (Carey & Barlett, 1978; Heibeck & Markman, 1987).

Fast mapping is a process of word learning in which existing knowledge is used to eliminate competition for word meaning. When an unknown word is encountered, a hypothesis of word meaning is quickly formed (Carey & Bartlett, 1978). Word meaning of a novel word is constrained by existing word knowledge. For example, if presented with a picture of a dog, a cat, and a *loris*, a child who had never encountered a *loris* before would still be likely to assign the word *loris* to the correct animal picture because of prior representations of cats and dogs. Categorical, syntactic, and semantic information may developed through fast mapping (Heibeck & Markman, 1987). However, fast mapping alone is insufficient to account for all vocabulary growth in part because of the polysemous nature of vocabulary words and the ambiguity of context (Trueswell, Medina, Hafri, & Gleitman, 2012). Novel word encounters are not always clear as the example of the *loris* above, so other processes must provide the growth necessary to

achieve normal levels of vocabulary knowledge, such as multiple encounters in varied contexts over time where semantic knowledge is constructed (Perfetti, 2007).

Estimates of vocabulary knowledge breadth by the time a student reaches high school approach 16,000 words (Nagy et al., 1987). Alternate estimates based on root word acquisition are slightly more conservative with estimates reaching 8,400 root words by 5<sup>th</sup> grade and increasing by 2.9 words per day (Biemiller, & Slonim, 2001). However, each of the root words known by students represents knowledge of several additional related words, so these estimates may be closer in absolute size than indicated by the estimates. It is unlikely that even the most conservative of these rates of acquisition occur as a result of rich vocabulary instruction due to the time constraints required by such instruction.

Effective vocabulary instruction is time intensive, requiring many hours of instruction to achieve well developed vocabulary knowledge of a small amount of words (Beck, McKeown, Omanson & Pople, 1985). A substantial portion of vocabulary knowledge is presumed to be acquired through wide reading (Nagy & Anderson, 1984; Perfetti, 2007; Stanovich, 1986). Incidental vocabulary acquisition (IVA) refers to the implicit knowledge gained about unknown vocabulary through normal reading without the intention to gain this knowledge (Nagy, Herman, & Anderson, 1985; Swanborn & de Glopper, 1999).

The positive reciprocal relationship between reading and vocabulary knowledge has been well documented across multiple research studies (e.g., Beck et al., 2002; Cain & Oakhill, 2011; Cromley & Azevedo, 2007; Joshi, 2005; Stanovich, 1986, Tunmer &

Chapman, 2012). The lexical quality hypothesis provides one explanation for this phenomenon (Perfetti, 2007). Lexical quality is comprised of four word properties: orthography, phonology, syntax, and semantics. A higher quality of representation of each of these individual properties as well as how tightly this information is bound together referred to as constituent binding, results in a reduction in processing demands.

When a word is ‘known’, the reader has a high quality, stable representation of the word. This stable representation reduces the demand on cognitive resources required to access semantic meaning and may facilitate comprehension by allowing greater resources to be utilized in comprehension processes. Thus, the lexical quality possessed by a reader for any given word has the potential to affect comprehension (Perfetti, 2007). Increased reading volume increases a reader’s opportunities to increase the quality of the representation of a word.

The relationship between poor reading comprehension and reduction in word learning has also been demonstrated in multiple studies (Cain, Oakhill, & Elbro, 2003; Cain, Oakhill, & Lemmon, 2004). Poor readers acquire vocabulary at lower rates through wide reading than average and above average readers (Herman, 1985). IVA rates increase with increases in numbers of contextual exposures in average readers (Jenkins, Stein, & Wysocki, 1984). Providing additional exposures to poor readers may help compensate for reduced acquisition rates as multiple encounters may allow readers to consolidate semantic information and develop higher quality lexical representations (Perfetti, 2007). Other factors may contribute to this process as well, such as richness of context (Beck,



McKeown, & McCaslin, 1983) and reader's morphological awareness (MA; Durkin, 1990; McBride-Chang et al., 2005).

### **The Role of Morphological Awareness in Incidental Vocabulary Acquisition**

Morphological awareness is an individual's cognizance of the existence of words morphemic components and ability to intentionally manipulate morphemes to create words (Carlisle, 2000). Similar to the vocabulary knowledge network described above, one of the underlying theories of morphological knowledge is that morphological knowledge is organized by a multi-nodal network of information with internodal connections representing multiple features: phonology, syntax, orthography, and semantic information (Bybee, 1985). In the network, nodes represent words and word parts and patterns of occurrence (i.e., frequency) develop the strength and density of nodal connections. Morphological knowledge allows the reader to decode new words and infer meaning of unfamiliar morphologically complex words through analysis of constituent parts and assignation of syntactic information to new words (Berko, 1958; Brown, 1973; Cazden, 1968; Nagy, Carlisle, & Goodwin, 2014). Morphological knowledge encompasses morphological awareness and morphological processing (Nagy et al., 2014).

Research has well established that very young children have already begun to develop and internalize the ability to apply morphological rules to new words, including altering inflectional endings, deriving new forms of novel words based on existing rules, compounding of new words as well as analyzing new compound words to evaluate their constituent parts (Berko, 1958). Morphologically complex words provide syntactic

information about the word as well as supplying partial meaning to part of the word (Brown, 1973). A reader's morphological awareness of grammatical morphemes has the potential to influence a reader's understanding of a large number of words, and since readers encounter increasing amounts of morphologically complex words as they progress through grade levels, morphological awareness may become increasingly important to the role of incidental vocabulary acquisition (Nagy & Anderson, 1984). Specifically, Morphological awareness and morphological analysis may allow the reader to generate more or more accurate meanings of unknown words. It has been proposed that the mental lexicon is organized on morphemes which suggest morphologically based words may be easier to learn (Kuo & Anderson, 2004). Morphological awareness has also been linked with reading comprehension.

MA has also been linked to reading comprehension in several studies (e.g., Carlisle, 2000; Deacon & Kirby, 2004; Nagy, Berninger, & Abbott, 2006; Tong, Deacon, Kirby, Cain, & Parrila, 2011; Nagy et al., 2014). The quality of morpheme representations is also linked to the lexical quality hypothesis (Perfetti, 2007; Reichle & Perfetti, 2003). The stable representations of word parts may facilitate comprehension and vocabulary acquisition. The maintenance of consistent orthography of word part representations indicates higher lexical representations. For example, morpho-syntactic inflections are an integral part of word knowledge in combination with meaning of related words and word parts (Perfetti, 2007).

Morphological processing is the underlying, largely unconscious, use of morphological knowledge in speech production and reading comprehension.

Morphological knowledge begins to develop as part of language processing of children. An example of the development of morphological knowledge in very young children is demonstrated in the generalization of plural and past tense verbs (O'Grady, 2005). Very young children pick up on the morphological regularities of spoken language, perhaps through statistical learning processes (Arciuli & Simpson, 2011). Young children maintain the regular structure in use with irregular words. For example, young children often produce 'mans' instead of men. This continues until the irregular forms are observed frequently enough for implicit knowledge of irregular forms to develop. Morphological knowledge continues to increase as children progress into formal reading instruction.

Increases in morphological knowledge have been demonstrated through upper elementary into middle school years (Nagy & Anderson, 1984). Ultimately, morphological knowledge becomes a larger contributor to later success in literacy outcomes than even phonological awareness (Nagy et al., 2006; Nagy et al., 2013). Morphological knowledge becomes increasingly important as students advance into higher grade levels in school because they encounter increasingly difficult texts. These texts include unfamiliar words, and 60% of those unfamiliar words are morphologically complex words that routinely occur in academic language and texts (Nagy & Anderson, 1984). Stable morphological knowledge of orthography (e.g., knowledge of the written form of the suffix morpheme *-tion*), phonology (i.e., knowledge of the sound(s) associated with the morpheme and its various forms, such as *co-*, *con-*, and *com-* which changes depending on the sounds it precedes) and semantics (e.g., *ex-* means 'out or

former’) allows the reader to process the words at the morpheme level (i.e., chunking) which results in decreased burden on working memory resources.

Morphologically complex words may be more easily acquired incidentally through reading than non-morphologically based words because readers may already ‘own’ components of the morphologically complex words and use this information to infer the meaning of remaining word parts (Carlisle & Fleming, 2003). This process has been referred to as ‘morphological generalization’ (Wysocki 1986; Wysocki & Jenkins, 1987), ‘morphological analysis’ (McCutcheon & Logan, 2011), ‘morphological problem solving’ (Anglin, 1993), and ‘lexical decomposition strategy’ (Kaye, Sternberg, & Fonseca, 1987). Additionally, readers with higher morphological awareness may excel at deducing the meaning of morphologically complex words more than readers with impaired morphological awareness. Skilled readers develop more stable orthographic and semantic representations of words, word parts and related words (Perfetti, 2007; Reichle & Perfetti, 2003). Less skilled readers may have less stable representations of morphemes, and thus, they may be less able to utilize morpheme level information in morphological analysis (Nagy, Berninger, Abbott, Vaughn, & Vermeulen, 2003). Studies have demonstrated improving morphological awareness through instructional intervention with positive outcomes for literacy (see Carlisle and Goodwin (2013) for a review).

### **The Role of Context in Incidental Vocabulary Acquisition**

The context within which a word appears is also a factor in incidental vocabulary acquisition. Research has demonstrated that words are best acquired through multiple

encounters in a rich context (Gipe, 1980, Beck, et al., 1983). Rich context facilitates the process of fast mapping (Axelsson & Horst, 2014). However, all contexts do not provide equal amounts of information about target words. According to Beck et al. (1983), contexts may be directive, general, nondirective, or misdirective, and each context type provides vastly different levels of support.

According to Beck et al. (1983), directive contexts are the most supportive of vocabulary acquisition. These contexts provide enough information for the reader to determine or derive meaning, often supplying a direct explanation of unknown words. Directive contexts occur most often in instructional materials where the emphasis is the acquisition of knowledge (i.e., textbooks, basal readers, etc.) (Beck et al., 1983).

Nondirective, general and misdirective contexts occur in authentic texts, such as newspaper articles or novels. Nondirective contexts typically do not provide enough information for the reader to determine meaning of an unknown word. For example: The realtor drove the couple to the home. They parked in the driveway, exited the vehicle, and walked up the path to the front door. The walkway led to the entrance of the *austere* house. The context that precedes *austere* does not provide enough information to determine the words meaning.

General contexts may provide some information about word meaning, though the reader may not be able to infer a complete meaning for an unknown word. For example: Martin's *loquacious* nature led to the development of many friendships. Here, the reader is likely to infer that *loquacious* represents a characteristic often found in friendly people.

The reader is less likely to infer the complete definition (i.e., talkative) from the context provided.

Misdirective contexts provide the least information to the reader. Misdirective contexts present information that leads readers to an erroneous conclusion of word meaning; for example, the statement, “Ben, who was famous for his avarice, donated his entire estate to the charity,” could lead a reader to conclude *avarice* means charitable. Even experienced adult readers may easily incorrectly infer the meaning of *avarice*, if unknown, without further contextual information (Beck et al., 1983).

### **The Role of Contextual Exposures in Incidental Vocabulary Acquisition**

The ideas of lexical quality (Perfetti, 2007), semantic networks (Adams, 1990), and morphological networks (Bybee, 1985) discussed above are interrelated by their reliance on frequency of exposure as well as co-occurrence as a source of knowledge building. Increased encounters with a word or word part leads to the development of higher quality of lexical representations (Perfetti, 2005) and a greater number of semantic or morphologic nodal connections (Vermeer 2001; Bybee & McClelland, 2005). Increased exposure also results in greater integration of knowledge and efficiency in performance, specifically access and use of knowledge (Bybee, 2006; Bybee & McClelland, 2005). Statistical learning may be the common underpinning of each of these theories of semantic knowledge.

Statistical learning is the implicit learning that occurs based on recognition of patterns encountered and consolidation of this input (Romberg & Saffran, 2010).

Statistical learning has been demonstrated in many aspects of language acquisition in

infants, including acquisition of syllable combinations, grammatical word order, and abstract relationships (Gomez & Gerken, 2000). Statistical learning in word meaning acquisition has been established in both infants (e.g., Estes, Evans, Alibali, & Saffran, 2007; Werker, Cohen, Lloyd, Casasola, & Stager, 1998) and adult learners (e.g., Vouloumanos, 2008; Yu & Smith, 2007). It has been suggested that cross-situational statistical learning underlies the process of fast mapping (Rueswell, Medina, & Gleitman, 2013). Recently, it has been proposed that statistical learning is the driving force behind the development of morphological knowledge in general (Deacon, Conrad, & Pacton, 2008). Readers attend to the frequency and conditional probabilities of word part meaning, orthography, and phonology as they also attend to whole word meaning, spelling, and pronunciation (Reichle & Perfetti, 2003).

### **The Role of Reader Characteristics in Incidental Vocabulary Acquisition**

Due to the positive reciprocal relationships between vocabulary knowledge and reading comprehension ability (Cromely & Azevedo, 2007; Kendeou, Savage, & van den Broek, 2009; Stahl & Nagy, 2005; Stanovich, 1986; Tannenbaum, Torgesen, & Wagner, 2009), the processes of incidental vocabulary acquisition should also be examined through the lens of reading ability. Previous research has demonstrated less skilled readers are less able to infer the meaning of unknown words from context and thus acquire vocabulary at lower rates than more skilled readers (Cain et al., 2003; Cain et al., 2004; Herman, 1985).

McKeown (1985) described acquisition as a search for stable word meaning. Upon an encounter with an unknown word, the word's status as 'unknown' must first be

identified by the reader. Subsequently, the reader examines the surrounding context to attempt to determine a plausible meaning. This process continues through multiple iterations (i.e., encounters with the word in context) until a fully developed meaning is created by refinements and corrections from contextual information. This suggests that if a fully representative definition were presented to the reader at the time of initial encounter, it should eliminate additional contextual encounters or at least reduce the number of contextual encounters necessary to consolidate semantic meaning of a new word. However, research has demonstrated low ability readers are unable to fully capitalize on contextual information to form well consolidated semantic representations of unknown words. Differences between low and high ability readers in vocabulary acquisition have been demonstrated in multiple studies (e.g., Bonacci, 1993; Cain et al., 2003; Cain et al., 2004; Herman, 1985, McKeown, 1985; Yang & Perfetti, 2006 as reported in Perfetti, 2007). Low ability readers are less able to extract the necessary contextual information and consolidate meaning of words. It may be that the mechanism of statistical learning may be hampered by reduced cognitive processing abilities, such as working memory, in some readers (Gomez & Gerken, 2000).

The need for research on word and reader features and the relative contributions of each to incidental vocabulary to further clarify this relationship are indicated. The purpose of this study was to examine the relative contributions of both item-level factors (i.e., morphological complexity and number of exposures) and person-level factors (i.e., basic reading skills, reading comprehension ability, vocabulary knowledge, working memory, morphological awareness and analysis, and print exposure) using recent



statistical techniques (i.e., an exploratory IRT approach of crossed random-effects modeling) in order to contribute new information to the existing body of research.

## CHAPTER TWO

### REVIEW OF LITERATURE

In summation, vocabulary knowledge is a crucial component of reading comprehension. Vocabulary knowledge acts as a governor on the process of reading comprehension. Vocabulary knowledge and reading comprehension have a positive reciprocal relationship. When vocabulary knowledge is sufficient, it facilitates reading comprehension; similarly, when reading comprehension ability is sufficient, it facilitates vocabulary acquisition.

A large percentage of vocabulary knowledge is acquired incidentally during the course of reading. When a word is encountered, a hypothesis of its meaning is formulated through the process of fast mapping. Several text level factors may support incidental vocabulary acquisition: contextual support, number of occurrences, and morphological complexity of unknown words. Similarly, several person-level factors may support incidental vocabulary acquisition: working memory, morphological awareness, and reading ability.

While the reciprocal relationship between vocabulary knowledge and reading ability has been demonstrated, less is known the conditions (e.g., context, number of occurrences, and nature of words) which insure incidental vocabulary acquisition in less skilled readers. An examination of the interaction of text-level and person-level factors would provide additional insight into the process of incidental vocabulary acquisition. This insight may provide guidance for the development of instructional materials and suggest appropriate instruction.

As such, a comprehensive literature review of these text-level and person-level factors was conducted in order to examine the conditions necessary and sufficient for incidental vocabulary instruction in less skilled readers. To locate relevant research articles for the review, an initial search was performed using the 'JEWL search engine' from James E. Walker Library of Middle Tennessee State University. The search engine accesses multiple databases, including *ERIC*, Education Source, OAIster, Medline, Academic OneFile, ScienceDirect, JSTOR, and PsycArticles. Search terms were 'incidental vocabulary acquisition' or 'word learning', 'reading' or 'context' with the restriction not 'L2', 'ELL', or 'ESL' and academic or scholar peer reviewed journal sources only. This search returned 3,457 hits. Despite the restriction on L2 studies, several hits were studies that focused on vocabulary acquisition of English Language Learners (e.g., Walsh, Rose, Sanchez, & Burnham, 2012; Kwok & Ellis, 2015); these studies were excluded. Other studies were excluded that focused vocabulary acquisition through listening (e.g., Blewitt, Rump, Shealy, & Cook, 2009; Evans & Saint-Aubin, 2013), through isolated word exposure (e.g., Clay, Bowers, Davis, & Hanley, 2007; Linebarger, Moses, Garrity-Liebeskind, & McMenamin, 2013); and through instruction (e.g., Perfetti, Wlotko, & Hart, 2005; Shore & Durso, 1990). Studies that examined general vocabulary knowledge were also excluded as incidental vocabulary acquisition studies, but used for background knowledge (e.g., Biemiller & Slonim, 2001; Tardif, Fletcher, Liange, Zhang, Kaciroti, & Marchman, 2008; Verhoeven & Perfetti, 2008). Studies that drew attention to vocabulary acquisition as the focus of the tasks, such as by pointing out word characteristics, were also excluded (e.g., Steele & Watkins, 2010).

Similarly, a search was performed in the ProQuest Dissertations and Theses database using the same keyword criteria resulting in 3,704 potential dissertations or theses for consideration. As above, works were excluded if the study focused on vocabulary acquisition from listening (e.g., Layne, 1996) or instruction (e.g., Gentry, 2006) or in L2 samples (e.g., Hein, 1998). Additionally, studies involving hearing impaired participants were excluded (e.g., Ahn, 1996) as were studies unrelated to incidental vocabulary acquisition (e.g., Mattos, 2013). These searches resulted in the 23 studies included in the incidental vocabulary literature reviewed below.

### **Rates of Acquisition**

Incidental vocabulary acquisition refers to the implicit knowledge gained about unknown vocabulary through normal reading without the intention to gain this knowledge (Swanborn & de Glopper, 1999). Many studies have examined the rate of IVA (e.g., Diakidov, 1993; Granick, 1997; Herman, 1985; Jenkins et al., 1984; Konopak, Sheard, Longman, Lyman, Slaton, Atkinson, & Thames, 1987; Konopak, 1988; Nagy et al., 1987; Reynolds, 2015; Shu, Anderson, & Zhang, 1995). The probability of incidental vocabulary acquisition from a single occurrence in text has been noted as low as 5% (e.g., Nagy et al., 1987) and as high as 15% (e.g., Herman, 1987). Other studies have failed to demonstrate even partial acquisition of word knowledge from authentic texts (e.g., Wagovich & Newhoff, 2004). In an effort to collapse existing data across studies, Swanborn & de Glopper (1999) performed a meta-analysis of IVA studies examining associated factors of the individual studies, including reading purpose, partial knowledge

acquisition, and time between pretest measures and reading and generated the overall learning probability of incidentally acquiring unknown vocabulary at 15%.

Swanborn and de Glopper (1999) compiled the results of 15 experiments to formulate their probability of learning an unknown vocabulary word from reading at 15%. Konopak (1987) examined IVA in a sample of 11<sup>th</sup> grade students of average reading ability ( $n = 65$ ). Treatment participants read a grade level, 1500 word, expository text passage excerpted from a U.S. history textbook in one 15 minute period. Ten target words were identified as target words within the passage. Students were asked to provide a definition of each of the target words on an immediate posttest measure. Participants were able to successfully gain six points on the posttest measure as compared to the pretest measure. Similar results were found in a study of incidental vocabulary acquisition at the elementary school level by Nagy et al. (1987). Participants read expository and narrative passages of approximately 1000 words in length. Results revealed significant acquisition of target vocabulary from both texts.

Recent research includes Reynolds' (2015) study of incidental vocabulary acquisition in both L1 and L2 samples. Reynolds examined acquisition of nonsense words in adult readers. Nonsense words, or novel psueowords, are words created to fulfill a specific purpose that are not part of the lexicon; they are not real words. The participants in the L1 and L2 treatment groups read a full length novel, *The BFG*. L1 and L2 treatment participants acquired significantly more of the nonsense words than the L1 and L2 control groups. L1 participants acquired significantly more of the nonsense words than L2 participants.

It should be noted that many of the nonsense words included in this rate of acquisition are closely related visually or phonologically to the real English word the nonsense word represents. For example in *The BFG*, ‘micies’ is used to represent *mice* and ‘rotsome’ is used to replace *rotten*. Given this level of transparency between the nonsense word and the real word it represents, the task of inferring a meaning of the nonsense word may not truly represent the level of difficulty typical with encountering unknown words where these types of cues are absent. Indeed, Reynolds (2015) proposed this similarity between nonsense and real words as a potential reason the L1 control participants were able to discern the meaning of some of the target words. While the overall rate of acquisition of L1 participants was approximately 61%, when the nonsense words that are closely related in appearance or sound to their real word counterparts are excluded, a less inflated average rate of incidental acquisition of .16 can be approximated which aligns well with prior research.

Recent studies on vocabulary acquisition have also utilized technology to further understand the processes of vocabulary acquisition. Brushnigan and Folk (2012) also examined incidental vocabulary acquisition in college aged participants. They examined the acquisition of opaque and transparent novel compound words using eye-tracking software to measure processing time for novel words. The researchers found readers have longer gaze durations on novel words, and this finding has been confirmed in other studies examining novel words in context (e.g., Wochna & Juhasz, 2013). Wochna and Juhasz (2013) found that novel words (i.e., nonwords) have longer fixation times than rare real words, even though acquisition rates are similar. Brushnigan and Folk (2012)

also found above average acquisition rates of novel compound words. The rate of acquisition for transparent compound words was 94%, but it should be noted the control was able to achieve 88% accuracy on the words without previous exposure in context. Clearly, the nature of the transparent compound words allowed accurate inference of meaning by adult readers without the support of context. An example of a transparent compound word was *drinkblend* for a mixed beverage; the meaning of the word is easily inferred from the word without context. *Deskdoor* was the opaque counterpart to *drinkblend*, and it would be more challenging to determine that this nonword meant mixed beverage. Similar rates of acquisition occurred for opaque compound words in the treatment condition (89%) suggesting the context facilitated the acquisition of the opaque words, but the treatment group scored significantly higher than the control group (42%) on this measure. Wochna and Juhasz (2103) did not find vocabulary acquisition above chance in their study of rare and nonword adjectives presented in either sentence or paragraph level informative contexts. Specifically, the participants did not score above 20% on a multiple choice measure of vocabulary knowledge with five choices.

Joseph, Wonnacott, Forbes, and Nation (2014) also examined gaze duration in the reading and acquisition of nonwords and found decrease in gaze time with additional occurrences of nonwords. Batterink and Neville (2011) examined event-related potentials during vocabulary acquisition of nonwords occurring 10 times. The researchers found decreased N400 activation levels following each occurrence of the nonwords. This suggests the acquisition of semantic information, and this is confirmed by high scores on a recognition measure (87%) and recall measure (67%). Of note, the nonwords

represented concrete, frequent nouns, such as *meeves* as a nonword representing clouds. Nouns are typically acquired faster than other word forms, and one hypothesis for this preferential acquisition is the concrete nature of nouns (Gentner, 1978; McDonough, Song, Hirsh-Pasek, Golinkoff, , & Lannon, 2011). Joseph et al. (2014) found a similar reduction in gaze fixation over contextual exposures, but the researchers did not find similar rates of acquisition despite the presence of 15 contextual occurrences of nonwords. Increased gaze duration for novel words has been documented in several research studies as has increased numbers of regressions to novel words (Chaffin, Morris, & Seely, 2001; Lowell, 2012; Williams & Morris, 2004). This finding indicates the readers are aware (at some level) that they have encountered a word they are not familiar with and readers use the surrounding context to infer meaning of the novel word (Williams, 2004). See Table 1 for a summation of characteristics of IVA studies.



Table 1

*Incidental Vocabulary Acquisition Study Characteristics*

Study	Grade	Ability	Reps	Time (hours)	Text Type	Text Length	<i>P(a)</i>
Batterink & Neville (2011)	13+	Average	10	5	Narrative	4500	.63
Brushnigan & Folk (2012)	13+	Average	1	1	Narrative	200	.47
Diakidov (1993)	6	Average	1	1	Expository	925	.1
Durkin (1990)	5	Average	1	1	Expository	70	.06
Gordon (1992)	5	High, Average	1	1	Expository		.03
Granick (1997)	8	Average	1	1	Narrative	1000	.06
Herman (1985)	8	Low	1	1	Expository	1000	.01
Jenkins, Stein & Wysocki (1984)	5	Average	0-10	3.5	Narrative	50	.16
Joseph, Wonnacot, Forbes, & Nation (2014)	13+	Average	15	1	Expository	150	.23

Table 1 (cont.)

Konopak (1987)	11	High,	1	.25	Expository	1500	.42
		Average					
Konopak (1988)	8	High,	1.8	.33	Expository	1000	.17
		Average					
Kranzer (1988)	8	All	1	1	Expository	2300	.21
de Leeuw, Segers, & Verhoeven (2014)	5	Average	2	.5	Expository	447	.25
Lowell (2012)	13+	Average	1	1	Narrative	1000	.40
Nagy, Anderson, & Herman (1987)	3,5,7	All	1	1	Both	1000	.05
Nagy, Herman, & Anderson (1985)	8	High,	1	1	Both	1000	.15
		Average					
Reynolds (2015)	13+	Average	3	3.6	Narrative	37K	.53
Schwanenflugel, Stahl, & McFalls (1997)	4	Average	1	1	Narrative	950	.12
Shu, Anderson, & Zhang (1995)	3,5	Average	1	1	Narrative		.1

Table 1 (cont.)

Stahl (1989)	6	Average	1	1	Narrative	500	.13
Stein (1988)	6	Average	1,3,5	-	Both	100	
Williams (2004)	13+	Average	1	1	Narrative	1000	.62
Wochna & Juhasz (2013)	13+	Average	1	1	Expository	15-170	0

*Note:*  $P(a)$  = probability of acquisition.

### **Trends across IVA Studies**

**Text Type.** IVA studies have varied widely on several text features, including the source of text, length of text, type of text, and richness of context. Prior studies have used unaltered existing text (e.g., Granick, 1997; Nagy et al., 1985; Reynolds, 2015), researcher created text (e.g., Diakidov, 1993; Durkin, 1990; Jenkins et al., 1984), or researcher modified authentic text (e.g., Konopak, 1987; Stahl, 1989). Nagy et al. (1985) used both expository and narrative passages from existing sources. Expository passages were extracted from a grade level science text, and narrative passages were excerpted from a basal reader. Jenkins et al. (1984), in their study of contextual exposures on vocabulary acquisition, created texts which consisted of paragraphs of 4 or 6 sentences that contained each target word. The paragraphs were a supportive context with clues or synonyms present from which the reader could determine the meaning. Stahl (1989) manipulated existing text to study the text characteristics that aided or impeded vocabulary acquisition by replacing every sixth word with a more difficult synonym in an excerpt from a grade level social studies text. The rate of acquisition was similar among studies using authentic, researcher created, and researcher modified text.

Expository texts (e.g., Herman, 1985; Stahl, 1989; de Leeuw et al., 2014) and narrative texts have been utilized (e.g., Brushnigan & Folk, 2012; Reynolds, 2015; Shu et al., 1995) as have a mix of both expository and narrative texts (e.g., Durkin, 1990; Nagy et al., 1987). Similarly, the genre of the texts does not seem to influence the rate of acquisition; most of these studies range from .06 - .18. Nagy et al. (1987) specifically

examined the differences in incidental vocabulary acquisition between narrative and expository text. They found no significant differences between expository and narrative texts. The majority of the studies used a passage length text of approximately 1000 words (e.g., Herman, 1985; Konopak, 1987; Schwanenflugel et al., 1997; Shu et al., 1995), though notable exceptions on both ends of the spectrum exist. Jenkins, et al. (1984) used a text length of only 50 words; whereas Saragi, Nation, and Meister (1978) and Reynolds (2015) used a full-length novel as the target text with 58,538 and 37,611 tokens, respectively.

**Variations in Contextual Richness.** The richness of context surrounding an unknown target word is often modified to determine its contribution to vocabulary acquisition outcomes as well (e.g., Bonacci, 1993; Konopak, 1988; Leewu et al., 2014). In a study of 11<sup>th</sup> grade students ( $n = 59$ ), Konopak (1988) modified an expository text to be more ‘considerate’ by placing synonyms or definitional information in appositives following the presentation of the target word. Acquisition of 10 target words encountered in the ‘considerate’ text was compared to the acquisition rates of 10 target words presented in an ‘inconsiderate’ text. Participants acquired significantly more target words from the ‘considerate’ text than the inconsiderate text, and higher ability participants were better able to capitalize on learning word meanings from the ‘considerate’ text than average ability participants.

Bonacci (1993) compared the influence of context on incidental vocabulary acquisition in skilled and less skilled 6<sup>th</sup> grade participants. Less skilled readers ( $n = 38$ )

were classified as readers of abilities between the 10<sup>th</sup> and 35<sup>th</sup> percentiles, and skilled readers were classified as readers of abilities between the 65<sup>th</sup> and 95<sup>th</sup> percentiles.

Unknown science words presented in expository text were utilized in Bonacci's study.

She used a definition context and an analogy context. A brief definition of the unknown word was embedded in the passage in the definition context. Information about the unknown word's meaning was presented by analogy in the analogy context. The student received the unknown word, a relationship, and a vehicle for each unknown word to provide students with a familiar concept upon which to map the new concept (e.g., a cell functions like a factory). The analogy condition required the student to infer information about the unknown word based on the student's understanding of the analogical relationship. Each participant received eight passages, four with definition context and four with analogy context. The definition context facilitated the most incidental vocabulary acquisition across both skilled and less skilled readers. There were significant differences between the performance of skilled and less skilled readers on both contexts. Skilled readers acquired more vocabulary knowledge than less skilled readers from either context. Less skilled readers were less able to acquire semantic information about an unknown word, even when the definition was embedded in the text. Additionally, the unknown words were acquired to a greater depth by skilled readers than unskilled readers. Of note, each unknown word's meaning was presented one time in each passage. The effect of combining a rich context and multiple contextual presentations of

the word and its meaning may produce greater rates of acquisition with more complete semantic information in less skilled readers.

De Leewu et al. (2014) examined the influence of local and global inferences in context on vocabulary acquisition outcomes in 5<sup>th</sup> grade native speakers of Dutch. Contextual cues occurred near the target word in a more closely related text in the local inference context (i.e., a more supportive context). In the global inference context (i.e., a less supportive context), information relevant to deriving target word meaning occurred further away from the target word. Participants read six expository texts on diseases over the course of two weeks. Within each text, half of the target words were presented in local inference context and the other half of the target words occurred in global inference. In this study, participants acquired target words presented in the local inference condition at a greater rate than global inference condition. Of course, it should be noted that both the global and local inference conditions in the study by de Leewu et al. contained sufficient information necessary to derive meaning. In this regard, de Leewu et al. investigated the relative benefit of two variations of considerate text. The degree of considerateness varied, but the reader had adequate information to discern the meaning of target words, so only the distance from the target word was manipulated. In Konopak's (1988) study, the 'inconsiderate' text did not contain the information necessary to discern the meaning of the target words. Thus there are degrees of considerateness within the category of considerate text.

Other findings suggest contextual support does not increase incidental vocabulary learning (e.g., Nagy et al., 1987). Nagy found that contextual support did not contribute to incidental vocabulary acquisition outcomes in a study of third, fifth, and seventh graders. It should be noted, however, that the highest strength of contextual support used in the study by Nagy et al. (1987) was a 5.2 on a scale of 8 on narrative texts, and the lowest level of contextual support was 4.2 on narrative texts. The narrow range of contextual support examined makes it difficult to conclude that contextual support cannot facilitate incidental vocabulary acquisition. Room for improvement in the level of contextual support offered by a text exists, and this is an area for further research.

**Participants' Characteristics.** Previous acquisition studies have also been conducted with participants who vary on several person features. The majority of vocabulary acquisition studies have included participants in late elementary to middle school grades (e.g., Durkin, 1990; Granick, 1997; Herman, 1985; Nagy et al., 1985; Schwanenflugel et al., 1997; Steele, 2008). Cross sectional studies have also been conducted across grade levels (e.g., Shu et al., 1995; Nagy et al., 1987), but these also fall within the late elementary to middle school range. Vocabulary acquisition has also been examined in adult learners (e.g., Brushnigan & Folk, 2012; Chaffin et al., 2001; Lowell, 2012; Saragi, Nation, and Meister, 1978; Reynolds, 2015; Williams & Morris, 2004). Only studies by Konopak (1988) and Konopak et al. (1987) examined vocabulary acquisition in secondary students, specifically 11<sup>th</sup> grade students. Interestingly, these studies reported the highest rates of acquisition of all studies examined by Swanborn and



de Glopper (2000) in their meta-analysis with rates of acquisition ranging as high as .54 for high ability readers. This finding supports the findings of Landauer and Dumais (1997) that learning from text increases as students age; however, this rate has not been substantiated by other findings with studies of adult learners. For example, Reynolds (2015) reported an adjusted rate of .18 which is more in line with the meta-analytic results of Swanborn and de Glopper's reported rate of .15 across IVA studies. The participants in the above studies were not described as high ability per se; however, the participants in these studies were students at the college level suggesting these participants were less likely to be low ability readers.

The majority of the above IVA studies have included only average or high readers as participants. Several studies, which report participant reading levels ranging from low to high, failed to distinguish results between ability levels though all reading levels were reported as included (e.g., Diakidoy, 1993; Durkin, 1990). One exception was the study by Herman (1985) which examined vocabulary acquisition by ability level and found differential rates of acquisition according to reading ability. Herman (1985) found readers below the 30<sup>th</sup> percentile acquired 5-10% of unknown words with a single contextual exposure while readers between the 31<sup>st</sup> and 80<sup>th</sup> percentiles acquired 12-26% of unknown words. Readers above the 80<sup>th</sup> percentile in Herman's study acquired unknown vocabulary at rates of 26-42%. Shu et al. (1995) reported differential probabilities of acquiring unknown words based on ability in a study examining the factors which influenced the acquisition of unknown words by both L1 English and L1 Chinese third

and fifth grade children in the respective L1 of each group. The probabilities of acquisition for low, average, and high ability readers was .02, .08, and .12 respectively. The relationship between poor reading comprehension and lower levels in word learning has been demonstrated in multiple studies (Bonacci, 1993; Cain et al., 2003; Cain et al., 2004).

Jenkins et al. (1984) also reported significant differences in high ability readers and low ability readers in rates of vocabulary acquisition. However, Jenkins et al. (1984) designated high ability and low ability readers by a median split in participant ability set at the 65<sup>th</sup> percentile. Thus, readers at the 64<sup>th</sup> percentile would have been included in the low ability reader analysis. Similarly, Stein (1989) classified students as high ability and low ability using a median split of the vocabulary subtest of the California Achievement Test and found significant differences between higher ability and lower ability readers. The median value falls well within normal reading parameters making it difficult to conclude the analysis represents low ability readers in general.

McKeown (1985) examined vocabulary acquisition by ability with a group of 30 5<sup>th</sup> grade students split into 15 low ability students and 15 high ability students as determined by vocabulary subtest scores of the Stanford Achievement Test. The participants encountered nonwords in a five step process. The participants read a sentence containing a nonword (e.g., “Standing in front of it we all agreed that it seemed like a narp house”) and a list of six real words from which to choose the nonword’s meaning (e.g., expensive, strange, brick, shy, ordinary, soft). At each step, the participant received

the nonword with further contextual information that constrained and enriched the meaning of the nonword presented in a sentence (e.g., “On every narp weekday, the children went to school and their parents went to work”). The participants had to make semantic decisions about correct use of the nonword based on the information presented thus far and explain the rationale for each of their decisions at each step. Low ability readers were less able to identify word meaning. They were also less able than high ability readers to capitalize on cues to generate word meaning. Furthermore, even when low ability readers did successfully derive meaning or when word meaning was provided to the low ability readers, they were not able to successfully consolidate meaning to the point where they could use the word accurately. While semantic recognition knowledge tends to precede productive knowledge, this finding was not present for high ability readers who were able to use words accurately based on the meaning derived from context and constraint information. This finding reflects a significant difference between low and high ability readers which suggests the need for further investigation. Contrary to the above findings, Shu et al. (1995) failed to find a significant difference based on ability in the acquisition rates of either L1 English or L1 Chinese participants. Given the convergence of information on the differences in vocabulary acquisition between readers of different abilities, this finding is unexpected. This issue requires further investigation to clarify the influence of reading ability on incidental vocabulary acquisition.

## **Factors Influencing Individual Differences**

**Print Exposure.** Print exposure refers to the amount of exposure to text a person has encountered through recreational and wide reading. Print exposure directly influences many factors associated with success in literacy, including vocabulary (Stanovich, 1986; Echols, West, Stanovich, & Zehr, 1996). Specifically, wide reading contributes independently to literacy outcomes of word knowledge and semantic recognition knowledge as well as fluency, general knowledge, and spelling after general cognitive ability and decoding have been taken into account (Cunningham & Stanovich, 1991). This influence has been detected in early childhood and extends throughout early adulthood (Mol & Bus, 2011). In fact, the influence strengthens over time and accounts for a greater percentage of variance on literacy outcomes, increasing from .10 in early childhood to over .30 by the time students reach higher education (Cunningham & Stanovich, 1991; Mol & Bus, 2011; Stanovich, 1986). Correlations between print exposure and literacy outcomes have been demonstrated in multiple research studies (McBride-Chang, Manis, Seidenberg, Custodio, and Doi, 1993; Sparks, Patton, & Murdoch, 2014; West & Stanovich, 1991). Print exposure has been shown to account for a significant portion of the variance on vocabulary knowledge measures in college students over and above the variance attributed to SAT verbal ability scores (West & Stanovich, 1991). The positive effects of print exposure have also been demonstrated for students with a reading disability as well (McBride-Chang et al., 1993; Mol & Bus, 2011).

Print exposure not only predicts vocabulary knowledge, but it has also been demonstrated to positively affect vocabulary growth (Echols et al., 1996). In a longitudinal study of 4<sup>th</sup>-6<sup>th</sup> graders, Echols et al. (1986) examined the predictive validity of the Title Recognition Test (TRT) and Author Recognition Test (ART) on various measures of verbal cognitive skills, including PPVT, PIAT, spelling tasks, vocabulary checklist, and reading comprehension (subtest of Virginia Literacy Passport Test). The TRT (Cunningham & Stanovich, 1990) and the ART (Stanovich & West, 1989) have been utilized as a nonbiased measure of relative levels of print exposure for participants. The TRT and ART were significant predictors on all literacy outcomes, and the TRT, specifically, accounted for a significant portion of variance in vocabulary growth on the PPVT (i.e., 7.8% to 10.6%) of the variance associated with growth on the PPVT (Echols et al., 1996). The ART, while a significant predictor of literacy outcomes, was not a significant predictor of vocabulary growth. While both measures are predictive of vocabulary knowledge, the TRT is additionally predictive of vocabulary growth. As such, the TRT was selected as a measure of print exposure for this study to examine its predictive value of incidental vocabulary acquisition—a commonly cited method of vocabulary growth—since it has been previously demonstrated to account for a portion of variance in vocabulary growth.

**Decoding.** Efficient decoding is a necessary, although insufficient, condition for the reader to be able to comprehend and learn from the text, including acquiring new vocabulary knowledge (Stanovich, 1986; Perfetti, 1985). Decoding is a critical feature for

success in early reading, but repeated encounters with new words quickly leads to the creation of visual word forms (Reitsma, 1983). For typically developing readers, a small number of word exposures can result in the creation of a visual word form. Word recognition efficiency frees up processing demands allowing these resources to be utilized for knowledge acquisition. Fluency is similarly a measure of adequate decoding. Fluent readers are by definition adequate decoders. The automaticity with which decoding happens facilitates or encumbers processing demands (Perfetti, 1985). Automaticity in decoding allows readers to allocate more cognitive resources to the task of text comprehension which facilitates knowledge acquisition, including incidental vocabulary acquisition.

**Reading Comprehension Ability.** The reciprocal relationship between vocabulary knowledge and comprehension ability is well documented (e.g., Cromley & Azevedo, 2007; Elleman et al., 2009; Kendeou et al., 2009; Stahl & Nagy, 2005; Stanovich, 1986; Tannenbaum et al., 2009 ). Superior readers are also superior word derivers (Nagy et al., 1985; Jenkins et al., 1984). The ability to derive word meanings from context is strongly correlated with reading comprehension ability (Sternberg & Powell, 1983). Skilled comprehenders learn new words more efficiently and more completely than less skilled comprehenders (Perfetti, 2007; Steele, 2015). Low frequency words tend to create more comprehension difficulties for less skilled readers (Perfetti, 2007), and low-frequency words occur more frequently in text than speech (Hayes, 1988). Thus, wide reading increases both the frequency and recency of exposure to low-

frequency words (Perfetti, 2007; Reichle & Perfetti, 2003). Better readers tend to read more and so have the opportunity to encounter more vocabulary words (Stanovich, 2000). It is likely the extended opportunities for practice hone the vocabulary derivation skills of these readers and foster the reciprocal relationship between vocabulary knowledge and reading comprehension (Stanovich, 1986; Elleman et al., 2009).

**Working Memory.** Working memory is a part of the cognitive processing, storage, and memory system. Within working memory, information is processed, retrieved, and ultimately converted to storage (Gathercole & Baddeley, 1993). Working memory is comprised of the central executive, visuospatial sketchpad, and the phonological loop. The processing and storage of verbal information occurs within the phonological loop (i.e., phonological short term memory or phonological working memory). Phonological working memory is a central factor in incidental vocabulary acquisition because limitations in a reader's ability to store phonological material may have negative consequences for reading comprehension and vocabulary acquisition. A reader's ability to hold phonological information in working memory is a necessary precursor to vocabulary acquisition (Gathercole & Baddeley, 1989; Gathercole, Willis, Emslie, & Baddeley, 1992). Specifically, a reader must be able to hold information in phonological working memory first before being able to store the information in long term memory. Working memory has been positively correlated with reading comprehension in several research studies (e.g., Alloway, 2009; Holmes, Gathercole, Place, Dunning, Hilton, & Elliott, 2010; St. Clair-Thompson, 2011; Swanson, 2011).

In contrast, other studies have failed to find a significant relationship between working memory and vocabulary acquisition (e.g., de Leeuw et al., 2014; Williams, 2004). De Leeuw et al. (2014) found that the working memory capacity did not significantly influence overall word learning in a study of 5<sup>th</sup> grade Dutch students. As discussed earlier, de Leeuw et al. (2014) investigated the contributions of context, task, and reader characteristics to incidental vocabulary acquisition using a global inference and local inference condition. Using a repeated measures ANOVA with vocabulary knowledge and working memory as covariates, the researchers found greater rates of vocabulary acquisition in the local condition, but working memory did not contribute to overall word learning. However, de Leeuw et al. (2014) did find an interaction between an inference question task and reader working memory. The researchers interpreted this interaction as evidence that readers with higher working memory capacities are better at learning words than readers with lower working memory capacities even though the study failed to demonstrate this relationship conclusively. Williams (2004) also noted that higher working memory was associated with higher vocabulary knowledge levels in the participants in her study of eye movements and vocabulary acquisition, though the working memory level of the participants did not generate significant differences in the acquisition of novel words in her study.

**Morphological Awareness.** Morphological awareness (MA) is an individual's cognizance of the awareness of morphemes within words and an individual's ability to intentionally manipulate morphemes (i.e., the smallest unit of meaning in language) to



create words (Carlisle, 2000). MA has been linked to reading comprehension in several studies (e.g., Carlisle, 2000; Carlisle & Fleming, 2006; Deacon & Kirby, 2004, Nagy et al., 2006; Tong et al., 2011; Nagy et al., 2013). MA has been correlated with vocabulary knowledge (e.g., Carlisle & Fleming, 2006; Sparks & Deacon, 2012). MA contributes to vocabulary knowledge and increases in importance as students advance in grade level (e.g., McBride-Chang et al., 2005; Nagy & Anderson, 1984). MA has also been demonstrated to contribute to vocabulary growth (Wysocki & Jenkins, 1987; Brunsnighan & Folk, 2012).

McBride-Chang et al. (2005) found that MA contributed an average of 10% of the variance of vocabulary knowledge in kindergarten and second grade students. For the kindergarten students, morphological awareness accounted for 8% of the variance of vocabulary knowledge whereas morphological awareness accounted for 15% of the variance of vocabulary knowledge in second grade students demonstrating a trend for increased importance of morphological awareness as students advance in grade level. This trend has been confirmed in research in other languages as well (McBride-Chang, Tardif Cho, Shu, Fletcher, Stokes, Wong, & Leung, 2009). In a study of morphological awareness in Cantonese, Mandarin, and Korean children, McBride et al. (2009) confirm the findings of McBride-Chang et al. (2005). Morphological awareness increases with age, and morphological awareness contributes to vocabulary knowledge.

The relationship between morphological awareness and vocabulary knowledge has been established, and it has been further proposed that this relationship is likely

bidirectional in nature in L1 speakers of English (Sparks & Deacon, 2012). In a longitudinal study of 100 second and third grade children, Sparks and Deacon (2012) examined the relationship between morphological awareness and vocabulary knowledge and the influence of each on the other through a cross-lagged regression analyses. Results confirmed the relationship between morphological awareness and vocabulary knowledge as demonstrated in prior research. Additionally, morphological awareness in grade two was a predictor of vocabulary growth in grade three. The reverse of this was not true: vocabulary knowledge in grade two was not a predictor of growth in morphological awareness in grade three. These findings are not entirely consistent with the other research in this area. The authors cite the vocabulary assessments used in their study as one possible reason for this inconsistency and suggest that the use of expressive measures of vocabulary knowledge would draw more heavily on morphological awareness as demonstrated in above studies.

Finally, MA is important to the development of vocabulary knowledge because as students advance through school, morphologically complex words are encountered more frequently (Nagy & Anderson, 1984). Nagy and Anderson (1984) examined the amount and type of words likely to be encountered in school (i.e., grades 3 through 9). Their findings revealed that approximately 170,000 of the 609,606 words present in print (i.e., 28% of the words analyzed) are suffixed, prefixed, or compounded. Additionally, when only semantically transparent words are considered, morphologically complex words account for approximately 23% of the words children typically encounter in school. Since

morphologically complex words comprise a large percentage of the words encountered in school, a student's morphological awareness may facilitate both the comprehension and the acquisition of new of morphologically complex vocabulary encountered.

***Morphological Generalization.*** Morphological generalization refers to a reader's ability to acquire new vocabulary during wide reading using existing knowledge of the meaning of word parts to discern the meaning of novel words containing known morphemes (e.g., Wysocki & Jenkins, 1987). The process of morphological generalization has been examined in multiple studies (e.g., Wysocki, 1986; Wysocki & Jenkins, 1987).

Wysocki and Jenkins (1987) examined the use of morphological generalization to derive meaning from unknown words in a multilevel grade study which included 4<sup>th</sup>, 6<sup>th</sup>, and 8<sup>th</sup> grades. Twelve high frequency morphological based stimulus words were selected and matched with 12 low frequency words transfer words that shared the base from the high frequency word. Students received instruction on six high frequency morphologically based stimulus words. Two weeks after stimulus word instruction, the students completed three vocabulary measures in the following order: transfer words within weak context sentences, transfer words with strong context sentences, and stimulus words within weak context sentences. Students were asked to define either the stimulus or transfer word. Strong context sentences containing words on which the students received no instruction led to significantly better vocabulary acquisition than weak context sentences across grade levels with no significant differences between

grades. Students at all grade levels also used morphological knowledge in combination with contextual information to determine the meanings of unknown words. Additionally, there were significant differences in the use of morphological knowledge to facilitate acquisition of vocabulary between fourth grade and the higher grade levels. Specifically, 4<sup>th</sup> graders used morphological knowledge 23% of the time to facilitate vocabulary acquisition while 6<sup>th</sup> graders used morphological knowledge 35% to facilitate acquisition (Wysocki, 1986). As students developed, they became more adept at using morphological knowledge, specifically the process of morphological generalization, and contextual information to support vocabulary acquisition.

Wysocki (1986) more closely examined the process of morphological generalization in samples of 4<sup>th</sup> and 6<sup>th</sup> grade students. She examined in which stage students encounter difficulty in the process of morphological generalization. Based on prior research (i.e., Wysocki & Jenkins, 1987), Wysocki proposed five stages of morphological generalization:

- 1) Student is aware the unknown word is morphologically related to a known word.
- 2) Student uses meaning of morphologically related known word.
- 3) Student determines syntactic classification of unknown word.
- 4) Student produces a meaning for unknown word and considers the syntactic classification of the unknown word.

- 5) Student changes meaning of known word to reflect the syntactic classification of the unknown word.

Wysocki compared an untrained condition in which participants received word and definition instruction only and a trained condition in which participants received instruction closely aligned with the processes occurring at each stage of morphological generalization. Training in morphological generalization did not produce significantly different results than word instruction; however, older students, similar to the Wysocki and Jenkins (1987) study, outperformed younger students in morphological generalization with 52% in 4<sup>th</sup> grade students versus 80% in 6<sup>th</sup> grade students. This difference was further demonstrated in the difference between semantic recognition and productive knowledge measures. Younger students were able to identify meanings of transfer words though they produced meanings of transfer words at lower levels than older students. Further examination of performance by stage of morphological generalization reveals that as students gain experience, they become more proficient at extracting and consolidating syntactic information about unknown words, and this contributes to the significant differences in performance between the grade levels. Post hoc analysis revealed lower ability readers benefited significantly more from the morphological generalization training than typically developing readers (Wysocki, 1986). This finding suggests lower ability readers may have weaknesses in morphological awareness.

There may be additional stages of morphological generalization not yet identified or investigated. In both the Wysocki and Jenkins (1987) and Wysocki (1986) studies, the target words and transfer words were closely related words. In fact, both sets contained the same base words with a suffix manipulation which changed the part of speech of the base word. For example, the target word ‘clandestinely’ was altered to the transfer word ‘clandestine’ (Wysocki, 1986). The close relationship between the target and transfer words may be related to the lack of significant differences found between the untrained group and the group who received training in morphological generalization. Specifically, either the words were similar enough in meaning (e.g., secretly and secret) for the untrained group to determine meaning, or the untrained group had sufficient morphosyntactic awareness to determine the meaning.

Nagy and Anderson (1986) speculated that for each word acquired a student may be able to derive the meaning of 1 to 3 related words, and the closely related target and transfer words used in Wysocki’s study supports this hypothesis. A student who knows the meaning of perceive would likely be able to generalize semantic information to the closely related words of perception or perceptive. In this manner, morphological generalization has the potential to contribute substantially to the vocabulary knowledge of students as they age given that abilities to use morphology to derive word meaning increases as students gain experience and students encounter increasing numbers of morphologically complex words (Nagy & Anderson, 1984). Although the process of morphological generalization has been investigated with transfer from known,

specifically instructed words, to unknown words (e.g., Baumann et al. 2003), the investigations have used whole words as the target words and manipulations of affixes as transfer words.

If a root word is known, many related words can be derived (Biemiller & Slonin, 2001). Deriving word meaning from related words increases one's vocabulary knowledge exponentially with little additional effort. A student can derive the meaning of one to three words from an acquired word, such as *prediction* or *predictive* from *predict*, as demonstrated in previous research (Wysocki & Jenkins, 1987). If a student can use the process of morphological generalization to transfer knowledge of the centrally bound morpheme (i.e., *dict*), the meaning of many more words containing the bound morpheme could be derived (e.g., *indication*, *contradict*, *dedicate*, *dictator*, *malediction*, *edict*, etc). There is a paucity of research in the process of morphological generalization with bound root word morphemes, such as *dict* as a bound morpheme in *predict* (Nagy et al., 2014).

Two studies exist which have examined using knowledge of bound morphemes in deriving word meaning. Shepherd (1973) examined contributions of word part knowledge to related word knowledge in a sample of 178 college students and found only weak correlations (i.e.,  $r = .18$ ) between knowledge of Latin root words and knowledge of derived words. Stronger correlations existed for whole words with added affixes such as those used in the above studies (i.e.,  $r = .62$ ). In a two part of study with college students and 8, 10, and 12 grade students, Kaye et al. (1987) examined the use of a lexical decomposition strategy (i.e., the use of knowledge of word parts to determine the

meaning of the entire word) by students in order to determine the meaning of unknown words. Kaye et al.(1897) found evidence of lexical decomposition strategy use in both college students and secondary students. Both secondary and college students used this strategy to determine the meaning of unknown words, but college students utilized the meaning of the stem to determine meaning of the word while this behavior was not reported in secondary students (Kaye et al., 1987). This finding suggests that the process of morphological generalization as represented by the lexical decomposition strategy continues to develop well through the educational process and into adulthood.

More recent investigations into the use of morphological analysis confirm the trend for this ability or strategy to develop as the linguistic development of students occurs. McCutcheon and Logan (2011) investigated the contributions of morphological analysis to vocabulary knowledge and reading comprehension. Unlike previous studies which included an instructional component on the strategy of morphological generalization (e.g., Wysocki, 1986) or word parts (e.g., Baumann et al., 2003) and investigated transfer of strategy use or application of morphological knowledge, McCutcheon and Logan examined naturally developed or pre-existing ability of 5<sup>th</sup> and 8<sup>th</sup> graders to use morphological analysis to determine the meaning of novel words. The participants completed measures of word identification, phonological awareness, morphological awareness, reading comprehension, and vocabulary knowledge as well as a morphological analysis task. The morphological analysis task developed by McCutcheon and Logan (2011) included a mix of both real words and nonwords



presented in a sentence. Real words were low frequency words which were either ‘morphologically accessible’ (i.e., complex with semantically transparent word parts) or ‘morphologically inaccessible’ (i.e., semantically opaque morphemes or morphologically simple words). Similarly, researcher created nonwords had varying degrees of accessibility and included novel word ending combinations (e.g., *blanding*) which were intended to be morphologically accessible, and ‘portmanteau’ words (e.g., *financestor*) which were intended to be less morphologically accessible. Students in both grades were more successful at determining the meanings of the morphologically accessible words than nonwords, and 8<sup>th</sup> grade students were better able to utilize morphological information than 5<sup>th</sup> grade students. Additionally, performance on the morphological performance task accounted for an additional portion of variance in both 5<sup>th</sup> grade participants (i.e., 11.7%) and 8<sup>th</sup> grade participants (i.e., 12.5%) in vocabulary knowledge after accounting for the contributions of word identification, phonological awareness, and morphological awareness. Of note, morphological awareness was measured through a production task that required students to alter a word to fill in the blank in a sentence and fit the syntactic and semantic requirements of the sentence. The additional variance accounted for by morphological analysis over and beyond morphological awareness suggests that morphological analysis is a separate, though likely dependent, skill beyond morphological awareness. McCutcheon and Logan (2011) did not find differences between average and high ability readers, but there were significant differences in morphological analysis by grade level which fall in line with the results of other studies

suggesting morphological analysis ability increases with age or other related factor, perhaps maturity or print exposure, even without instruction in morphological generalization as a strategy for word learning or comprehension.

McCutcheon and Logan (2011) examined the process of morphological analysis, or morphological generalization, in sentence level context and its ability to predict vocab knowledge, but they did not examine the influence of morphological generalization on incidental vocabulary acquisition in extended text. No transfer measure was administered to see if the participants retained the semantic knowledge derived through morphological analysis. Thus, the question remains if the process of morphological generalization facilitates incidental vocabulary acquisition by either increasing completeness of word knowledge or decreasing the number of contextual exposures necessary to achieve partial or full knowledge of unknown words. Additionally, less skilled readers were not included in the McCutcheon and Logan study. Less skilled readers may demonstrate different relationships between morphological analysis and vocabulary knowledge, or less skilled readers may not utilize morphological analysis strategies to the same extent as their peers of average and high reading ability.

### **Task Level Features**

**Contextual Exposures.** Multiple encounters with words provide readers with the opportunity to consolidate semantic information about those words. The importance of number of exposures has also been documented in vocabulary instruction research (e.g., Beck, Perfetti, & McKeown, 1982; Beck, McKeown, Omanson, & Pople, 1985). Prior

research has demonstrated that 10 instructional encounters with a word are sufficient for a reader to acquire adequate levels of word knowledge to facilitate greater reading comprehension (McKeown, Beck, Omanson, & Perfetti, 1983). Research suggests that between 5 and 12 instructional exposures to an unknown word are necessary to acquire sufficient word knowledge (Beck et al., 2002; Beck et al., 1982). However, substantially higher numbers of instructional exposure have failed to demonstrate complete retention of semantic information (Beck et al., 1982).

Repetition of contextual encounters has been shown to facilitate word learning through fast mapping processes (Axelsson & Horst, 2014), but the number of contextual encounters necessary to promote sufficient word knowledge is less certain. Jenkins et al. (1987) examined the effect of number of contextual occurrences on rate of vocabulary acquisition. Increased exposures, specifically 10 occurrences, produced significantly higher rates ( $P = .453$ ) of acquisition than 2 occurrences ( $P = .198$ ). Although Jenkins et al. (1987) failed to find significant differences between two and six exposures or between six and 10 exposures, the results indicate higher probabilities of acquisition as the number of exposures increases.

Using age-matched and reading ability-matched control groups, Steele (2008) examined the word learning abilities of language impaired 4<sup>th</sup> and 5<sup>th</sup> grade children to determine the roles of contextual richness and occurrence frequency of target words. Target words were nonsense words which occurred either twice or five times within adjacent context or nonadjacent context passages. Language impaired participants

acquired significantly less vocabulary than their age matched peers on both oral and multiple choice written tasks, but there was no significant difference between language impaired participants and reading ability matched participants on the oral task. Steele (2008) found no differences in vocabulary acquisition rates between groups based on context presentation, but there were significant differences between groups on number of presentations of target words. Participants scored higher on the definition task for words that they had encountered five times in the passage. These findings differ somewhat from the findings of Jenkins et al. (1987) who did not find significant differences in vocabulary acquisition on words between two and six presentations. However, the participants in Steele's (2008) study were informed that they would encounter words that did not appear to be real words and to attempt to discern the word's meaning whereas the participants in Jenkins et al. (1984) were blind to the true purpose of the study and encountered low frequency real words instead of nonwords or nonsense words. The focus of attention on acquisition of semantic information or the use of nonsense words may have influenced the effectiveness of multiple presentations. Increased acquisition rates with increased exposures were demonstrated, however, and this finding is consistent with other studies as is the outcome of lower acquisition rates for less skilled readers.

Stein (1989) also examined the effect of the number of contextual occurrences on acquisition, but she did not find any significant difference between 1, 3, and 5 exposures. However, the maximum number of exposure occurrences included in Stein's study is below the threshold demonstrated in previous research (i.e., Jenkins et al., 1984).

Additionally, this study found no interaction between ability and number of exposures suggesting that five exposures is not sufficient to generate differential rates of learning between readers of different skill levels on the multiple choice measures or perhaps that low and high skill readers can extract partial meaning from text to perform similarly on the partial knowledge tapped by multiple choice assessments. Stein found a significant difference between acquisition rates based on pre-test skill level and an interaction between number of exposures and skill level on the vocabulary measure requiring students to supply the definition. In this instance, higher ability readers benefitted significantly from more exposures (i.e., 5 versus 1). Lower ability readers did not glean sufficient information from the additional exposures to provide a full definition of the target words. This finding suggests higher ability students may be able to capitalize on multiple contextual exposures to build more complete representations of word meaning, and lower ability students may require more exposures to achieve the same resulting knowledge. This phenomenon may be as a result of increased practice or print exposure on the part of higher ability readers (Stanovich, 1986). Greater numbers of unknown words are encountered through wide reading. This leads to more opportunities to infer word meaning. Increased opportunities to practice deriving word meaning result in greater skill at deriving word meaning as well as increased vocabulary and background knowledge which in turn further facilitate word learning.

Similarly, Reynolds (2015) reports the number of exposures for each of the nonsense words included in his study and the related rate of acquisition. Though there is

considerable variability within each range of number of exposures, the general trend is increased acquisition rates with increased numbers of contextual exposure. For example, 2 exposures yielded an average rate of acquisition of .15 and a rate of occurrence greater than 12 exposures yields an average rate of acquisition of .23. There is evidence of diminishing returns with increased exposures across several studies (e.g., Jenkins et al., 1984; Reynolds, 2015; Vidal, 2011), and this phenomenon is demonstrated in vocabulary instruction research as well (Beck et al., 1982). Possible factors contributing to this phenomenon include individual cognitive resources, such as working memory (Bolger, Balass, Landen, & Perfetti, 2008).

***Massed Versus Distributed Practice.*** Learning research has indicated that not only is number of contextual exposures important, but the distance in time and frequency also may play a role in vocabulary acquisition (Baddley, 1999). According to Baddley (1999), distributed practice, multiple exposures across longer periods of time, is more effective for retaining acquired vocabulary than massed practice, multiple exposures in a condensed time period. Additionally, the pattern of contextual occurrences may also play a role. Baddley (1999) reports repetitions should initially occur more frequently with subsequent exposures further apart in time to maximize retention. Stein (1989) included a massed versus distributed practice condition in which students of low and high skill levels either completed the readings in one sitting or over the course of three separate days which were spaced two to three days apart. In this instance, lower skilled readers benefited from the distributed practice condition. They had significantly improved

acquisition (or retention) of the meaning of words on multiple choice measures, though not for supply definition measures. Interestingly, high ability readers performed worse under the distributed practice condition than on the massed practice condition. One plausible explanation for this outcome may be the higher ability students were better able to remember the meaning of the words from the passage they had read immediately before the test, yet lost this advantage in the distributed practice condition. No follow up post-testing was administered, so it is not possible to predict the longer term outcomes of the acquisition gained by either ability level under either set of practice conditions. The benefits from distributed practice may occur as a result of consolidation of information as suggested by recent studies (e.g., Henderson, Devine, Weighall, & Gaskell, 2015; Landi, 2015).

**Morphological Complexity.** The morphological complexity of words contributes to the acquisition when the reader encounters unknown words (Roman, Kirby, Parrila, Wade-Wooley, & Deacon, 2009). Contributions of morphological awareness to IVA occur as a result of facilitation of new vocabulary through morphological generalization as described in detail above (Wysocki & Jenkins, 1987).

Other studies, however, have failed to find significant contributions of morphology to vocabulary acquisition (e.g., Shu et al., 1995). In Shu et al. (1995), morphological transparency was not found to contribute significantly to the vocabulary acquisition among L1 English students; however, morphological transparency was a significant predictor of vocabulary acquisition among Chinese students. One potential

cause of these contradictory results may be the type of morphological awareness being examined. Several research studies have examined morphological awareness in languages other than English. Often, morphological processes in languages other than English differ from processes typically encountered in English. This is particularly true of languages with logographic writing systems such as Chinese in which the morphological process most commonly used is compounding. The process of compounding creates a new word by the joining of two preexisting words (e.g., keyhole). This is particularly true of languages, such as Mandarin in which the morphological process most commonly used is compounding and inflectional morphology is almost entirely absent. Words in Mandarin often consist of one or two syllable morpheme, particularly two syllable morpheme words because of the frequency of compound words present in the language. The process of compounding creates a new word by the joining of two preexisting words (e.g., keyhole). For this reason, Mandarin is a noticeably more analytic language than many other languages, even more so than English, and this differs from the English language in which inflection and derivation are more common morphological processes (Anglin, 1993). The process of inflection maintains the essential meaning of a base word while changing the ending to fit the grammatical conditions of a context, such as changes in verb tense (e.g., *run* to *runs*) or plurality (e.g., *girl* to *girls*) are common inflectional processes. The process of derivation forms new words by the addition of morphemes to a base word (e.g., combining *anti-* and *septic* to form *antiseptic*) to alter meaning or change syntactic category (e.g., *secret* to *secretly*).



Readers are typically more sensitive to the morphological processes common in their language (Ku & Anderson, 2003). For instance, target words used by Shu et al. were classified by their level of morphological transparency, but not by the type of morphological process that occurred in the target word. It is possible that different types of morphological processes resulted in the differential importance of morphological transparency to vocabulary acquisition to each L1 sample. Further research should be conducted to determine the relative influence of specific morphological processes on vocabulary acquisition.

**Frequency.** The probability of knowing a word is highly correlated with the word's frequency of occurrence (Anderson & Freebody, 1981; Vemmer, 2001). This holds true for both semantic recognition and productive vocabulary though research suggests stronger correlations between frequency and productive vocabulary (Vemmer, 2001). Given the association between relative frequency, or how often a word typically occurs in oral and written language, and probability of knowing a word, the number of occurrences of a given word that a person encounters should influence the acquisition of that word. This has been demonstrated in Age-of-Acquisition (AoA) research where subject area specialists have greater familiarity with the low frequency, late acquisition age vocabulary of their domain than other low frequency words with similar AoA classification (Stadthagen-Gonzales, Bowers, & Damian, 2004). Stadthagen-Gonzales et al. (2004) found that subject areas specialists are likely to know the late acquisition, low frequency words encountered in their areas of specialty over late acquisition, low

frequency words not typically encountered in their area. For example, chemists are more likely to be familiar with the term electron which is a late acquisition, low frequency word that occurs frequently in the content area of chemistry; whereas, they are less likely to be familiar with cognition which is an equivalently late acquisition, low frequency word. The relative frequency of electron is high for a chemist.

**Age of Acquisition.** There is a degree of overlap between frequency and AoA (McDonough et al., 2011). Age of acquisition ratings and frequency levels of words usually have negative correlation; logically, the less frequent a word is, the later a reader acquires it. Prototypical words (e.g., dog) are acquired earliest in development of vocabulary knowledge; that is, prototypical words have earlier ages of acquisition. Hypernyms, that is superordinate terms such as mammal, and hyponyms, that is subordinate terms such as collie, are acquired later in vocabulary development (Atchison, 2012). Prototypical words also tend to occur more frequently which contributes to the potential confounding of these two constructs: frequency and AoA (Vemeer, 2001). However, AoA has been successfully disentangled from frequency in several research studies (e.g., Dewhurst & Barry, 2006; Dewhurst, Hitch, & Barry, 2006).

**Imageability.** A word is considered highly imageable if the reader can easily construct mental images of what the word represents (Wolter, 2014). Words which have greater imageability are more easily acquired than words than words which represent abstract, less imageable concepts (McDonough et al., 2011; Wolter, 2014). Words of greater imageability may be easier to acquire because they have a processing advantage.

Information on highly imageable words may be stored within the visual system, as an image, and within the language system, as a word. This ‘dual coding’ may allow them to be more accessible than less imageable words (Paivio, 1991). Imageability and concreteness are closely related terms, often used as synonyms. The advantage of concrete words in acquisition has been addressed in several studies (e.g., McFalls, Schwanenflugel, & Stahl, 1996; Schwanenflugel et al., 1997). Furthermore, less skilled readers have greater difficulties with the reading (i.e., decoding) of abstract words than average readers (Coltheart, Laxon, & Keating, 1988).

### **Purpose of the Study**

Research has demonstrated wide reading as a viable means of vocabulary growth with .15 probability of incidentally acquiring unknown vocabulary words encountered in text (Swanborn & de Glopper, 1999). Various item-level features have been manipulated in an attempt to influence incidental vocabulary acquisition. Text manipulations in past research have included number of contextual occurrences (e.g., Jenkins et al., 1984; Stein, 1989) and richness of context (Bonacci, 1993; Lewuu et al., 2014). Richer context and greater contextual occurrences have individually been shown to increase probability of incidental vocabulary exposure. The number of contextual exposures has been shown to have diminishing returns after a given level of exposure; that is, the improvement in the rate of acquisition reaches a plateau after initial improvement in rates of acquisition (e.g., Jenkins et al., 1984; Reynolds, 2015; Vidal, 2011). The possibility of diminishing returns in IVA with increasing exposure has not been explicitly explored in samples of

less skilled readers. Less skilled readers may continue to benefit from a greater number of occurrences of novel words even after the point that average readers would begin to experience diminishing rates of vocabulary acquisition.

Research has demonstrated that less skilled readers have several key characteristics which influence vocabulary acquisition. Compared to more skilled readers, they have lower print exposure (Stanovich, 1986); lower levels of vocabulary knowledge (Cromley & Azevedo, 2007), and less working memory capacity (Williams, 2004; Perfetti, 2007). These characteristics may result in reduced vocabulary acquisition by less skilled readers as demonstrated in prior research (e.g., Cain et al., 2004).

Research has also demonstrated that several word and text level factors influence vocabulary acquisition. These factors include morphological complexity (Roman et al. 2009; Wysocki & Jenkins, 1987), word frequency (Anderson & Freebody, 1981; Perfetti, 2007), contextual exposures (Jenkins et al., 1984) and contextual richness (Bonacci, 1993; Konopak, 1988). These item-level factors have the potential to support the acquisition of vocabulary in less skilled readers.

Prior research studies have examined combinations of the above person, word, and text characteristics. However, there is still much to investigate. Research on the relative ease of acquisition of morphologically simple words and morphologically complex words is lacking. While some studies have examined the influence of morphological complexity in IVA outcomes (e.g., Nagy, Herman, & Anderson, 1987), the studies did not include multiple contextual exposures of words, rich contexts, or less

skilled readers. No study was discovered that has examined participants' ability to assign meaning to a bound morpheme based on knowledge acquired through IVA.

Research on less skilled readers in combination with manipulating the number of contextual exposures in a rich context is incomplete. While prior research manipulating contextual exposures in the task has included less skilled readers, the term 'less skilled readers' has been broadly interpreted and often included readers at the 50<sup>th</sup> percentile (i.e., Jenkins et al., 1984). Current identification practices suggest the 25<sup>th</sup> percentile is an appropriate guideline to classify struggling readers (Fuchs & Fuchs, 2006). A closer examination of less skilled readers using a typical criterion of reading below the 25<sup>th</sup> percentile is warranted. Readers below this level may have reading characteristics that are substantially different from the 'less skilled readers' used in previous research. Herman (1985) did examine readers who fell below a similar threshold, specifically readers who fell below the 30<sup>th</sup> percentile, but words occurred only one time in the task. Furthermore, when manipulations of contextual exposures have been examined (e.g., Jenkins et al., 1984), the maximum number of contextual exposures with non-adult samples used in prior research was 10. Ten contextual exposures may be insufficient for less skilled readers to achieve acquisition. Finally, the effect of richness of context in combination with greater than 10 contextual exposures has not been examined. Specifically, few studies placed definitions of the novel words in the text (e.g., Bonacci, 1993; Konopak, 1988). Some studies included a text which used synonyms in close proximity to the target word (e.g., Jenkins et al., 1984) or contextual cues from which a meaning might be

inferred (e.g., de Leeuw et al., 2014). Providing a definition embedded near the target word may allow the reader to develop decontextualized semantic information about novel words (Bolger et al., 2008).

The current study examines incidental vocabulary acquisition outcomes through the lens of reading ability and other individual factors which may serve to mediate the outcomes. This study further examines the processes of morphological analysis in words containing bound morphemes. Specifically, this study examines if bound morpheme meaning can be identified and extracted in similar fashion to whole word knowledge by 9<sup>th</sup> and 10<sup>th</sup> grade students. This study examines the effect of morphological analysis on incidental vocabulary acquisition by comparing acquisition of knowledge morphologically complex and morphologically simple words in extended text in various frequencies of contextual occurrence in a rich context. The number of contextual exposures examined doubles the number of occurrences found in existing research with this population in order to provide additional information on the influence of contextual exposures. Additionally, this study includes readers of low, average, and high ability in order to discover additional insights into the reader characteristics of readers at all levels. The examination of the above person and task characteristics is accomplished through the use of a crossed random-effects model item response model analysis. This analysis has not been utilized in any research study of incidental vocabulary acquisition to date; thus, the results of this analysis contribute additional information to the body of research on incidental vocabulary acquisition.

**Research Questions**

- 1) What are the item-level factors (i.e., number of exposures and morphological complexity) that contribute to IVA? Specifically, are morphologically complex words more easily acquired than morphologically simple words (at a higher percentage of acquisition or with fewer contextual exposures)?
- 2) What person-level factors (i.e., vocabulary knowledge, decoding ability, reading comprehension, working memory) contribute to IVA?
- 3) Are there important interactions between person-level and item-level factors? Specifically, do readers with greater working memory capacity acquire words with fewer contextual exposures than readers with lower working memory capacity? Does morphological complexity benefit readers of different abilities differentially?

## CHAPTER THREE

### METHOD

In order to investigate the item- and person-level factors that contribute to incidental vocabulary acquisition in secondary students, specifically 9<sup>th</sup> and 10<sup>th</sup> grade students, the following methodology was implemented.

#### **Participants**

Participants were 78 9<sup>th</sup> and 10<sup>th</sup> grade students enrolled in a rural school district in the Southeastern US where the principal investigator is an English Language Arts teacher. The primary language of the students is English. Previous representative samples have been drawn from this population (Cooper, Coggins, & Elleman, 2015), and 90% of students are Caucasian. Subgroups include approximately 5% of students who receive special education services and 2% of the students are English Language Learners (ELL). ELL students were excluded during screening. Potential participants (N=168) were informed about the study, asked to participate, and allow their data to be included in the analysis. Informed parental and participant consent was obtained for 98 individuals, and 78 participants had complete data available for analysis.

#### **Materials**

**Target Words.** Target words consisted of 20 morphologically complex words and 20 simple rare words. All 40 target words were rare. They have a frequency of occurrence of less than 10 times out of 1,000,000 words, or less than 4,100 times out of 410,000,000 which is the number of words in the Corpus of Contemporary American



English database (COCA; Davies, 2011). This rate of occurrence has been used as a threshold for rareness in previous research (Perfetti, 2007). Target words fall well below this threshold with a range of 4 to 1396,  $M = 411.56$ .

All 40 target words, 20 morphologically complex and 20 morphologically simple words, were selected as target words from the MRC Psycholinguistic Database (Wilson, 1988). Initial search criteria were set to include words with an imageability rating, an age of acquisition (AoA) of 500 or greater, two or more syllables, and a syntactic classification of noun, verb, or adjective. Of note, imageability ratings are available on 9,240 of the 150,837 words in the MRC database, and only 3503 of the words in the database have age of acquisition ratings. This search yielded approximately 500 words, but insufficient numbers of morphologically simple adjectives. The search was expanded to include age of acquisition ratings of 400 or greater, and sufficient words returned available for selection. Target words are statistically equivalent in Age of Acquisition, imageability, and frequency (See Table 2 below). Each of these factors has been demonstrated to influence vocabulary acquisition, and so each of these factors was controlled for by equating the target words on these factors. This allowed an investigation of the influence only of morphological complexity and number of exposures without potentially confounding the results with the above factors.

Morphologically complex nonwords were created using existing morphologically complex words. Prefixes and suffixes of existing word were retained, and morphological roots were replaced with a phonologically transparent nonwords comprised of possible

English letter combinations. Similarly, morphologically simple words were replaced by nonwords of equivalent syllable length. Syllable length has been shown to influence incidental vocabulary acquisition (Nagy et al., 1987). Manipulating the length of morphologically simple words controlled for pre-existing knowledge and produced target words that are statistically equivalent in length and number of syllables to the morphologically complex nonwords. This process reduced the inherent variation in word length and syllables between simple and morphologically complex words to provide greater clarity to any differential gain between the two word types.

Table 2

*Target Word Characteristics*

Morphology	AoA	Imageability	Number of Syllables	Number of Letters	Kucera- Francis Written Frequency	Thorndike- Lorge Written Frequency	COCA Frequency
Simple Words	545	398	1.75*	5.7*	6.3	39.5	248.45
Complex Words	566	374	3.5*	10.17*	9.25	76.09	420.17

Note:  $*p < .001$  in original form.  $p = .37$  syllables;  $p = .64$  letters in nonword form. COCA Frequency is the number of times the target word occurs in the 410 million word corpus (Davies, 2011).

Table 3  
*Nonword Characteristics*

Original	Letters	Syllables	Replacement	Letters	Syllables
Target			Nonword		
Word			/nonroot		
brigand	7	2	barrazon	8	3
clamor	6	2	doppelate	9	3
coffer	6	2	brasterer	9	3
craven	6	2	skiticult	9	3
cunning	7	2	commerine	9	3
dowager	7	3	fenneriser	10	4
eyrie	5	2	glisteren	9	3
lumber	6	2	blonterstape	12	3
melee	5	2	tafflest	8	3
plunge	6	1	frescovent	10	3
realm	5	1	empliforven	11	4
rogue	5	1	bannifer	8	3
simper	6	2	cannarrate	10	3
snub	4	1	happement	9	3
stile	5	1	commerant	9	3
stoic	5	2	hampent	7	2

Table 3 (cont.)

succor	6	2	perplisteronk	13	4
thane	5	1	contramponist	13	4
urchin	6	2	prindle	7	2
vale	4	1	thaskrel	8	2
<b>absolution</b>	10	3	<b>absalcion</b>	9	3
<b>allegation</b>	10	4	<b>allanation</b>	10	4
<b>benefactor</b>	10	4	<b>tullfactor</b>	10	4
<b>capitulate</b>	10	4	<b>ropitulate</b>	10	4
<b>compile</b>	7	2	<b>comdute</b>	7	2
<b>complication</b>	12	4	<b>comfresation</b>	12	4
<b>concurrent</b>	10	3	<b>condarent</b>	9	3
<b>conspirator</b>	11	4	<b>condravator</b>	11	4
<b>decomposition</b>	13	5	<b>decomfubition</b>	13	5
<b>expedition</b>	10	4	<b>expispition</b>	11	4
<b>fortification</b>	13	5	<b>fretification</b>	13	5
<b>obstruction</b>	11	3	<b>obsatsion</b>	10	3
<b>precipitate</b>	11	3	<b>pretudate</b>	9	3
<b>projectile</b>	10	3	<b>prosuville</b>	9	3
<b>proportion</b>	10	3	<b>prophapsion</b>	10	3

Table 3 (cont.)

pro <b>vis</b> ional	10	4	pro <b>ti</b> bional	10	4
re <b>cept</b> acle	10	4	re <b>zond</b> acle	10	4
re <b>duc</b> tion	9	3	re <b>mub</b> tion	9	3
re <b>mitta</b> ance	10	3	re <b>kibb</b> ance	10	3
sup <b>posit</b> ion	11	4	suff <b>ub</b> ition	11	4

**Tasks.** Eight researcher created texts were developed. Texts contain 16 target words of varying numbers of contextual occurrences. Target words appear as 1 exposure, 6 exposures, 12 exposures, or 20 exposures in the tasks. The tasks were analyzed using Coh-Metrix Version 3.0 (McNamara, Louwerse, Cai, & Graesser, 2013). Each task is narrative and approximately 1,100 words long (i.e.,  $M = 1166.25$ , range 755-1588). The tasks are at or below the 7<sup>th</sup> grade reading level (i.e., Flesh-Kincaid  $M = 6.48$ ) to reduce decoding requirement of the texts. Lexile measures were obtained for each task by the researcher with the free online analyzer. The tasks have an average Lexile level of 1025. See Table 4 for story specific task characteristics. The tasks include narratives about activities commonly experienced in the sample (e.g., camping, playing games), frequently encountered in the media (e.g., airplanes, doctors, amputees), or recently popular in movie culture (e.g., pirates, bears). The sample is likely to have necessary prerequisite background knowledge to understand the texts. See Table 5 for frequency of

occurrence and order of presentation of target words. Each occurrence of a target word is followed by a brief definition. Prior research has demonstrated highly supportive contexts support the creation of decontextualized semantic information (Bolger et al., 2008).

Table 4

<i>Task Characteristics</i>					
Story	Lexile	Mean	Story	Flesh-	Flesh-
	Level	Sent.	Length	Kincaid	Kincaid
		Length	(words)	Grade	Reading
		(words)		Level	Ease <sup>a</sup>
1	1030L	15.723	1588	6.46	76.751
2	990L	14.725	1502	6.50	74.718
3	1020L	15.458	912	5.85	80.658
4	920L	15.382	846	5.49	83.103
5	1050L	16.778	755	6.57	77.88
6	960L	15.531	1258	6.36	77.115
7	1160L	17.658	1289	7.01	69.795
8	1070L	16.164	1180	6.74	75.542

<sup>a</sup> Scale ranges from 0-100; 0 = difficult 100 = easy

Table 5

*Target Word Occurrence and Distribution by Story*

	S1	S2	S3	S4	S5	S6	S7	S8	Total
clamor	2	3	1	1	1	3	-	1	12
brigand	3	5	3	5	-	-	-	4	20
coffer	3	-	-	3	-	-	-	-	6
craven	-	-	1	-	-	-	-	-	1
cunning	2	5	4	3	2	3	-	1	20
dowager	4	-	-	-	-	5	2	1	12
eyrie	-	-	-	-	-	-	-	1	1
lumber	3	1	3	1	1	2	6	3	20
melee	-	6	-	3	-	2	-	1	12
plunge	3	5	3	2	2	2	2	1	20
realm	-	-	-	-	-	-	3	3	6
rogue	-	6	-	3	5	-	-	6	20
simper	-	2	-	-	-	-	5	5	12
snub	-	2	-	1	-	-	-	3	6
stile	3	-	2	-	-	-	6	1	12
stoic	-	-	2	1	-	-	1	2	6
succor	1	-	-	-	-	-	5	-	6



Table 5 (cont.)

thane	-	-	-	-	-	-	-	1	1
urchin	6	1	-	-	-	7	-	6	20
vale	-	-	-	-	-	-	-	1	1
absolution	-	-	-	-	-	-	-	1	1
allegation	1	2	-	2	-	1	-	-	6
benefactor	1	-	-	-	-	-	-	-	1
capitulate	4	1	1	1	2	2	1	-	12
compile	-	-	1	-	1	-	3	1	6
complication	3	2	-	-	2	-	3	2	12
concurrent	5	2	1	3	2	2	3	2	20
conspirator	3	3	-	-	-	-	-	-	6
decomposition	-	-	1	-	2	1	-	2	6
expedition	-	-	3	2	-	2	4	1	12
fortification	2	1	2	1	4	2	4	4	20
obstruction	8	2	-	-	2	3	4	1	20
precipitate	2	1	1	-	1	-	1	-	6
projectile	4	4	2	2	3	3		2	20
proportion	-	-	-	2	-	3	-	1	6
provisional	2	2	2	2	3	2	5	1	20

Table 5 (cont.)

receptacle	6	1	3	-	1	1	-	-	12
reduction	-	-	-	-	-	-	1	-	1
remittance	-	-	-	-	-	2	2	2	6
supposition	-	1	-	-	-	-	-	-	1

Table 6

*Equivalency of Word Features by Frequency of Occurrence*

Frequency in Task	Age of Acquisition	Imageability	Syllables	Letters	Kucera- Francis Freq.	Thorndike- Lorge Freq.	Corpus of Contemporary American
1:6	0.66	0.93	0.65	0.92	0.46	0.33	0.25
1:12	0.50	0.18	0.77	0.76	0.73	0.16	0.49
1:20	0.35	0.21	0.55	0.60	0.44	0.39	0.32
6:12	0.21	0.13	0.81	0.84	0.25	0.99	0.56
6:20	0.15	0.15	0.86	0.65	0.38	0.96	0.84
12:20	0.61	0.90	0.66	0.74	0.28	0.96	0.74

Note: *p* values; no significant differences

## Measures

**Peabody Picture Vocabulary Test III (PPVT-III).** The PPVT-III was used to measure vocabulary knowledge. The PPVT-III is an individually administered measure of receptive vocabulary knowledge. Participants are presented orally with a target word and shown four pictures. The participant selects the picture that best represents the meaning of the target word. The average individual administration time is approximately 15 minutes. The PPVT-III is a normed, standardized instrument for a broad range of ages (2:6-90 years) and is a reliable instrument with reliability scores of .90.

The PPVT was modified for group administration (see Cunningham & Stanovich, 1990; Echols et al. 1996). The participants looked at four picture alternatives while the researcher read the word out loud. The participants were instructed to choose the picture that best fit the meaning of the word presented by the researcher. The participants marked their response on answer sheets. This administration methodology has been successfully performed in prior studies (i.e., Cunningham & Stanovich, 1991; Echols et al., 2006) and was utilized to reduce the total testing time of participants. Measure reliability for the PPVT as a group administered measure with this sample was  $\alpha = .96$ .

**Test of Word Reading Efficiency 2 (TOWRE 2).** The TOWRE 2 was used to measure decoding and word reading fluency. The TOWRE 2 is an individually administered standardized measure which consists of two subtests: Phonetic Decoding Efficiency (PDE) and Sight Word Efficiency (SWE). The PDE subtest uses phonetically

decodable nonwords to measure decoding ability. Participants were presented with a list of decodable nonwords and asked to decode as many as possible within the time constraint of 45 seconds. The SWE subtest is a measure of word level fluency.

Participants were presented with a list of real words and asked to read as many as possible with a 45 second time period. The TOWRE 2 has been normed and standardized for ages six through 24 with reliability coefficients of .90. The TOWRE is a measure of context free decoding efficiency which has been strongly correlated with reading comprehension and knowledge acquisition (Stanovich, 1986).

**Gates-MacGinitie Reading Test, 4<sup>th</sup> Edition, Form T (GMRT).** The Gates-MacGinitie Reading Test is a group administered, norm-referenced measure of general reading ability. The reading comprehension subtest was used in the study. This measure presents participants with short passages followed by several multiple choice comprehension questions. Literal and inferential questions are included in this measure. Reading comprehension subtest reliability ranges from .87 to .92. Reading comprehension ability has been strongly correlated with the ability to derive the meanings of unknown words from context (Nagy et al., 1985; Jenkins et al., 1984). Sample reliability was  $\alpha = .94$  on this measure.

**Working Memory Test Battery for Children, Listening Recall (WMTB-C).**

The listening recall subtest of the WMTB-C was used to assess working memory of participants. This test is an individually administered assessment of working memory

included in a larger standardized test battery that was developed for use in 5 to 15 year olds. This task evaluates central executive functioning. Participants were presented with a series of sentences beginning with one sentence. The participants determined if the sentences were correct and then attempted to recall the last word in each sentence presented. An additional sentence was added in each round of assessment (i.e., after every six sentences, an additional sentence is added) until the participant could no longer recall the last word of the added sentence for three sentences in any given level. WMTB-C listening recall subtest has a reliability coefficient of .62 (Gathercole & Pickering, 2000). Sample reliability for this measure was  $\alpha = .75$ .

**Modified Title Recognition Test (TRT).** A modified TRT was used to assess the relative print exposure level of each participant. The Title Recognition Test (TRT, Cunningham & Stanovich, 1990) has frequently been utilized to measure relative levels of print exposure for participants. The TRT was developed in 1990 by Cunningham and Stanovich. These measures were later validated with a group of 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade students (Cunningham & Stanovich, 1991). The TRT has advantages not found in other measures of print exposure. Because the TRT does not seek to measure absolute amounts of time spent reading participants, it is not influenced by participants' desire to provide socially acceptable responses (Cunning & Stanovich, 1990). Misrepresentation of reading time has been problematic with other measures that attempted to determine time spent reading (Stanovich & West, 1989). Instead of using participant self-report of reading

amounts or asking the participant to keep a detailed reading diary (e.g., Anderson et al., 1988), the TRT consists of a checklist with titles of real works likely to be encountered in wide reading, such as *A Wrinkle in Time*, *Call of the Wild*, or *My Friend Flicka*, and foil titles. The participant is asked to select the titles with which they are familiar. *Signal detection logic* is utilized in the scoring of this measure (Cunningham & Stanovich, 1991). This technique has been effectively used in additional literacy measures (e.g., Freebody & Anderson, 1983). The proportion of foils identified is subtracted from the proportion of identified titles to create a final score. This results in an easily administered, highly reliable measure without the bias of self-report or the time requirements of a diary (Freebody & Anderson, 1983; Cunningham & Stanovich, 1991).

The TRT was updated by Marschark et al. (2012) for undergraduate college students. An updated version of Marschark's TRT (2012) was utilized in this study. The measure is a checklist of 85 real book titles and 85 foils. The real titles were selected by Marschark as works likely to be read recreationally from kindergarten through the 12<sup>th</sup> grade. Four titles were deleted from Marschark's version of the TRT; the titles *A Wrinkle in Time*, *The Outsiders*, *The Odyssey*, and *The Hobbit*, were removed because they are included in the grade 3 through 8 curricula in the school system used in the study or because the title was read in the course of RTI intervention by some students included in this study. Recent popular titles were added for the years from 2013-2015, and an equal number of foil titles were added also. The 168 titles, real and foil, were randomized with

a random list generator. Co-reliability estimates of the TRT from Marschark's research which include the MRT are reported as  $\alpha = .697$  with participants with normal hearing. Reliability for the original instrument was Cronbach's  $\alpha = .82$  (Cunningham & Stanovich, 1990). Cronbach's alpha estimate of reliability is  $\alpha = .89$  for this measure with sample data. See measure in Appendix D.

**Modified Test of Morphological Awareness.** This was used to measure morphological awareness. The Modified Test of Morphological Awareness is a 30-item, group administered measure developed from Carlisle's original Test of Morphological Awareness (Carlisle, 2000) for use with secondary students. It measures both derivational and decomposition processes of morphological awareness. The original five items from each process of Carlisle's task were included to provide appropriate floor of the test with additional items of lesser frequency included to avoid ceiling effects originally detected with young children. This measure has been piloted in a prior study with a sample drawn from a similar population (Cooper et al., 2014) and demonstrated reliability coefficients of .85. Similarly, measure reliability was .83 for this sample.

**Morphological Nonword Analysis Task.** This is a measure of morphological analysis which underlies the process of morphological generalization. This 18-item multiple-choice measure contains of nine morphologically accessible and nine morphologically inaccessible nonwords. Each of the nonwords is presented in a context sentence followed by three answer choices. The choices are comprised of answer ranging



from single word to short phrase in length. Each of the answer choices is semantically plausible in the sentence. For example, the context sentence for the nonword *addicant* is: *The addicant was removed from the store shelves; the possible answer choices are: problematic drug, expired food, and fire-causing chemicals.* To determine the intended meaning of the nonword *addicant*, the participant must analyze the morphological structure of the word to determine ‘problematic drug’ is the correct answer. Reliability estimates from McCutcheon and Logan (2011) for this measure are  $\alpha = .74$ . Measure reliability for this sample was  $\alpha = .744$ .

**Semantic Productive Knowledge Acquisition Measure.** This measure is a researcher created measure specifically designed to measure knowledge of words included in target text, and assessments of this type in which the student is asked to supply a definition for a target word have been routinely included in vocabulary acquisition studies to determine level of vocabulary knowledge acquisition in writing (e.g., Jenkins et al., 1984; Reynolds, 2015) and through an interview format (Nagy et al., 1985). This 40-item measure was used to assess acquisition of complete vocabulary knowledge of target words. Each item is open-ended. Target nonwords were provided to students. Student was asked to provide a short definition of the target word. Only the target word was presented to the participant; the target word did not appear in a sentence context. Successful performance on this assessment reflects development of decontextualized semantic knowledge. Measure reliability for this sample was  $\alpha = .84$ .

**Semantic Recognition Knowledge Acquisition Measure.** This measure was used to assess acquisition of partial knowledge of target words. This 40-item measure is a multiple choice measure designed to be sensitive to smaller increases of word knowledge than with the semantic productive knowledge measure. This measure was administered after the semantic productive knowledge measure to avoid test sensitivity. This measure is a researcher created measure designed to measure partial acquisition of knowledge of words included in target text. Target nonwords are presented as question stems followed by four randomly ordered definitions: the target nonword definition and three distractor definitions. The definitions of the target words are the definitions which appeared embedded in the text of each task. The definitions of the distractors are definitions of words of the same syntactic class as the target words. The distractor definitions are loosely related to the meaning of the target word. For example, the distractors for the target nonword *rekibbance* (i.e., real word, remittance) are ‘a piece of writing in a newspaper’; ‘a report or description of an event’; and ‘an object made by a human being’. Each distractor represents something produced by a human, two of which specifically reference paper. Additionally, distractors are of similar length to the definition of the target nonword, and parallel construction of definitions or similar beginnings were used. These measures reduce a participant’s ability to select a correct answer based on a factor other than semantic knowledge. Measure reliability for this sample was  $\alpha = .77$ .

**Syntactic Class Knowledge Acquisition Measure.** This 40-item researcher created measure was designed to assess a student's acquisition of syntactic class information of target words. Acquisition of syntactic class information of target words also represents partial knowledge acquisition. Each target word was presented in a two sentences. One sentence contains the target word in a syntactically possible position. One sentence contains the target word in a syntactically impossible position. The participants were asked to judge in which sentence the target word is used correctly. Correct identification of the syntactically plausible sentence represented partial knowledge development of semantic information even when the participant was not explicitly aware of semantic knowledge of the target word (Shore & Durso, 1990). Sample reliability for this measure was  $\alpha = .73$ .

**Morphological Knowledge Measure.** This is a 20-item researcher created, open-ended measure designed to assess a student's ability to extract the meaning of root words from target words. The Morphological Knowledge Measure is a productive measure of morphological knowledge. Students were presented with the target word with the root portion bolded and asked to define the bolded portion of the word. This measure was scored 0 for no response or an incorrect response and 1 for a correct meaning or synonym of the nonroot. Calculation of reliability was not possible due to low participant response rates.

**Procedure**

Participants were recruited from freshmen and sophomore English classes in the school in which the researcher is employed. Participants were informed that the purpose of the study was to obtain general information about how they read and learn from reading and presented with IRB permission forms. After obtaining informed parental and participant consent, participants completed the battery of independent variable measures (i.e., GMRT-R, PPVT, TOWRE, WMTB-C, modified TRT, Test of Morphological Awareness, and Morphological Nonword Analysis Task). Because experimental tasks were unlikely to alter the abilities tested in the reader characteristic battery, testing continued through the presentations of the tasks. Every student received the same tasks, number of exposures, and presentation of nonwords in tasks in order to allow a cross random-effects model analysis to be performed while minimizing the number of participants required.

All measures were administered in English class. The tasks were presented to the students in English class each day for a total of 8 reading sessions. Dependent variable measures were administered immediately after the final reading of the texts and on the following day (i.e., Morphological Knowledge Measure, Semantic Productive Knowledge Measure, Syntactic Class Knowledge Measure, and Semantic Receptive Knowledge Measure respectively).

## Design

A within-subjects experimental design was used to measure incidental vocabulary acquisition and the relative contribution of factors associated with word-level and person-level features. The text-level independent variables were the number of contextual exposures of the target words and the level of morphological complexity of each word. The use of nonwords and nonroots allowed knowledge acquisition to be measured without the potential influence of preexisting knowledge of target words influencing outcome measures. Of course, prior knowledge might influence vocabulary growth generally and specifically. Background knowledge has been shown to facilitate reading comprehension generally (e.g., Cromley & Azevedo, 2007), and the process of fast mapping relies on the use of existing vocabulary knowledge to determine meanings of novel words (Carey & Bartlett, 1987); thus, persons with higher vocabulary levels might have more resources from which to draw to map novel word meanings. For this reason, the person-level independent variables of print exposure, working memory, morphological awareness, vocabulary knowledge, and reading comprehension were measured. Each of these variables has been demonstrated in prior research to influence comprehension and vocabulary acquisition (Stanovich, 1986; Gathercole, Willis, Emslie, & Baddeley, 1992; Carlisle & Fleming, 2006; Perfetti, 2007; Cain et al., 2003). The dependent variable was vocabulary acquisition as measured as described above. The

measures were administered in order from most challenging to least challenging in terms of knowledge acquired. Administering the tests in this order reduces the likelihood that the participant can utilize information presented on prior measures to increase performance on later measures. For instance, if the semantic recognition measure which requires a student to select the correct definition from a list of choices precedes the productive measure which requires the student to provide the definition without context or choice, the student may be able to glean additional information about the definition of the word. Seeing the word and the definition together in the semantic recognition measure could be considered another exposure to the target word and influence the results of outcome measures. The order of the measures was as follows:

1. Morphological Knowledge Measure. This measure is a productive measure of vocabulary knowledge that requires participants to have successfully inferred the exact meaning of the bound morpheme.
2. Semantic Productive Knowledge Acquisition Measure. This measure is a productive measure of vocabulary knowledge that requires participants to have successfully acquired the exact meaning of the target word.
3. Syntactic Class Knowledge Acquisition Measure. This measure is a receptive measure of syntactic class knowledge of target word. This measure requires participants to have acquired syntactic class information only, not definitional

information, and thus, this measure represents the least amount of knowledge acquisition.

4. Semantic Recognition Knowledge Acquisition Measure. This measure is a receptive measure of vocabulary knowledge that requires the participant to recognize the correct definition.

### **Analysis**

In order to make straightforward comparisons to prior research, similar analyses were included in this study. Specifically, probability of vocabulary acquisition was calculated to compare to the meta-analysis of Swanborn and de Glopper (1999) and the studies contained within as well as recent literature which reports probabilities of acquisition (e.g., Reynolds, 2015). A 2 x 4 ANOVA was performed to examine the differences of relative exposures and morphological complexity in order to compare this study to studies which have used this particular analysis (e.g., Jenkins et al., 1984). In order to contribute new information to the existing body of literature and answer the research questions proposed in this study, a crossed random-effects item response modeling was used to analyze data. Crossed random-effects model offers the ability to examine person-level characteristics and item-level characteristics simultaneously (Cho & Rabe-Hesketh, 2011). Random effects are examined as every item is offered to all persons and every person responds to all items. Thus, participants are treated as raters of similar items. This allows variance to be more appropriately partitioned based on

differences across both person and item (Van Den Noortgate, De Boeck, & Meulders, 2003). Further, crossed random-effects item modeling allows interactions between person characteristics and item characteristics to be examined. This analysis also creates increased accuracy of estimated standard errors of the estimated coefficients which reduces Type I errors (Cho, Partchev, De Boeck, 2012). This type of analysis has been used successfully to examine person-level factors and task level factors in several studies of elements of reading comprehension (e.g., Piasta & Wagner, 2010; Miller, Davis, Gilbert, Cho, Toste, Street, Cutting, 2014; Kim, Foorman, Petscher, & Zhou, 2010).

In the current study, this analysis provides the ability to examine reader and task characteristics simultaneously. Specifically, the analysis examined the level of vocabulary acquisition associated with each level of contextual exposure (i.e., 1, 6, 12, 20) and each level of morphological complexity (i.e., simple or complex) in order to address the first research question: What are the item-level factors that contribute to IVA? The second research question regarding the person-level factors that contribute to IVA was examined through the analysis of reader characteristics (i.e., vocabulary knowledge, decoding ability, reading comprehension, working memory, print exposure, and morphological awareness and analysis). An examination of interactions between reader characteristics and contextual exposures was performed to address the final research question. For example, the analysis investigated the relative benefits of 20 exposures for less skilled readers compared to average readers. An examination of



interactions between word characteristics (i.e., morphologically simple or complex), contextual exposures, and reader characteristics which addresses question 3 was performed in order to reveal if different word or task characteristics foster acquisition differentially in less skilled readers. For example, less skilled readers may not be able to capitalize on the information provided by the morphological constituents of a word and have equivalent rates of acquisition regardless of morphological complexity; whereas, skilled readers may be able to utilize the morphological information present in target words to acquire the morphologically complex words at a faster rate than morphologically simple words or with fewer contextual exposures. The above analysis offers more information than traditional ANOVA repeated measures analysis has the potential to offer by the simultaneous examination of person and task characteristics and the interactions between them.

## CHAPTER FOUR

### RESULTS

Data from this study were analyzed using two different approaches. The first analysis is comparable to analyses historically included in vocabulary acquisition studies (i.e., proportion of acquisition and 2 x 4 ANOVA) and offers comparisons to existing studies. The second analysis used crossed classified random effects modeling techniques to consider item- and person-level factors simultaneously in the analysis. Informed consent for 106 participants was collected. Participants with missing data were excluded from analysis. The majority of missing data points represented a participant missing one measure due to absence from school on the day of testing. Specifically, 22 students were missing 1 measure; eight students were missing two measures, seven students were missing three measures, and two students were missing four measures. Numbers of missing measures include Gates-MacGinitie Reading Comprehension (N=9), PPVT (N=8), Morphological Awareness (N=6), Morphological Analysis (N=15), Print Exposure (N=16), Syntactic Class Knowledge Outcome Measure (N=4), Semantic Recognition Knowledge Outcome Measure (N=4), and Semantic Productive Knowledge Outcome Measure (N=13). Complete data were obtained for 78 participants and were retained for analysis. Participant demographic and independent variables (i.e., reader characteristics) are presented below in Table 7.

Table 7

*Participant Demographics and Mean Reader Characteristics*

<i>N</i> = 78					
Variable	<i>n</i>	%	<i>M</i>	<i>SD</i>	
Demographics					
Age (years)			15.89	.63	
Grade					
9	24	30.77			
10	54	69.23			
Gender					
Female	29	37.18			
Male	49	62.82			
Race					
African American	3	3.84			
Caucasian	75	96.15			
	Measure			Student	
Reader Characteristics	Range		<i>M</i>	<i>SD</i>	Range
Gates	0-48		23.55	9.02	9-40
PPVT <sup>a</sup>	20-160		91.82	13.71	48-117
TOWRE-PDE <sup>a</sup>			96.24	12.25	58-127

Table 7 (cont.)

TOWRE-SWE <sup>a</sup>		94.21	10.00	68-120
WMTB-C <sup>b</sup>	0-36	13.54	2.83	5-21
Morphological Awareness <sup>b</sup>	0-30	14.64	4.63	1-25
Morphological Analysis <sup>b</sup>	0-18	9.01	3.35	2-23
Print Exposure <sup>c</sup>	0-84	18.88	8.79	0-37

<sup>a</sup> Standard scores ( $M = 100$ ,  $SD = 15$ )

<sup>b</sup> Raw scores

<sup>c</sup> Adjusted raw scores

Table 8

*Correlation of Reader Characteristics to Total Score on Outcome Measures at Each Level of Exposure*

						Morphological		Print	Total Score by Exposures			
	Gates	PPVT	PDE	SWE	WM	Aware	Analysis	Exposure	1	6	12	20
Gates	-											
PPVT	<b>.276*</b>	-										
PDE	0.032	0.132	-									
SWE	0.025	0.215	<b>.684**</b>	-								
WM	0.147	0.027	<b>.268*</b>	0.138	-							
Aware	<b>.398**</b>	0.207	0.217	<b>.245*</b>	0.174	-						
Analysis	0.119	0.115	-0.041	0.022	-0.038	0.068	-					
Exp	0.032	-0.134	-0.005	0.008	-0.017	0.108	-0.096	-				
1	0.17	0.162	0.14	0.162	0.167	<b>.309**</b>	0.187	-0.144	-			

Table 8 (cont.)

6	0.199	0.161	0.141	0.118	0.152	<b>.478**</b>	0.047	-0.199	<b>.395**</b>	-		
12	<b>.481**</b>	<b>.264*</b>	<b>.235*</b>	<b>.253*</b>	<b>.248*</b>	<b>.414**</b>	0.09	-0.034	<b>.472**</b>	<b>.533</b>	-	
20	<b>.474**</b>	<b>.334**</b>	<b>.295**</b>	<b>.270*</b>	0.188	<b>.484**</b>	0.194	-0.039	<b>.404**</b>	<b>.549**</b>	<b>.712**</b>	-

Note: Correlations in bold are significant at  $^*p = .05$ ,  $^{**}p = .01$ .

### **Correlational Data**

The CCREM analysis limits examination of outcome measures to dichotomous scores (i.e., measures are scored 0 for incorrect and 1 for correct). In order to further examine the relationship between person independent variables and total knowledge acquisition at each level, correlations were examined (see Table 8). This reveals significant correlations on combined outcome measures for morphological awareness at all levels of exposures; this finding is similar to the findings of significance in the results of the CCREM analysis above. Additionally, at levels of 12 and 20 exposures, there are significant correlations between outcome measures and reading comprehension and vocabulary knowledge which were included in the model of some outcome measures of the CCREM analysis. Phonemic decoding efficiency and sight word efficiency were also significantly correlated with outcome measures at the levels of 12 and 20 exposures which differed from the CCREM analysis. Interaction between exposures and combined vocabulary outcome measures is presented in Figure 4. Examination of the slopes at each level reveals a comparable increase in the slope of vocabulary acquisition at each exposure level.

### **Probabilities and Numbers of Exposures**

The probability of acquiring the target vocabulary as represented by proportion by the number of contextual exposures and morphological complexity on each type of outcome measure is presented in Table 9. Of note, only two students were successfully

able to extract any precise meaning of the bound root in the target words. One student successfully identified the meaning of the root *pisp* (i.e., ped) as ‘foot’, and another student successfully identified the meaning of the root *suv* (i.e., ject) as ‘throw’. As a result of the lack of measurable acquisition of root knowledge, the Morphological Knowledge Measure was excluded from the analysis.

Overall probability of acquisition of semantic productive knowledge ranges from .03 for words occurring one time to a probability of acquisition of .26 for words occurring 20 times. The trend of increased rates with increased exposures is consistent across all dependent variables (i.e., the outcome measures of semantic productive knowledge, syntactic class knowledge, and semantic recognition knowledge) and word types (i.e., morphologically complex versus morphologically simple). There are significant differences in probability of acquiring a target word based on its morphological complexity. As expected, morphologically complex words were generally acquired at higher rates than morphologically simple words, except at the level of 20 exposures where participant performance on measures of acquisition of simple words is significantly greater. In fact, participants’ scores on outcome measures of simple words were almost double the participants’ performance on measures of acquisition of morphologically complex words (see Figure 1). The additional information provided by the prefixes and suffixes of the morphologically complex words appears to aid in acquisition. The acquisition rate across each type of knowledge acquisition at most levels



of occurrence is higher for morphologically complex words; however, surprisingly, significant differences were found between morphologically simple and morphologically complex words in favor of morphologically simple words on all dependent variable measures and combined vocabulary measures at the 20 exposures level, (see Table 8 below). Possible explanations for this finding will be addressed in the discussion.

Additionally, results revealed that participants were more likely to extract syntactic class information than other types of semantic information. The acquisition of syntactic class information occurred at considerably higher probabilities at each level of exposure than either semantic recognition or productive information. In fact, participants were able to identify the correct syntactic usage of morphologically simple words with 100% accuracy for words that occurred 20 times over the course of the readings. The probability of gleaning semantic recognition information consolidation followed syntactic class knowledge with relatively high probabilities of acquisition ranging from .29 to .81, again with the highest probability of acquisition of semantic recognition information occurring with the simple target words with the exposure rate of 20 occurrences. Finally, semantic productive information was the most challenging for readers to extract with much lower overall probabilities of acquisition ranging from .03 to .45. There is a significant increase in the probability of semantic productive knowledge acquisition at the 20 exposure threshold with increases to nearly 4 times the rate of semantic

productive knowledge acquisition probability between the 12 and 20 exposures level (i.e.,

$P = .07$  versus  $P = .26$ )

Table 9

*Probability of Vocabulary Acquisition by Exposures and Morphological Categorization*

	Overall	Simple	Complex	Overall	Simple	Complex	Overall	Simple	Complex	Overall	Simple	Complex
Exposures	1	1	1	6	6	6	12	12	12	20	20	20
Syntactic	0.55	0.52	0.57	0.57	0.54	0.59	0.59	0.48	0.6	0.69	1	0.57
Recognition	0.29	0.3	0.29	0.31	0.32	0.3	0.39	0.32	0.4	0.49	0.81	0.29
Productive	0.03	0.06	0	0.05	0.04	0.06	0.07	0.06	0.06	0.26	0.45	0
M	5.18	2.04	<b>3.14</b>	8.79 <sup>a</sup>	3.36 <sup>b</sup>	<b>5.44<sup>c</sup></b>	10.82 <sup>a</sup>	5.01 <sup>b</sup>	<b>5.81<sup>c</sup></b>	13.98 <sup>a</sup>	<b>9.25<sup>b</sup></b>	4.73 <sup>c</sup>
SD	1.91	1.32	1.26	2.55	1.5	1.74	4.22	2.29	2.59	5.46	3.62	2.44

*Note.* Means in bold are significant at the  $p < .001$  level and represent comparisons between simple and complex words.

<sup>a</sup> Probabilities of overall acquisition are significantly higher than the previous level of exposures at the  $p < .001$  level.

<sup>b</sup> Probabilities of overall acquisition of simple words are significantly higher than the previous level of exposures at the  $p < .001$  level.

Table 9 (cont.)

<sup>c</sup> Probabilities of overall acquisition of complex words are significantly higher than the previous level of exposures at the  $p < .001$  level.

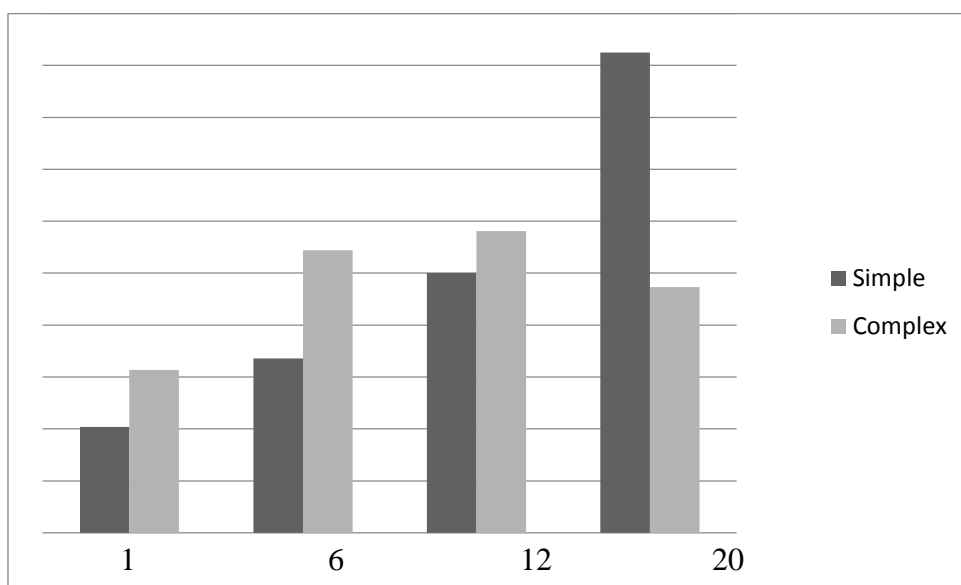


Figure 1

*Combined Performance on Outcome Measures at Each Exposure Level*

Examination of acquisition rates by level of contextual occurrences reveals significant differences by occurrence frequency on each dependent variable outcome with increased exposure levels leading to increased rates of acquisition. Significant differences were found between each level of exposures: 1:6, 6:12, and 12:20. See Table 8 for exposure descriptive statistics and acquisition rate comparisons. Table 10 presents the average acquisition by word. As expected, 20 exposure words individually have the highest rates of acquisition on each outcome measure. Surprisingly, participant performance on the syntactic class knowledge outcome measure was relatively high even

on one exposure words even when semantic knowledge outcomes were negligible or nonexistent (e.g., *contramponist* Syntactic Class Knowledge Measure  $M = .64$ ,  $SD = .48$ , Semantic Receptive Knowledge Measure  $M = .14$ ,  $SD = .35$ , Semantic Productive Knowledge Measure  $M = 0$ ,  $SD = 0$ ). This finding suggests syntactic class knowledge of an unknown word is consolidated at higher rates than productive or receptive knowledge.

Table 10

*Descriptive Statistics by Syntactic Class Knowledge, Semantic Recognition Knowledge, and Semantic Productive Knowledge Measures for Target Words*

Word	Complex	Exposures	Syntactic		Semantic		Semantic	
			Class		Syntactic		Productive	
			Knowledge		class		Knowledge	
					Knowledge			
			$M^a$	$SD$	$M^a$	$SD$	$M^a$	$SD$
absalcion	1	1	0.74	0.44	0.41	0.50	0.01	0.11
allanation	1	6	0.72	0.45	0.27	0.45	0.00	0.00
bannifer	0	20	0.81	0.40	0.71	0.46	0.35	0.48
barrazon	0	20	0.76	0.43	0.68	0.47	0.54	0.50
blonterstape	0	20	0.67	0.47	0.51	0.50	0.41	0.50

Table 10 (cont.)

brasterer	0	6	0.51	0.50	0.49	0.50	0.00	0.00
cannarrate	0	12	0.73	0.45	0.28	0.45	0.08	0.27
comdute	1	12	0.63	0.49	0.23	0.42	0.00	0.00
comfresation	1	12	0.72	0.45	0.47	0.50	0.03	0.16
commerant	0	12	0.40	0.49	0.32	0.47	0.00	0.00
commerine	0	20	0.68	0.47	0.58	0.50	0.18	0.39
condarent	1	20	0.68	0.47	0.32	0.47	0.12	0.32
condravator	1	6	0.71	0.46	0.29	0.46	0.09	0.29
contramponist	0	1	0.64	0.48	0.14	0.35	0.00	0.00
decomfubition	1	6	0.54	0.50	0.44	0.50	0.21	0.41
doppelate	0	12	0.56	0.50	0.38	0.49	0.10	0.31
empliforven	0	6	0.42	0.50	0.19	0.40	0.05	0.22
expispition	1	12	0.72	0.45	0.60	0.49	0.22	0.42
fenneriser	0	12	0.64	0.48	0.49	0.50	0.13	0.34
frescovent	0	20	0.76	0.43	0.29	0.46	0.01	0.11
fretification	1	20	0.68	0.47	0.42	0.50	0.17	0.38
glisteren	0	1	0.45	0.50	0.29	0.46	0.18	0.39
hampent	0	6	0.74	0.44	0.38	0.49	0.04	0.19





### Complexity and Contextual Exposures

A 2 (word complexity) x 4 (number of occurrences) repeated-measures ANOVA was performed through the MANOVA approach. Significant main effects were found for number of occurrences for vocabulary acquisition measures,  $F(3, 75) = 97.53, p < .001$ , Wilks'  $\Lambda = .20$ . Contrasts revealed increased occurrences of words produced significantly higher vocabulary acquisition outcomes between levels of occurrence with large effects at each level of comparison: 1:20,  $F(1,77) = 1510.62, p < .001, d = 2.15$ ; 6:20,  $F(1,77) = 524.11, p < .001, d = .1.22$ ; 12:20,  $F(1,77) = 194.733, p < .001, d = .65$ . Increased rates of occurrences resulted in significantly increased rates of acquisition in both morphologically simple and morphologically complex words with the most dramatic effect between one occurrence and twenty occurrences, but each level of occurrence produced a larger effect than the previous level on vocabulary acquisition. There was a nonsignificant main effect for word complexity,  $F(1,77) = 1.35, p = .249$ , Wilks'  $\Lambda = .98$ ; however, there was a significant interaction between word complexity and number of occurrences,  $F(3,75) = 97.88, p < .001$ , Wilks'  $\Lambda = .20$ . Examination of interaction contrasts revealed significant differences between simple and complex words at each level of occurrence with large effects between morphologically complex and simple words: 1:20,  $F(1,77) = 197.33, p < .001, r = .85$ ; 6:20,  $F(1,77) = 292.108, p < .001, r = .89$ ; 12:20,  $F(1,77) = 31.037, p < .001, r = .79$ . Descriptive statistics for overall

acquisition by complexity type are presented in Table 8. Examination of contrast information and descriptive statistics reveal morphologically complex words are acquired at significantly higher rates at the levels of one, six, and twelve occurrences. At 20 occurrences, morphologically simple words are acquired at a significantly higher rate than morphologically complex words.

### **Cross Classified Random Effects Modeling**

Data were analyzed for each outcome measure using item-response crossed random effects modeling in order to simultaneously analyze item- and person- level information and partition variance to both. A null model was created for each outcome measure (i.e., syntactic class knowledge, semantic recognition knowledge, and semantic productive knowledge) that included only person and item random effects. The null model for semantic productive knowledge acquisition had an intercept logit estimate of -4.214 representing the low baseline semantic productive knowledge acquisition probability of .03. The null model for semantic recognition knowledge acquisition had an intercept logit estimate of -0.611 representing the semantic recognition knowledge acquisition probability of .29. The null model for syntactic class acquisition had an intercept logit estimate of 0.443 representing the highest level of acquisition in the outcomes categories with probability of .55. Null model summary data are presented below in Table 11.

Table 11

*Model Comparison Data by Outcome Measures*

Model	Outcome	Intercept	Log	Random Variance	
		Estimate	Likelihood	Person	Item
Unconditional	Productive	-4.214	-725.7	2.36	5.67
Unconditional	Recognition	-0.611	-1912.3	.48	.39
Unconditional	Syntactic	0.415	-2032.2	.44	.48
Conditional	Productive	-3.796	-686.5	1.23	2.86
Conditional	Recognition	-0.516	-1885.1	.32	.23
Conditional	Syntactic	0.415	-2007.2	.07	.17

Every item-level and person-level characteristic was entered into the fixed effects model. Multiple models with random effects for both item and person-level characteristics were created and tested against the fixed effects model to find model with best fit. No models with random effects fit significantly better than the fixed effects models. Interactions were examined using the fixed effects models for each outcome measure.

**Syntactic Class Knowledge Acquisition Model.** Fixed effects model revealed the number of contextual exposures to be a significant item-level characteristic ( $\gamma_{001} =$

.242,  $z = 3.171$ ; see Table 12). This is a consistent finding among all analyses.

Morphological complexity was not a significant factor of syntactic class knowledge acquisition in this model as in the ANOVA analysis, but there is no significant interaction detected between morphological complexity and exposures which was present in the traditional analysis. Significant person-level factors include reading comprehension ( $\gamma_{003} = 0.136$ ,  $z = 2.396$ ) and morphological awareness ( $\gamma_{009} = 0.173$ ,  $z = 2.497$ ). There were no significant interactions. This represents a deviation from the findings of the traditional analyses and the other CCREM models on the semantic recognition and productive outcomes of word acquisition. The interaction between exposures and reading comprehension which were significant in the semantic recognition and productive knowledge models, fell to a  $p$  value of  $p = .10$  in the model of syntactic class acquisition.

Table 12

*Fixed Effect Estimates for Response on Syntactic Class Knowledge Acquisition*

Fixed Effect Parameters	Estimate	SE	z
Intercept ( $\gamma_{000}$ )	<b>0.415</b>	<b>0.112</b>	<b>3.698</b>
Item Covariate			
Exposures ( $\gamma_{001}$ )	<b>0.242</b>	<b>0.076</b>	<b>3.171</b>
Morphological Complexity ( $\gamma_{002}$ )	0.067	0.152	0.437
Person Covariates			
Reading Comprehension ( $\gamma_{003}$ )	<b>0.136</b>	<b>0.057</b>	<b>2.396</b>
Working Memory ( $\gamma_{004}$ )	0.077	0.053	1.473
Vocabulary ( $\gamma_{005}$ )	-0.004	0.055	-0.072
Decoding Efficiency( $\gamma_{006}$ )	-0.012	0.071	-0.169
Sight Word Efficiency ( $\gamma_{007}$ )	0.083	0.071	1.165
Morphological Analysis ( $\gamma_{008}$ )	0.019	0.064	0.295
Morphological Awareness ( $\gamma_{009}$ )	<b>0.173</b>	<b>0.069</b>	<b>2.497</b>
Print Exposure ( $\gamma_{010}$ )	-0.033	.051	-0.644

Table 12 (cont.)

Interactions			
	0.083	0.078	1.061
Morphological Complexity			
× Morphological Awareness( $\gamma_{011}$ )			
Morphological Complexity	0.044	0.077	0.578
× Morphological Analysis ( $\gamma_{012}$ )			
Exposures × Vocabulary ( $\gamma_{013}$ )	0.054	0.041	1.325
Exposures	0.076	0.044	1.720
× Reading Comprehension ( $\gamma_{014}$ )			
Exposures	0.062	0.040	1.538
× Working Memory ( $\gamma_{015}$ )			
Exposures × Decoding ( $\gamma_{016}$ )	0.055	0.041	1.323
Exposures	0.051	0.039	1.289
× Morphological Analysis ( $\gamma_{017}$ )			

*Note.* Parameters in bold are significant at the  $p < .05$  level.

**Semantic Recognition Knowledge Acquisition Model.** Fixed effects model revealed the number of contextual exposures to be a significant item-level characteristic ( $\gamma_{001} = 0.366, z = 4.145$ ; see Table 13). This finding is consistent with the traditional analyses. As in the semantic productive knowledge model, morphological complexity was not a significant factor of semantic recognition knowledge acquisition in this model. Significant person-level factors include reading comprehension ( $\gamma_{003} = 0.207, z = 2.378$ ) and morphological awareness ( $\gamma_{009} = 0.204, z = 2.092$ ). There was also a significant interaction between item-level characteristic of exposures and the person-level characteristic of reading comprehension ability ( $\gamma_{014} = 0.137, z = 2.995$ ), but not between morphological complexity and the number of exposures as in the traditional analyses (see Figure 3). Again, the significant person-level factor of morphological awareness likely creates the divergence in outcomes between the CCREM analysis and traditional analysis.

Table 13

*Fixed Effect Estimates for Response on Semantic Recognition Knowledge Acquisition*

Fixed Effect Parameters	Estimate	SE	z
Intercept ( $\gamma_{000}$ )	<b>-0.516</b>	<b>0.140</b>	<b>-3.674</b>
Item Covariate			
Exposures ( $\gamma_{001}$ )	<b>0.366</b>	<b>0.088</b>	<b>4.145</b>
Morphological Complexity ( $\gamma_{002}$ )	-0.174	0.176	-0.989
Person Covariates			
Reading Comprehension ( $\gamma_{003}$ )	<b>0.207</b>	<b>0.087</b>	<b>2.378</b>
Working Memory ( $\gamma_{004}$ )	-0.037	0.081	-0.464
Vocabulary ( $\gamma_{005}$ )	0.011	0.082	0.128
Decoding Efficiency ( $\gamma_{006}$ )	0.183	0.109	1.684
Sight Word Efficiency ( $\gamma_{007}$ )	0.018	0.108	0.171
Morphological Analysis ( $\gamma_{008}$ )	0.069	0.087	0.768
Morphological Awareness ( $\gamma_{009}$ )	<b>0.204</b>	<b>0.098</b>	<b>2.092</b>
Print Exposure ( $\gamma_{010}$ )	-0.114	.079	-1.448



Table 13 (cont.)

Interactions			
Morphological Complexity	-0.103	0.083	-1.252
× Morphological Awareness( $\gamma_{011}$ )			
Morphological Complexity	-0.075	0.079	-0.948
× Morphological Analysis ( $\gamma_{012}$ )			
Exposures × Vocabulary ( $\gamma_{013}$ )	0.009	0.042	0.207
Exposures	<b>0.137</b>	<b>0.046</b>	<b>2.995</b>
× Reading Comprehension ( $\gamma_{014}$ )			
Exposures	-0.034	0.043	-0.809
× Working Memory ( $\gamma_{015}$ )			
Exposures × Decoding ( $\gamma_{016}$ )	0.061	0.045	1.36
Exposures	-0.015	0.040	-0.362
× Morphological Analysis ( $\gamma_{017}$ )			

*Note.* Parameters in bold are significant at the  $p < .05$  level.

**Semantic Productive Knowledge Acquisition Model.** Consistent with the traditional analyses conducted, the fixed effects model revealed the number of contextual exposures to be a significant item-level characteristic ( $\gamma_{001} = 1.475$ ,  $z = 4.63$ ; see Table 14). Morphological complexity was not a significant factor of semantic productive knowledge acquisition in this model. This finding is consistent with the 2 x 4 repeated-measures ANOVA analyses that also revealed a lack of a significant main effect for morphological complexity. However, the model does not reveal a significant interaction between morphological complexity and exposure level that is found in the traditional analysis. Significant person-level factors include vocabulary ( $\gamma_{005} = 0.553$ ,  $z = 2.946$ ) and morphological awareness ( $\gamma_{009} = 0.485$ ,  $z = 2.509$ ). The significance of morphological awareness as a person-level characteristic is likely related to the significant interaction effect between morphological complexity and exposure level from the traditional analyses. The crossed random-effects analysis, a more conservative approach, considers all of the factors simultaneously and the portioning of variance to the person-level factor of morphological awareness likely reduces variance associated with a word's morphological complexity. This person-level partitioning of variance does not occur in the repeated measures ANOVA, and so the interaction effect between morphological complexity and number of exposures is detected. There is also a significant interaction between item-level characteristic of exposures and the person-level characteristic of reading comprehension ability ( $\gamma_{014} = 0.202$ ,  $z = 2.396$ ; see Figure 2).

Table 14

*Fixed Effect Estimates for Response on Semantic Productive Knowledge Acquisition*

Fixed Effect Parameters	Estimate	SE	z
Intercept ( $\gamma_{000}$ )	<b>-3.796</b>	<b>0.467</b>	<b>-8.122</b>
Item Covariate			
Exposures ( $\gamma_{001}$ )	<b>1.478</b>	<b>0.319</b>	<b>4.630</b>
Morphological Complexity ( $\gamma_{002}$ )	-0.801	0.612	-1.310
Person Covariates			
Reading Comprehension ( $\gamma_{003}$ )	0.098	0.184	0.531
Working Memory ( $\gamma_{004}$ )	0.221	0.193	1.142
Vocabulary ( $\gamma_{005}$ )	<b>.553</b>	<b>.188</b>	<b>2.946</b>
Decoding Efficiency( $\gamma_{006}$ )	0.131	0.233	0.565
Sight Word Efficiency ( $\gamma_{007}$ )	0.061	0.222	0.277
Morphological Analysis ( $\gamma_{008}$ )	0.300	0.172	1.748
Morphological Awareness ( $\gamma_{009}$ )	<b>0.485</b>	<b>0.193</b>	<b>2.509</b>
Print Exposure ( $\gamma_{010}$ )	-0.193	.164	-1.173

Table 14 (cont.)

Interactions			
Morphological Complexity	0.333	0.172	1.937
× Morphological Awareness( $\gamma_{011}$ )			
Morphological Complexity	-0.039	0.141	-0.277
× Morphological Analysis ( $\gamma_{012}$ )			
Exposures × Vocabulary ( $\gamma_{013}$ )	-0.034	0.091	-0.379
Exposures	<b>0.202</b>	<b>0.084</b>	<b>2.396</b>
× Reading Comprehension ( $\gamma_{014}$ )			
Exposures	-0.046	0.100	-0.425
× Working Memory ( $\gamma_{015}$ )			
Exposures × Decoding ( $\gamma_{016}$ )	0.009	0.096	0.102
Exposures	-0.007	0.074	-0.095
× Morphological Analysis ( $\gamma_{017}$ )			

*Note.* Parameters in bold are significant at the  $p < .05$  level.

## **Overall Results of CCREM Analysis**

**Person-Level Factors.** The CCREM analysis revealed that reading comprehension, vocabulary knowledge, and morphological awareness were significant person-level factors in the process of incidental vocabulary acquisition in this study. Vocabulary knowledge was a significant factor in the acquisition of semantic productive knowledge. Morphological awareness was also a significant factor in the acquisition of all outcome measures of vocabulary acquisition: syntactic class, semantic recognition, or semantic productive knowledge. Reading comprehension ability was a significant factor in the acquisition of partial knowledge, as measured by syntactic class knowledge and semantic recognition knowledge outcome measures, and reading comprehension ability also interacted with the number of exposures of a word within the text on the semantic recognition and productive knowledge models.

**Item-Level Factors.** The number of exposures of a word is the only significant item-level factor revealed by the CCREM analysis on each outcome measure. The number of exposures was a significant item-level factor at each level of vocabulary acquisition. Morphological complexity of an item does not appear to significantly affect vocabulary acquisition outcomes.

**Interactions between Person-Level and Item-Level Factors.** Analysis revealed interactions of person-level and item-level factors occur between the item-level factor of number of exposures and the person-level factor of reading comprehension on the

semantic recognition and productive acquisition outcomes. Visual examination of interaction graphs on the semantic productive knowledge outcome measure (see Figure 2) reveal increasing slopes at each level of exposure and a dramatic increase between 20 exposures level and the levels of 12 and below. Visual examination of the interaction graphs on semantic recognition outcome measure (see Figure 3) revealed more dramatic increases between each level of exposure until the 12 exposure level is reached. The slopes and outcomes of the 12 exposure level and 20 exposure level are virtually identical.

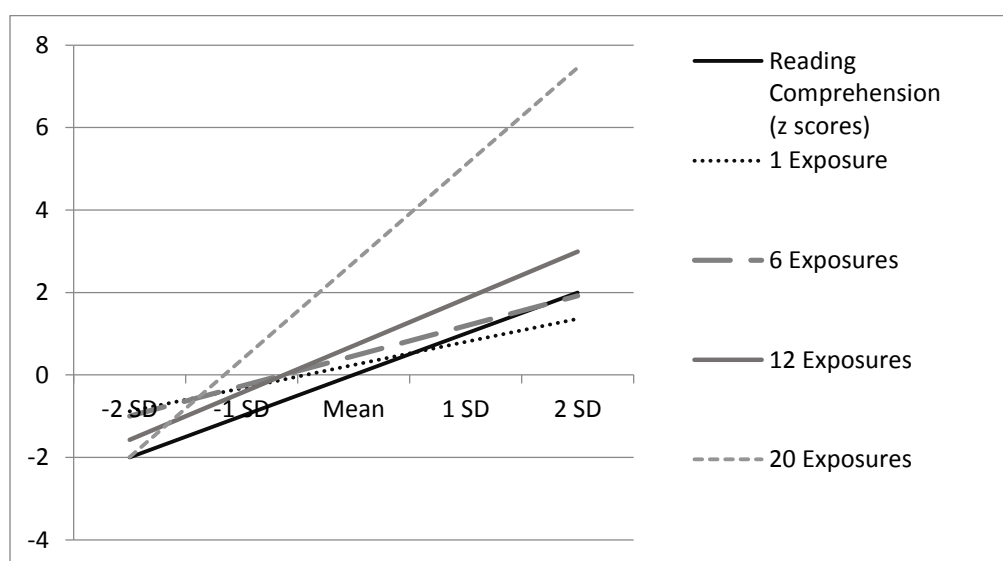


Figure 2

*Interaction between Reading Comprehension and Exposures on Productive Outcome*

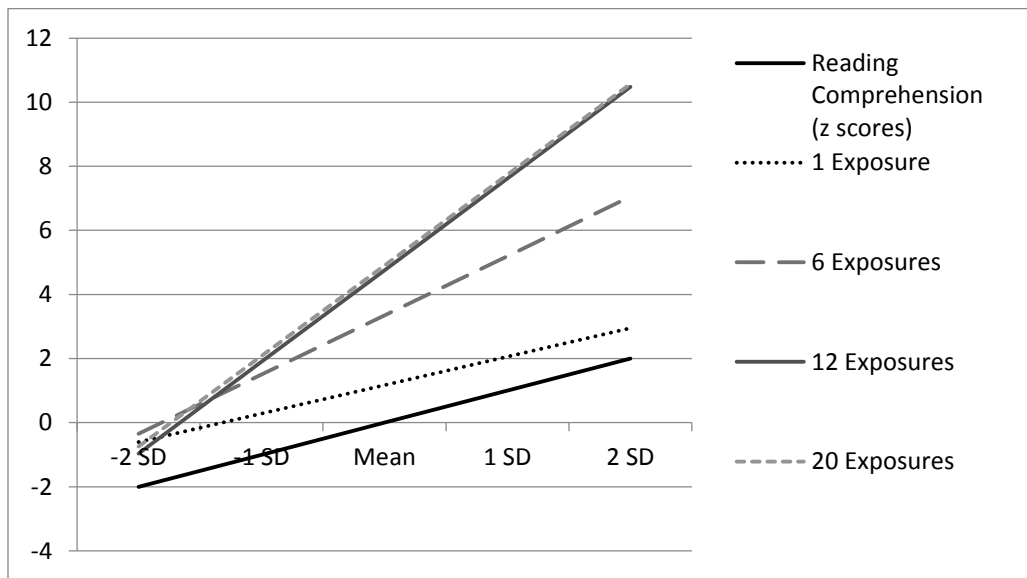


Figure 3

*Interaction between Reading Comprehension and Exposures on Semantic Recognition Outcome*



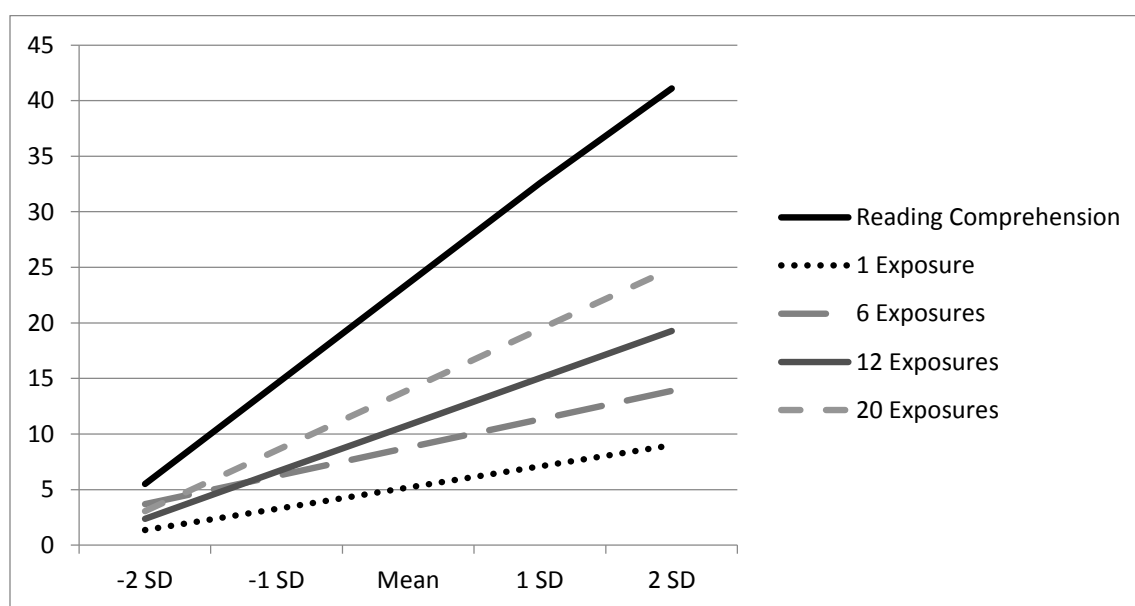


Figure 4

*Trend of Overall Knowledge Acquisition by Exposure Level*

## CHAPTER FIVE

### DISCUSSION

As above in Chapter 4, the discussion of findings proceeds in the same manner comparing the findings of this study to historical studies in the order presented in Chapter 4 and proceeding to findings of crossed classified random effects analysis.

In order to add to the existing research, this study examined incidental vocabulary acquisition in average to below average readers with the majority of participants falling below the 25<sup>th</sup> percentile in vocabulary knowledge (i.e., 50% at or below 25<sup>th</sup> percentile and 26% at or below 10<sup>th</sup> percentile) and 38% of the participants were at or below the 25<sup>th</sup> percentile in basic reading skills (i.e., sight word efficiency and phonemic decoding efficiency) with almost 20% of participants below the 10<sup>th</sup> percentile. Incidental vocabulary acquisition was supported through highly supportive context.

#### **Probability of Acquisition and Numbers of Exposures**

The traditional analyses (i.e., calculation of probabilities and 2 x 4 ANOVA) of vocabulary acquisition performed in the current study are consistent with the extant research on incidental vocabulary research. The overall probability of acquiring productive information on a single word in this study was .03 which is similar to the findings of Nagy et al. (1987) of .05 probability of semantic productive knowledge acquisition after a single occurrence of a target word. Although the probability in the

current study is lower, target words and population are potentially mitigating factors to this reduced rate of acquisition.

In this study, multisyllabic nonwords which represented semantic information of rare target words were used to control for preexisting knowledge whereas in Nagy et. al (1987) rare real words were used as targets. Similarly, the results of the probabilities of acquiring semantic productive knowledge from a single exposure to a target word in the present study are aligned with relatively low rates of semantic productive knowledge acquisition probabilities of earlier studies, including the probabilities of 0 (Wochna & Juhasz, 2013), .01 (Herman, 1985), and .03 (Gordon, 1992). This study found that the acquisition of partial knowledge (i.e., syntactic class or semantic recognition knowledge) is more probable than semantic productive knowledge, and this finding is also consistent with prior research on incidental vocabulary acquisition (i.e., Kranzer, 1988; Brushnigan & Folk, 2012).

The number of exposures as a significant factor in vocabulary acquisition outcomes was consistent across all analyses. There were significant differences in the probabilities of acquisition at each exposure level. The ANOVA analyses revealed significant differences between each level of exposure, and exposures were the only significant item-level factor identified in the CCREM analysis for each outcome measure. Results of the CCREM analysis reveal the only significant item-level factor as the number of exposures with increasing acquisition rates at each level of exposure. This

finding is also consistent with previous research on acquisition (e.g., Jenkins et al., 1984) and consolidation of semantic information (Perfetti, 2007). Multiple encounters help create a higher quality representation of semantic information (Perfetti, 2007). This finding suggests increasing the numbers of exposures experienced by readers can positively influence the rate of vocabulary acquisition. Examination of other analyses indicate that 20 exposures produces a sharp increase in the probability of acquiring an unknown word, particularly semantic productive knowledge, although 20 exposures does not guarantee acquisition.

While prior research has documented a general increase in rates of acquisition with increased exposures (i.e., Batterink & Neville, 2012; Joseph, et al., 2014), other studies have failed to detect significant differences between comparisons of lower exposure rates of 1:3 (e.g., Williams, 2004), 1:5 (e.g., Stein, 1988), and 2:6 (e.g., Jenkins et al., 1984). This study reveals significant differences between acquisition rates at each level of exposure: 1:6; 6:12; and 12:20. A significant main effect for increased levels of exposures is revealed on all analyses. This finding is consistent with recent research by Reynolds (2015) which also found increased acquisition with increased occurrences of words. The current study did not detect diminishing returns of acquisition at higher levels of occurrences, but instead, found substantial and significant increases in the probability of acquisition on all outcome measures (i.e., syntactic class, semantic recognition, or semantic productive knowledge) as a result of increased exposures up to the level of 20

exposures. These findings may be as a result of the nature of the text (i.e., supportive text) used in this study as well as the length of time of the study (i.e., distributed practice).

Past research has demonstrated that differences in acquisition occur based on the supportiveness of the text. Considerate text, where text contains synonym or definitional information embedded near target words, has been shown to support vocabulary acquisition (Konopak, 1988). This study found participants were able to capitalize on embedded semantic information to support acquisition of target words. The use of multiple contextual presentations in conjunction with highly considerate text may have provided the additional support necessary to facilitate vocabulary acquisition in the participants. However, poor readers have been shown to be less able to capitalize on the use of embedded semantic information in prior studies (e.g., Bonacci, 1993), and this finding is supported by the current study by the significant interactions revealed between both vocabulary and semantic productive knowledge acquisition and reading comprehension and semantic recognition knowledge acquisition. The only significant interactions between person-level and item-level factors occurred between reading comprehension and the number of exposures on the semantic recognition and semantic productive knowledge outcome measure models. Participants with reduced reading comprehension ability were less able to consolidate recognition or semantic productive knowledge at every level of exposure than higher reading comprehension ability—even

with the highly supportive context utilized in this study. This indicates that exposures alone cannot produce vocabulary acquisition in the face of poor reading comprehension ability.

Participants with lower reading comprehension ability demonstrated acquisition rates of 30% less than participants with higher reading comprehension ability on semantic recognition knowledge acquisition measures and rates less than 50% on semantic productive knowledge acquisition measures. This effect was even more pronounced when vocabulary knowledge and outcomes were examined. Participants with less prior vocabulary knowledge (i.e., PPVT standard score 2 SD or more below the mean,  $n=8$ ) demonstrated no vocabulary acquisition on semantic productive knowledge outcome measures. Better readers have been shown to be better able to acquire the meaning of new words (i.e., Jenkins et al, 1984; Cain et al. 2003; Cain et al., 2004).

Furthermore, prior research has demonstrated that encounters with novel words over an extended time allows better consolidation of semantic information (Baddley, 1999). The participants in the current study encountered the target words over the course of eight days. The majority of other acquisition studies did not utilize distributed practice in the study, but instead used massed practice where readers encountered all of the target word occurrences within one reading session (e.g., Granick, 1997; Herman, 1985; Joseph et al., 2014. Nagy et al., 1987). The opportunity to have both multiple encounters of target words in highly supportive text in a distributed practice condition to allow greater

consolidation significantly enhanced the vocabulary acquisition of target words at the 6, 12, and 20 exposure levels. These findings suggest that highly supportive text in combination with repeated exposures may enable readers to better extract semantic information at the syntactic class, semantic recognition, or semantic productive knowledge levels over time.

### **Morphological Complexity**

The analyses revealed disparate results on the influence of morphological complexity of words on vocabulary acquisition. Morphological complexity of the word was not a significant item-level factor on the CCREM analysis. The person-level factor of morphological awareness was significant which indicates the variance explained with this factor occurs at the person-level. Acquisition is influenced by the requisite morphological knowledge on the part of the reader, rather than the morphological characteristic of the word. This suggests that Kuo and Anderson's (2004) proposal that morphologically based words may be easier to learn because the mental lexicon is organized on morphemes is partially right, but the ease with which morphologically complex words are learned is dependent on the morphological awareness of the reader.

The probability of acquiring semantic information reveals mixed results concerning the relative influence of morphological complexity. The semantic productive knowledge measures reveal readers are less likely to capture enough semantic information on morphologically complex words compared to simple words to produce a

definition of the target word after one exposure with comparative semantic productive knowledge probabilities of .00 and .06 respectively. However, when other semantic measures (i.e., semantic recognition and syntactic class knowledge) are included in the comparison, it appears that reader still retains more overall semantic information about morphologically complex words than morphologically simple words at 1, 6, and 12 exposure levels on average. This additional semantic information may be as a result of the meaning attached to the individual components of morphologically complex words (i.e., prefixes, roots, and suffixes).

Morphologically complex words offer syntactic information not necessarily present in morphologically simple words. The suffix *-tion* indicates the syntactic category of a word is noun. The reader may implicitly glean the syntactic information present in the suffixes attached to morphologically complex words. Previous research has shown that readers typically have longer gaze durations when unknown words are encountered (Chaffin et al., 2001). The familiarity of prefixes and suffixes in morphologically complex words may result in reduced attention to the target word (i.e., gaze duration). The reduction in attention in combination with the informative nature of morphologically complex prefixes and suffixes may reduce the reader's focus on extracting semantic information from an unknown morphologically complex word. Additionally, readers may have been better able to utilize existing knowledge of prefix meaning to both recognize the correct definition on outcome measure and acquire the



meaning of a morphologically complex word (i.e., partial knowledge) at a faster rate than morphologically simple words. Semantic productive knowledge may not receive the same advantage because of the depth of knowledge (i.e., complete definitional knowledge) required in order to produce a definition.

By the time the reader has encountered a word at the level of 20 exposures, the morphologically simple word appears to be better acquired with higher probabilities across all three measures and overall means. The reader may focus more on the morphologically simple word to gain semantic meaning because there is no inherent information provided due to the lack of suffixes, and the reader may focus more on the morphologically simple word because no parts of the word are familiar (i.e., there are no prefixes or suffixes which may reduce the unfamiliarity of the target word). This increased attention may have a cumulative advantage after a given number of exposures. Again, the increased focus required to extract semantic information from a morphologically simple word may ultimately better facilitate a more complete representation of semantic acquisition. After 20 encounters, the reader may have acquired more complete semantic meaning and assigned appropriate syntactic class to the morphologically simple word. Alternatively, the relative distributions of target words (i.e., morphologically simple words occurred at higher relative frequency per task than morphologically complex words despite overall equivalent number of exposures) and the relative conceptual difficulty of the target words at each level of complexity (i.e., simple

words may have been conceptually easier than complex words) may provide plausible explanations for this change in acquisition between word types at the 20 exposure level.

Examinations of distributions of target words in texts reveal one possible explanation for this discrepancy in the relative acquisition rates switching the advantage from morphologically complex words to morphologically simple words at the level of 20 exposures. Relative frequency has been demonstrated to provide an advantage to the likelihood of knowing rare words within a given subject-area (Stadthagen-Gonzales, et al., 2004). Morphologically complex words with 20 occurrences were located in at least seven of the eight texts from 1 to 8 times with a mean occurrence of 2.63 per day. Morphologically simple words with 20 occurrences were located across four to eight of the texts from 1 to 7 times with a mean occurrence of 3.24 times per day. This increase in mean occurrence may have facilitated the acquisition of morphologically simple words with 20 contextual exposures.

Another potential explanation for this change in the advantage demonstrated by morphologically complex words is the underlying semantic concept of the real words represented by the target words. The real morphologically complex words represented by the target nonwords of 20 contextual exposures were *concurrent*, *fortification*, *obstruction*, and *provisional*. The real morphologically simple words represented by the target nonwords of 20 contextual exposures were *brigand*, *cunning*, *lumber*, *plunge*, *rogue*, and *urchin*. The target word *provisional* ‘serving for a short time only’ may be

conceptually more challenging than *plunge* ‘to thrust quickly.’ Additionally, even though the rare real words were matched on imageability and frequency, there are more frequent and possibly more imageable synonyms for the morphologically simple words. The target word *brigand* has thief as a more frequent synonym while synonyms for the target word *obstruction* include other rare words such as obstacle and barrier. The existence of the more frequent synonyms may have aided acquisition preferentially of the simple target words and created the discrepancy in the advantage seen for morphologically complex words at other levels of exposure where synonyms were less available (e.g., *dowager*, *realm*).

### **Person-Level Characteristics and Interactions**

The CCREM analysis was performed to address the research questions for this study. Specifically, this analysis was utilized to examine item- and person-level factors as well as potential interactions between item- and person-level factors simultaneously and more correctly proportion variance among them. Results of this analysis reveal person-level factors of morphological awareness, vocabulary knowledge, and reading comprehension as significant contributors to the process of IVA and the relative importance of each factor. There are differences and similarities among each of the models analyzed by outcome variable.

Morphological awareness was a significant person-level factor in each model of vocabulary acquisition outcome. Given that half of the words were morphologically

complex, but that the complexity of a word was not a significant item-level factor in any model, it seems plausible that the variance explained by a person's morphological awareness results in the lack of significance of the item-level factor of morphological complexity and that a person's morphological awareness accounts for the variance associated with the acquisition of morphologically complex words. Higher levels of morphological awareness have been associated with higher levels of vocabulary acquisition in prior studies as well (e.g., Brushnigan & Folk, 2012; McBride-Change et al., 2005; Wysocki & Jenkins, 1987). Kuo and Anderson (2004) proposed that morphologically complex words may be easier to acquire because the mental lexicon is organized on morphemes, but a person's morphological awareness is likely the underlying mechanism of this acquisition, so readers with low levels of morphological awareness may not receive an advantage in the acquisition of morphologically complex words over morphologically simple words.

Vocabulary knowledge which is typically highly correlated with vocabulary acquisition (e.g., Stanovich, 1986) was only a significant factor in the semantic productive knowledge outcome model on the CCREM analysis. It is surprising that vocabulary knowledge was not a significant predictor in the other outcome models; however, existing vocabulary knowledge may offer a unique advantage to readers in the acquisition of semantic productive knowledge of new words. Readers may be able to assign the meaning of existing known words (i.e., synonyms or closely related words) in

their vocabulary to the newly encountered unknown word through the process of fast mapping (Cary & Barlett, 1978). Under this process, a larger vocabulary size offers an advantage to the reader as they encounter unknown words because they have more existing knowledge onto which they may map the new word's meaning. Thus, the reader gains semantic productive knowledge about the unknown word. Additionally, a large general vocabulary may have assisted the participants in producing and composing a definition for the target words. Semantic recognition and syntactic class knowledge may not receive the same level of benefit from vocabulary knowledge as other factors, such as the inference from contextual information (i.e., reading comprehension) and grammatical presentation.

Reading comprehension was a significant person-level factor of both syntactic class and semantic recognition knowledge outcome models. Specifically, participants with lower reading ability were less able to acquire or demonstrate acquired vocabulary knowledge on any outcome measure. This finding is well aligned with prior research on the relationship between reading comprehension and vocabulary acquisition (Cain et al., 2003; Cain et al., 1985). Better readers are better able to acquire meaning from text, and reading comprehension ability hindered or helped the acquisition of vocabulary knowledge at each level of exposure on syntactic class and semantic recognition knowledge measures, and the effect of the person-level factor of reading comprehension interacted significantly with the item-level factor of the number of exposures to cause

differential gains in vocabulary acquisition by reading comprehension ability on both semantic measures: recognition and productive.

Reading comprehension did not interact with exposure level at a significant level in the syntactic model. This may be due to a different underlying process contributing to the development of syntactic class information, such as statistical learning or implicit pattern recognition. Readers develop implicit syntactic class knowledge from repeated exposures to grammatical information as demonstrated in prior research (Gomez & Gerken, 2000). This process may be a significant factor in the development of syntactic class information that doesn't rely on reading comprehension.

The lack of significance of other person-level factors is surprising. Working memory has been demonstrated to play a critical role in vocabulary acquisition in prior research (e.g., Gathercole & Baddeley, 1989), though findings are mixed (e.g., de Leeuw et al., 2014). One possible explanation for the lack of significance in any model is the highly supportive context utilized in the texts in combination with multiple exposures. The constant availability of definitional information embedded in the text with each target word encountered may have facilitated the conversion of semantic information to long term memory.

The lack of significance of basic reading skills (i.e., phonemic decoding and sight word efficiency) was another unanticipated finding of the models. This may be an artifact of the age of the participants in this study. Every participant may have had sufficient

decoding skills and sight word vocabularies to prevent these skills from being a significant factor in this study, particularly since the texts were designed to be a minimum of two grade levels below the grade of participants. In retrospect, this may have limited the ability to find significance of basic reading skills in the vocabulary acquisition process. This finding is consistent with existing research which indicates that decoding becomes less significant in the process of reading comprehension as students proceed through their education (Cromley & Azevedo, 2007). However, significant correlations between acquisition outcomes and basic reading skills were found which suggests this relationship deserves further examination in secondary students.

Another surprising finding was that print exposure was not a significant person-level factor despite research that has repeatedly demonstrated a positive correlation between vocabulary knowledge and print exposure (Stanovich, 1986; Cunningham & Stanovich, 1990; Stanovich & West, 1989). Print exposure has also been demonstrated to positively affect vocabulary growth (Echols et al., 1996). In the current study, there was a small negative correlation between vocabulary and print exposure. This may be an artifact of the sample who participated in the current study. There may be other potential sources of vocabulary knowledge growth not accounted for in existing research (e.g., the amount of text encountered in social media or online communities) or in the print exposure measure (e.g., blogs, websites, or magazines).

### **Limitations and Future Directions**

As previously discussed, one potential limitation of this study is word selection and relative distributions of target words. Although the original words were equated on factors of age of acquisition, frequency and imageability, and the target words were additionally equated on number of syllables and letters, the existence of conceptual difficulty and existence of more frequent synonyms was not equivocal among words. This may have resulted in the differential acquisition of simple versus complex words at the 20 exposure level compared to other levels. Additionally, the words did not appear the same number of times across or between passages. The morphologically simple words appeared at higher relative frequencies (i.e., more times per task) than morphologically complex words despite the words appearing 20 times each. This may have contributed to differential rates of acquisition. In future studies, these discrepancies should be addressed.

Manipulation of the text level of the passages in future studies may generate additional findings on the person-level features that significantly contribute to the model. For example, if the text level of the passages used were at or above the grade level of the reader, basic reading skills may have been a significant person-level factor in this model. Comparisons between text levels may reveal new insights into the process of incidental vocabulary acquisition.



Similarly, the highly supportive context of the materials used in this study is not typical of text encountered in either textbooks or novels. While the findings of this study suggest the facility of increasing the contextual support found in texts, particularly in textbooks, as a means to support student learning, the use of highly supportive contexts limits the generalizability of the findings of the study. Readers, particularly those with low reading comprehension ability, low morphological awareness, or limited vocabularies, may not have achieved the same rates of vocabulary acquisition without the supportive text, regardless of the number of exposures. General background knowledge was not measured. While the tasks do not rely on specific background knowledge per se, greater general background knowledge may influence the outcome of vocabulary knowledge acquisition.

Finally, the definitiveness of the models produced in this analysis is limited by the number of participants in this study for whom complete data was available. The minimum participant number suggested for this analysis is 100 participants, but complete data were collected on only 78 participants in this study. This number of participants was likely insufficient to fully test a model which included eight person-level factors and perhaps should have additionally included statistical learning to effectively model the syntactic class acquisition outcome. The recruitment of additional, and sufficient, participants in future studies or the utilization of simulated data modeling as suggested by

recent researchers (e.g., Zevin & Miller, 2016) in lieu of participants could potentially address this concern.

## **Conclusions**

The combined findings of these analyses indicate that readers, including less skilled readers, do benefit significantly from increased exposures on acquisition outcome measures. There were dramatic increases in the level of acquisition between the 12 exposure level and the 20 exposure level for overall semantic productive knowledge outcomes and steady increases in the level of acquisition for overall syntactic class and semantic recognition outcomes. These findings indicate the importance of providing the necessary contextual exposures to facilitate knowledge acquisition. This is an important consideration for the classroom teacher as they strive to foster learning in content area instruction. It may also be important to consider increasing the level of contextual support provided in our textbooks and instructional materials to better facilitate student learning outcomes.

Additionally, vocabulary knowledge is a significant factor in the development of semantic productive knowledge. Reading comprehension is a significant factor in the development of both syntactic class and semantic recognition knowledge and interacts with the level of exposures on semantic recognition and productive outcomes.

Morphological awareness is a significant person-level factor on all outcomes.

Instructional and interventional focus on increasing skills and knowledge related to these

person-level features (i.e. vocabulary knowledge, morphological awareness, and reading comprehension) may foster the student's ability to derive semantic information from text in the classroom.

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## APPENDICES

## APPENDIX A

## Target Words and Definitions

**Morphologically Simple Words:**

brigand: n. A bandit, one of a band of robbers

clamor: v. to say noisily

coffer: n. a small chest to hold money or treasure

craven: n. a coward

cunning: adj. clever, sly, shrewd

dowager: n. a dignified elderly woman

eyrie: n. the nest of a bird of prey

lumber: v. to move clumsily or heavily

melee: n. a confused struggle

plunge: v. to push quickly into

realm: n. a kingdom

rogue: n. a dishonest or unprincipled man

simper: v. to smile or speak in a way that is not sincere or natural

snub: v. to ignore (someone) in a deliberate and insulting way

stile: n. a step or set of steps for crossing a fence or wall

succor: v. to give aid to (one in need or distress)

stoic: adj. not showing emotion

thane: n. lord or chief of the land

urchin: n. a mischievous child

vale: n. a valley

**Morphologically Complex Words:**

absolution: n. release from blame or guilt

allegation: n. a statement not supported by proof or evidence

benefactor: n. a person who does good for another, especially by giving money

capitulate: v. to give up

compile: v. to make a list

complication: n. something that makes a situation more difficult

concurrent\*: adj. happening or existing at the same time

conspirator: n. a person who is involved in a secret plan

decomposition: n. the breakdown of plant or animal matter

expedition: n. a journey or trip by foot

fortification: n. to strengthen something

obstruction: n. something that gets in the way

precipitate: v. to cause to happen

projectile: n. a body or object thrown forward

proportion: n. a part of a whole

provisional\*: adj. serving for the time only

receptacle: n. something used to receive and contain smaller objects

reduction: n. the act of making something less

remittance: n. the sending of money

supposition: n. an opinion or judgment based on little or no evidence

## APPENDIX B

### Original Task Sample

Ships sail routes through the sea like cars follow highways on land. The routes of passage are known well by captains of ships. Many ships use the routes concurrently, or running together at the same time. Because the routes are well known, pirate ships know where to look for other ships to raid. Ships are always on the lookout for pirate ships, but the captains of the pirate ships are very cunning, or clever, so sometimes, pirate ships are able to sneak up on the other ships without being seen.

Once there was a famous pirate captain, Blackbeard, and he was very cunning, or clever. Blackbeard was quite a rogue, or dishonest man. He used the fog to sneak up on other ships and raid them. Blackbeard sailed with a band of brigands, or robbers, who helped him raid other ships. One night when the fog was very thick, Blackbeard's pirate ship was able to sneak up on a large passenger ship without being seen. The captain of the pirate ship ordered his band of brigands, or robbers, to get ready to attack. As the pirate ship pulled along the side of the passenger ships, Blackbeard's men began to clamor, or speak noisily, on the deck of the ship. The captain and crew of the passenger ship heard the men clamor, or speak noisily, and they knew they were under attack. The captain of the passenger ship shouted at his crew to prepare to fight off the pirates.

Blackbeard heard the captain's order. This precipitated, or caused to happen sooner, the pirates boarding the passenger ship. They wanted to get aboard before the

crew could get prepared to fight. Most of Blackbeard's men jumped across the gap between the boats and landed on the deck of the passenger ship. The brigands, or robbers took their guns and untied their swords as they jumped on the deck of the cargo ship. As the men landed on the ship, a melee, or confused struggle, started between the pirates and the sailors.

A few pirates stayed on Blackbeard's ship and rolled out the cannons concurrent, or at the same time, with the boarding party jumping onto the other board. As the melee, or confused struggle, broke out on the ship's deck, the rogues, or dishonest men, got the cannons ready. The cannons were very heavy, and the men lumbered, or walked heavily, across the deck pushing the cannons towards the side of the ship next to the passenger ship. The pirate brigands, or robbers, aimed cannons at the passenger ship. They were prepared to fire a projectile, or object thrown, from the cannon at the other ship. The captain of the other ship didn't see the cannons being aimed at his ship because of the melee, or confused struggle, happening on the deck of his ship.

Blackbeard ordered the captain of the other ship to surrender. The captain of the passenger ship didn't want to surrender. Blackbeard shouted back to the pirates on his ship to get ready to fire the cannons. The cunning, or clever, threat worked. The captain on the passenger ship capitulated, or gave up, to the captain of the pirate ship without a fight. He thought his life and those of his crew was worth more than the ship.

Unfortunately, one of the pirates on Blackbeard's ship heard the word fire and lit the fuse on the cannon. The cannon fired a projectile, an object thrown forward, at the passenger ship. The cannon ball plunged, or was quickly thrust, into the water right by the ship. The projectile, or object thrown forward, hit the passenger ship and left a big round hole in the side of the ship.

The hole in the ship was a complication, or something that made the situation more difficult. The water began to rush through the hole left by the projectile, or object thrown forward. All of the men--brigands, or robbers, from the pirate ship and crew members from the passenger ship--ran down below deck to try to stop the water from sinking the ship. The men had many suppositions, or opinions based on little evidence, about how to plug the hole. They had never dealt with a hole in the side of a ship before.

What the men needed was a fortification, or something made to strengthen, for the side of the ship. If they didn't get the hole plugged, the cargo would all be subject, or thrown under, to being ruined as the water filled the boat. The captain and Blackbeard quickly talked about how to plug the hole.

Both men were cunning, or clever, and they scanned the room concurrently, or running at the same time, to see what they could use as a provisional, or serving for a short time only, plug. There were several barrels in the room. The barrels were used as receptacles, or containers, for the food and supplies the ship needed while at sea. They



saw an empty barrel floating in the corner of the room. The captain and Blackbeard looked at the barrel. They looked at each other and nodded.

They told the other men to use the empty barrel as a plug for the hole. The men plunged, or thrust quickly, through the water and grabbed the empty barrel. As the men pushed the barrel into the hole, they put rags around the barrel to close the hole concurrently, or together at the same time. The barrel and rags created an obstruction, or something that gets in the way, to the water. The captains' cunning, or clever, plan worked. The provisional, or serving for a short time only, plug worked. The water was stopped. The men stacked the full barrels against the side of the ship as a fortification, or strengthening, of the repair. The men clamored, or spoke noisily, as they congratulated each other. They were happy the water had stopped coming into the ship.

Of course, there were still many complications, or some things that made things difficult. Even though the pirates and sailors had worked together to fix the hole, the pirate captain still had captured the passenger ship. There was still a hole in the ship even though the barrel worked as an obstruction, or something that gets in the way, to the water. The ships were a long way from home where the ship builders worked. The barrel stopped the water, but the captains didn't think the repair would last. There was thick fog that made it hard to see where the ships were going.

Blackbeard was not happy the cannon had been fired. He wanted to know who had fired the cannon without his orders. He talked to the pirates who had stayed on the

pirate ship during the melee, or confused struggle, that took place when the pirates boarded the ship. He told them they would all take a plunge, or quick dive, into the sea unless they told him who fired the cannon. Each pirate made allegations, or statements without proof, against the others. No one wanted to plunge, or dive quickly, into the cold, icy sea. Another melee, or confused struggle, broke out among the pirates as they argued about who fired the cannon. Blackbeard fired a shot into the air from his pistol over the men. This ended the melee, or confused struggle, at once. Blackbeard questioned the men one at a time. Many more allegations were made, or statements without evidence. Most of the allegations, or statements without proof, were that Two-Fingers Pete was the rogue, or dishonest man, who fired the cannon.

Blackbeard called Two-Fingers Pete forward. Two-Fingers Pete stepped out of the group of pirates and walked towards the pirate captain. Two-Fingers Pete really had eight fingers. Two-Fingers Pete had lost two fingers playing with an ax when he was just an urchin, or mischievous child. Two-Fingers Pete simpered, or spoke in an insincere way, to Blackbeard, "Yes, Captain?" Blackbeard asked him if he fired his cannon. Two-Fingers Pete spoke insincerely or simpered again, "Why no Captain!" Blackbeard raised his eyebrow and scowled at Two-Fingers Pete. Two-Fingers Pete gulped and looked away. The captain looked very angry. "Well, maybe I did after all" Pete said in a weak voice. Blackbeard glared at Two-Fingers Pete. He was angry. He was a rogue, or dishonest man. He was also a fair captain.

Two-Fingers Pete was on night watch for the next two months. The other pirates snubbed him, or ignored him on purpose, at the supper table for the next six months.

Two-Fingers Pete didn't mind. Two-Fingers Pete could put up with being snubbed, or ignored on purpose, by his fellow rogues, or dishonest men. He could stand staying up all night on night watch. He had been afraid Blackbeard was going to make him walk the plank, and anything was better than taking a plunge, or quick dive, into the icy waters.

## APPENDIX C

### Altered Task Sample

Ships sail routes through the sea like cars follow highways on land. The routes of passage are known well by captains of ships. Many ships use the routes condarently, or running together at the same time. Because the routes are well known, pirate ships know where to look for other ships to raid. Ships are always on the lookout for pirate ships, but the captains of the pirate ships are very commerine, or clever, so sometimes, pirate ships are able to sneak up on the other ships without being seen.

Once there was a famous pirate captain, Blackbeard, and he was very commerine, or clever. Blackbeard was quite a bannifer, or dishonest man. He used the fog to sneak up on other ships and raid them. Blackbeard sailed with a band of barrazons, or robbers, who helped him raid other ships. One night when the fog was very thick, Blackbeard's pirate ship was able to sneak up on a large passenger ship without being seen. The captain of the pirate ship ordered his band of barrazons, or robbers, to get ready to attack. As the pirate ship pulled along the side of the passenger ships, Blackbeard's men began to doppelate, or speak noisily, on the deck of the ship. The captain and crew of the passenger ship heard the men doppelate, or speak noisily, and they knew they were under attack. The captain of the passenger ship shouted at his crew to prepare to fight off the pirates.

Blackbeard heard the captain's order. This predated, or caused to happen sooner, the pirates boarding the passenger ship. They wanted to get aboard before the crew could get prepared to fight. Most of Blackbeard's men jumped across the gap between the boats and landed on the deck of the passenger ship. The barrazons, or robbers took their guns and untied their swords as they jumped on the deck of the cargo ship. As the men landed on the ship, a tafflest, or confused struggle, started between the pirates and the sailors.

A few pirates stayed on Blackbeard's ship and rolled out the cannons condarent, or at the same time, with the boarding party jumping onto the other board. As the tafflest, or confused struggle, broke out on the ship's deck, the bannifers, or dishonest men, got the cannons ready. The cannons were very heavy, and the men blonterstaped, or walked heavily, across the deck pushing the cannons towards the side of the ship next to the passenger ship. The pirate barrazons, or robbers, aimed cannons at the passenger ship. They were prepared to fire a prosuvile, or object thrown, from the cannon at the other ship. The captain of the other ship didn't see the cannons being aimed at his ship because of the tafflest, or confused struggle, happening on the deck of his ship.

Blackbeard ordered the captain of the other ship to surrender. The captain of the passenger ship didn't want to surrender. Blackbeard shouted back to the pirates on his ship to get ready to fire the cannons. The commerine, or clever, threat worked. The

captain on the passenger ship capitulated, or gave up, to the captain of the pirate ship without a fight. He thought his life and those of his crew was worth more than the ship.

Unfortunately, one of the pirates on Blackbeard's ship heard the word fire and lit the fuse on the cannon. The cannon fired a prosuville, an object thrown forward, at the passenger ship. The cannon ball frescoventd, or was quickly thrust, into the water right by the ship. The prosuville, or object thrown forward, hit the passenger ship and left a big round hole in the side of the ship.

The hole in the ship was a comfresation, or something that made the situation more difficult. The water began to rush through the hole left by the prosuville, or object thrown forward. All of the men--barrazons, or robbers, from the pirate ship and crew members from the passenger ship--ran down below deck to try to stop the water from sinking the ship. The men had many suffubitions, or opinions based on little evidence, about how to plug the hole. They had never dealt with a hole in the side of a ship before.

What the men needed was a fresification, or something made to strengthen, for the side of the ship. If they didn't get the hole plugged, the cargo would all be subject, or thrown under, to being ruined as the water filled the boat. The captain and Blackbeard quickly talked about how to plug the hole.

Both men were commerine, or clever, and they scanned the room condarently, or running at the same time, to see what they could use as a provisional, or serving for a short time only, plug. There were several barrels in the room. The barrels were used as

receptacles, or containers, for the food and supplies the ship needed while at sea. They saw an empty barrel floating in the corner of the room. The captain and Blackbeard looked at the barrel. They looked at each other and nodded.

They told the other men to use the empty barrel as a plug for the hole. The men frescoventd, or thrust quickly, through the water and grabbed the empty barrel. As the men pushed the barrel into the hole, they put rags around the barrel to close the hole condarently, or together at the same time. The barrel and rags created an obsatsion, or something that gets in the way, to the water. The captains' commerine, or clever, plan worked. The provisional, or serving for a short time only, plug worked. The water was stopped. The men stacked the full barrels against the side of the ship as a fresification, or strengthening, of the repair. The men doppelateed, or spoke noisily, as they congratulated each other. They were happy the water had stopped coming into the ship.

Of course, there were still many confresations, or some things that made things difficult. Even though the pirates and sailors had worked together to fix the hole, the pirate captain still had captured the passenger ship. There was still a hole in the ship even though the barrel worked as an obsatsion, or something that gets in the way, to the water. The ships were a long way from home where the ship builders worked. The barrel stopped the water, but the captains didn't think the repair would last. There was thick fog that made it hard to see where the ships were going.

Blackbeard was not happy the cannon had been fired. He wanted to know who had fired the cannon without his orders. He talked to the pirates who had stayed on the pirate ship during the tafflest, or confused struggle, that took place when the pirates boarded the ship. He told them they would all take a frescovent, or quick dive, into the sea unless they told him who fired the cannon. Each pirate made allanations, or statements without proof, against the others. No one wanted to frescovent, or dive quickly, into the cold, icy sea. Another tafflest, or confused struggle, broke out among the pirates as they argued about who fired the cannon. Blackbeard fired a shot into the air from his pistol over the men. This ended the tafflest, or confused struggle, at once. Blackbeard questioned the men one at a time. Many more allanations were made, or statements without evidence. Most of the allanations, or statements without proof, were that Two-Fingers Pete was the bannifer, or dishonest man, who fired the cannon.

Blackbeard called Two-Fingers Pete forward. Two-Fingers Pete stepped out of the group of pirates and walked towards the pirate captain. Two-Fingers Pete really had eight fingers. Two-Fingers Pete had lost two fingers playing with an ax when he was just a prindle, or mischievous child. Two-Fingers Pete cannarrated, or spoke in an insincere way, to Blackbeard, "Yes, Captain?" Blackbeard asked him if he fired his cannon. Two-Fingers Pete spoke insincerely or cannarrated again, "Why no Captain!" Blackbeard raised his eyebrow and scowled at Two-Fingers Pete. Two-Fingers Pete gulped and looked away. The captain looked very angry. "Well, maybe I did after all" Pete said in a



weak voice. Blackbeard glared at Two-Fingers Pete. He was angry. He was a bannifer, or dishonest man. He was also a fair captain.

Two-Fingers Pete was on night watch for the next two months. The other pirates happemented him, or ignored him on purpose, at the supper table for the next six months. Two-Fingers Pete didn't mind. Two-Fingers Pete could put up with being happemented, or ignored on purpose, by his fellow bannifers, or dishonest men. He could stand staying up all night on night watch. He had been afraid Blackbeard was going to make him walk the plank, and anything was better than taking a frescovent, or quick dive, into the icy waters.

## APPENDIX D

## Novel Recognition Test

Directions: The list contains real and fake titles of books. Place a check mark next to every title you recognize as a real book title. Do not guess.

- \_\_\_\_\_ Give it to Ringo
- \_\_\_\_\_ A Farewell to Arms
- \_\_\_\_\_ Why Knees are Needed
- \_\_\_\_\_ Paper Towns
- \_\_\_\_\_ Goodnight Moon
- \_\_\_\_\_ The Pearl
- \_\_\_\_\_ Buck the Bully's New Braces
- \_\_\_\_\_ Where the Sidewalk Ends
- \_\_\_\_\_ Manhattan Dynasties
- \_\_\_\_\_ The Telephone Tango
- \_\_\_\_\_ Mandy's Garden on the Rooftop
- \_\_\_\_\_ Tending to My Soul
- \_\_\_\_\_ Weekend Voodoo
- \_\_\_\_\_ Summoned by Danger
- \_\_\_\_\_ Where the Red Fern Grows

- \_\_\_\_\_ Green Eggs and Ham
- \_\_\_\_\_ In Envy of Silver
- \_\_\_\_\_ Operation Sierra One
- \_\_\_\_\_ How to Eat Fried Worms
- \_\_\_\_\_ Madeline
- \_\_\_\_\_ Ivanhoe
- \_\_\_\_\_ The Perils of Evenrude
- \_\_\_\_\_ Until You've Walked in My Sandals
- \_\_\_\_\_ Time of the Breezes
- \_\_\_\_\_ Cheese and Moon Pies
- \_\_\_\_\_ Looking for Alaska
- \_\_\_\_\_ The Black Stallion
- \_\_\_\_\_ The Very Hungry Caterpillar
- \_\_\_\_\_ Restless Game
- \_\_\_\_\_ He's Your Little Brother!
- \_\_\_\_\_ Searching the Wilds
- \_\_\_\_\_ The Pirate and the Big Green Sea
- \_\_\_\_\_ Harvey Plaid Pants
- \_\_\_\_\_ A Balloon Ride to the Moon
- \_\_\_\_\_ Snakes, Fish, and Other Furry Creatures

- \_\_\_\_\_ Hot Top
- \_\_\_\_\_ Curious George
- \_\_\_\_\_ Where the Wild Things Are
- \_\_\_\_\_ The Wind in the Willows
- \_\_\_\_\_ The Story of Babar
- \_\_\_\_\_ A Tale of Two Cities
- \_\_\_\_\_ Aesop's Fables
- \_\_\_\_\_ Photosynthesis Shop
- \_\_\_\_\_ The Peacock Conspiracy
- \_\_\_\_\_ Find Your Way to Luxembourg
- \_\_\_\_\_ The Reason Why
- \_\_\_\_\_ Go Tell It on the Mountain
- \_\_\_\_\_ Wuthering Heights
- \_\_\_\_\_ The Last of the Mohicans
- \_\_\_\_\_ Swiss Family Robinson
- \_\_\_\_\_ The Borrowers
- \_\_\_\_\_ A Light in the Attic
- \_\_\_\_\_ Black Beauty
- \_\_\_\_\_ The Book Thief
- \_\_\_\_\_ Robinson Crusoe

- \_\_\_\_\_The New Girl in Class
- \_\_\_\_\_Sadie Goes to Hollywood
- \_\_\_\_\_The Rescuers
- \_\_\_\_\_Dragons in My Desk
- \_\_\_\_\_The One and Only Ivan
- \_\_\_\_\_The Scarlet Letter
- \_\_\_\_\_Sarah Plain and Tall
- \_\_\_\_\_Murder at Wellington Court
- \_\_\_\_\_Is There Chrome in Chromosomes
- \_\_\_\_\_Maurice the Magician
- \_\_\_\_\_The Little Engine That Could
- \_\_\_\_\_How to Get Fired in 7 Days
- \_\_\_\_\_The Count of Monte Cristo
- \_\_\_\_\_What Time Is Tomorrow?
- \_\_\_\_\_Little Women
- \_\_\_\_\_The Jungle
- \_\_\_\_\_Vatania's Silver Spoon
- \_\_\_\_\_Crime and Punishment
- \_\_\_\_\_Inferno
- \_\_\_\_\_Of Mice and Men

- \_\_\_\_\_The Hunchback of Notre Dame
- \_\_\_\_\_Doctor Doolittle
- \_\_\_\_\_Haunted Castle
- \_\_\_\_\_Death of a Salesman
- \_\_\_\_\_The World Is Round, Except On The Sides
- \_\_\_\_\_Chocolate Burgers and Dandelion Soup
- \_\_\_\_\_The Rollaway
- \_\_\_\_\_The Grape Flavored House
- \_\_\_\_\_Fahrenheit 451
- \_\_\_\_\_Treasure Island
- \_\_\_\_\_Nobody Ever Guessed It
- \_\_\_\_\_Corduroy
- \_\_\_\_\_At the Top of the Muffin
- \_\_\_\_\_The Yearling
- \_\_\_\_\_Froggie Domingo Leaps to London
- \_\_\_\_\_Tales of the Fourth Grade Nothing
- \_\_\_\_\_The Relative Encounter
- \_\_\_\_\_And You Thought Kittens Couldn't Fly
- \_\_\_\_\_Call of the Wild
- \_\_\_\_\_Golden Blue Jeans

- \_\_\_\_\_ The Secret Garden
- \_\_\_\_\_ Frankweiler
- \_\_\_\_\_ Breaking Albert's Code
- \_\_\_\_\_ The Ghosts of Rio Vista
- \_\_\_\_\_ My Daddy the Superhero
- \_\_\_\_\_ The Cat in the Hat
- \_\_\_\_\_ The Magic of Cat Whiskers
- \_\_\_\_\_ Blackout in the Maze
- \_\_\_\_\_ Once Upon a President
- \_\_\_\_\_ Popsicle Pie
- \_\_\_\_\_ Jupiter's Lost Moon
- \_\_\_\_\_ The Tale of Peter Rabbit
- \_\_\_\_\_ The Legend of Sleepy Hollow
- \_\_\_\_\_ My Friend Flicka
- \_\_\_\_\_ Amelia Bedelia
- \_\_\_\_\_ Johnny Tremain
- \_\_\_\_\_ Harold and the Purple Crayon
- \_\_\_\_\_ Ramona the Pest
- \_\_\_\_\_ Alexander and the Terrible, Horrible, No Good, Very Bad Day
- \_\_\_\_\_ Timmy's Train Ride

- \_\_\_\_\_ Dracula's Last Dram
- \_\_\_\_\_ Adventures of Pinocchio
- \_\_\_\_\_ The Red Badge of Courage
- \_\_\_\_\_ From the Mixed-Up Files of Mrs. Basil E.
- \_\_\_\_\_ The Glimmering Phoenix
- \_\_\_\_\_ Our Town
- \_\_\_\_\_ Don't Blow Up the Chemistry Lab
- \_\_\_\_\_ Brave New World
- \_\_\_\_\_ Winnie-the-Pooh
- \_\_\_\_\_ Their Eyes Were Watching God
- \_\_\_\_\_ Harriet the Spy
- \_\_\_\_\_ The Phantom Tollbooth
- \_\_\_\_\_ How Many Windows Are in the White House?
- \_\_\_\_\_ White Blossoms in Denver
- \_\_\_\_\_ Grandma and the Licorice Stick
- \_\_\_\_\_ Pippi Longstocking
- \_\_\_\_\_ Bunnies on Your Birthday
- \_\_\_\_\_ My Lucky Keychain
- \_\_\_\_\_ Superfudge
- \_\_\_\_\_ I Know Why the Caged Bird Sings



- \_\_\_\_\_Mystery at Pine Valley Camp
- \_\_\_\_\_The Spiral Staircase to Jupiter
- \_\_\_\_\_Shades of Madness
- \_\_\_\_\_The Princess Problem
- \_\_\_\_\_Wilma Walrus Goes to the Dentist
- \_\_\_\_\_Zelda's Imagination
- \_\_\_\_\_The Garbage Truck Disaster
- \_\_\_\_\_Anywhere
- \_\_\_\_\_Abandonment of Nelson
- \_\_\_\_\_Blue Bells and Nightingales
- \_\_\_\_\_Rendezvous with Rembrandt
- \_\_\_\_\_Entering My TV Time Machine
- \_\_\_\_\_Don Quixote
- \_\_\_\_\_Mummies in Museums
- \_\_\_\_\_War of the Worlds
- \_\_\_\_\_I Told You So
- \_\_\_\_\_Inspiration Sings
- \_\_\_\_\_20,000 Leagues Under the Sea
- \_\_\_\_\_What Color Is Your Apple?
- \_\_\_\_\_Heidi

- \_\_\_\_\_ Call Me Topsy-Turvy
- \_\_\_\_\_ Bones in the Garage
- \_\_\_\_\_ The Story of Light Bulb Jackson
- \_\_\_\_\_ Trapped in Cyberspace
- \_\_\_\_\_ The Three Little Pigs
- \_\_\_\_\_ The Knight in the Basement
- \_\_\_\_\_ Anna Karenina
- \_\_\_\_\_ A Tree Grows in Brooklyn
- \_\_\_\_\_ The Catcher in the Rye
- \_\_\_\_\_ Stone Soup
- \_\_\_\_\_ Simon's Sinister Plan
- \_\_\_\_\_ Charlotte's Web
- \_\_\_\_\_ The Old Man and the Sea

## APPENDIX E

## Modified Test of Morphological Knowledge

## Part 1: Derivation

Practice: a. Assist. The teacher will give you \_\_\_\_\_.

b. Absorb. She chose the sponge for its \_\_\_\_\_.

1. Perform. Tonight is the last \_\_\_\_\_.
2. Expand. The company planned an \_\_\_\_\_.
3. Revise. The paper is his second \_\_\_\_\_.
4. Major. He won the vote by a \_\_\_\_\_.
5. Mystery. The dark glasses made the man look \_\_\_\_\_.
6. Climate. Under certain \_\_\_\_\_ conditions, hummingbirds migrate south for the winter.
7. Convey. The hikers built a \_\_\_\_\_ from fallen branches when Isaac twisted his ankle on the trail.
8. Cause. The researcher was studying the role of nitrates in the \_\_\_\_\_ of cancer.
9. Admonish. When the rain began, Mary wished she had listened to her mother's \_\_\_\_\_ to bring an umbrella.
10. Subsist. When the crop failed, the family was unable to produce enough rice for their \_\_\_\_\_.

11. Suffice. John wasn't aware his debit card was missing until he received the notice of \_\_\_\_\_ funds from his bank.
12. Demonstrate. Despite his sadness over the situation, Terry remained \_\_\_\_\_ at his father's funeral.
13. Found. The prophet's message was one of great simplicity as well as \_\_\_\_\_.
14. Function. Until Sarah was placed with her new foster family, she was unaware of how \_\_\_\_\_ her natural family was.
15. Apt. Malcolm was surprised at his own \_\_\_\_\_ when he realized how poorly he had performed on the task.

## Part 2: Decomposition

Practice: a. Discussion. The friends have a lot to \_\_\_\_\_.

b. Description. The picture is hard to \_\_\_\_\_.

1. Remubtion. The overweight man was trying to \_\_\_\_\_ his weight.
2. Reliable. On his friend he could always \_\_\_\_\_.
3. Continuous. How long will the storm \_\_\_\_\_?
4. Admission. How many people will they \_\_\_\_\_?
5. Variable. The time of his arrival did not \_\_\_\_\_.
6. Compilation. Zach selected his favorite songs to \_\_\_\_\_ a playlist.

7. Bewilderment. Anna's sleight of hand at card tricks was enough to \_\_\_\_\_

Jack.

8. Popularization. The widespread \_\_\_\_\_ appeal of Twitter caused a decline in the use of Facebook.

9. Charismatic. The leader of the political movement gained his position in large part due to his \_\_\_\_\_.

10. Elimination. Leigh's plan to win the contest was to \_\_\_\_\_ the other contestants in the obstacle course.

11. Indelibly. Aaron meant to \_\_\_\_\_ the email, but he accidentally forwarded it to his entire contact list.

12. Miscalculated. The missing bill caused David to incorrectly \_\_\_\_\_ the amount of money he owed the cable company.

13. Decomposition. Charlotte chose her words carefully to \_\_\_\_\_ her letter of resignation.

14. Evaporation. The heating of the liquid in the beaker caused the \_\_\_\_\_ to rise into the tube and collect in the flask.

15. Proportional. Evan used fractions to \_\_\_\_\_ the cake into even slices.

## APPENDIX F

## Morphological Nonword Analysis Task

Select the best meaning from the choices provided for the words below.

1. The acquitation was reported in the newspaper.
  - a. jury decision
  - b. unsolved crime
  - c. resignation
2. The actress looked luxoxious in what she was wearing.
  - a. overdressed
  - b. elegant
  - c. casual
3. On the property was a perimetous wall.
  - a. rough stone
  - b. deteriorating
  - c. encircling
4. The people were worried about the effects of omnicommerce.
  - a. prolonged droughts
  - b. illegal immigration
  - c. global trade

5. The color of the walls had a blanding effect.
- a. boring
  - b. outdoors-like
  - c. artistic
6. The addicant was removed from the store shelves.
- a. problematic drug
  - b. expired food
  - c. fire-causing chemical
7. The explanusionist calmed the concerns of the crowd.
- a. crafty interpreter
  - b. former architect
  - c. stimulating speaker
8. The sinisterity of the man convinced the couple to leave.
- a. irritating voice
  - b. untrustworthiness
  - c. shabby looks
9. The room was full of sociophites of all types.
- a. aspiring celebrities
  - b. hanging plants
  - c. swarming insects

10. The literist was welcomed by a large crowd.
- a. author
  - b. actor
  - c. singer
11. The young man was grateful to his financesteor.
- a. trusty friend
  - b. wealthy grandparent
  - c. supportive boss
12. Her husband's behavior made the woman jealosipate.
- a. happy
  - b. insecure
  - c. apologetic
13. The equivalation of the speaker made an impression on the audience
- a. balanced perspective
  - b. powerful delivery
  - c. charming personality
14. The man became rich by secreteering.
- a. spying
  - b. singing
  - c. writing plays



15. The congressman argued that the nuclearance was important.

- a. study of stem cells
- b. elimination of bombs
- c. remubtion of taxes

16. The woman was very proud of the vegeslation.

- a. tree trimming
- b. food preparation
- c. environmental laws

17. The drug was expensive because it was magicinal.

- a. illegal
- b. effective
- c. rare

18. The political adviser was known for his strategery.

- a. great wisdom
- b. borderline dishonesty
- c. humble sincerity

## APPENDIX G

## Semantic Productive Knowledge Task

Provide a definition for each of the words listed below.

1. absalcion
2. allanation
3. bannifer
4. barrazon
5. blonterstape
6. brasterer
7. cannarrate
8. comdute
9. comfresation
10. commerant
11. commerine
12. condarent
13. condravator
14. contramponist
15. decomfubition
16. doppelate
17. empliforven

18. expispition
19. fenneriser
20. frescovent
21. fretification
22. glisteren
23. hampent
24. happement
25. obsatsion
26. perplisteronk
27. pretudate
28. prindle
29. prophapion
30. prosuvile
31. protibional
32. rekibbance
33. remubtion
34. rezondacle
35. ropitulate
36. skiticult
37. suffubition

38. tafflest

39. thaskrel

40. tullfactor

## APPENDIX H

## Morphological Knowledge Measure (MKM)

Each of the words below is made up of word parts. Provide a definition for the word part in **bold**.

1. abs**al**cion
2. all**an**ation
3. **tull**factor
4. **ropi**tulate
5. com**dute**
6. com**fres**ation
7. con**dare**nt
8. con**dra**vator
9. de**comfub**ition
10. exp**isp**ition
11. **fres**ification
12. obs**ats**ion
13. pre**tud**ate
14. pro**su**vile
15. pro**phap**ion
16. pro**tibi**onal

17. rez**ond**acle

18. rem**ub**tion

19. rek**ibb**ance

20. suff**ub**ition

## APPENDIX I

## Syntactic Class Knowledge Acquisition Measure

1. \_\_\_\_\_
  - a. The man gave us **absalcion**.
  - b. The **absalcion** was delicious.
2. \_\_\_\_\_
  - a. The **allanation** was not nice.
  - b. The **allanation** girl found the key.
3. \_\_\_\_\_
  - a. The **bannifer** was quiet.
  - b. The girl **bannifer** the hat.
4. \_\_\_\_\_
  - a. The kite **barrazon** through the sky.
  - b. The **barrazon** ate the pie.
5. \_\_\_\_\_
  - a. The dog **blonterstaped** up the hill.
  - b. The hill was very **blonterstape**.
6. \_\_\_\_\_
  - a. The **brasterer** man ran down the street.
  - b. The **brasterer** sat on the table.

7. \_\_\_\_\_

- a. The children **cannarated** at the teacher.
- b. The **cannarate** was on the ground.

8. \_\_\_\_\_

- a. The **comdute** man was at the movies.
- b. The girl **comduted** the answers.

9. \_\_\_\_\_

- a. The **confresation** was big.
- b. The **confresation** girl caught the ball.

10. \_\_\_\_\_

- a. The man was on the **commerant**.
- b. The man **commeranted** at the car.

11. \_\_\_\_\_

- a. The **commerine** was blue.
- b. The girl was **commerine**.

12. \_\_\_\_\_

- a. The cat **condarent** the food.
- b. The movies were **condarent**.



13. \_\_\_\_\_

- a. The **condravator** drove the bike.
- b. The cat **condravator** the mouse.

14. \_\_\_\_\_

- a. The **contramponist** was very popular.
- b. The **contramponist** man was lost.

15. \_\_\_\_\_

- a. The **decomfubition** was easy.
- b. The art **decomfubitioned** at the sale.

16. \_\_\_\_\_

- a. The kids **doppelate** for pizza.
- b. The pizza was too **doppelate** to eat.

17. \_\_\_\_\_

- a. The **empliforven** was far away.
- b. The **empliforven** man was happy.

18. \_\_\_\_\_

- a. The **expipsition** girl hit the ball.
- b. The **expispition** was short.

19. \_\_\_\_\_

- a. The **fenneriser** walked in the park.
- b. The umbrella **fenneriser** the rain.

20. \_\_\_\_\_

- a. The **frescovent** was orange.
- b. The man **frescovented** into the crowd.

21. \_\_\_\_\_

- a. The **fresification** lasted a while.
- b. The family **fresificationed** in the car.

22. \_\_\_\_\_

- a. The **glisteren** hat was lost in the wind.
- b. The **glisteren** was as big as a car.

23. \_\_\_\_\_

- a. The **hampent** girl walked towards us.
- b. The **hampent** ran through the woods.

24. \_\_\_\_\_

- a. The man **happemented** the girl.
- b. The **happement** was very shiny.

25. \_\_\_\_\_

- a. The cat jumped on the **obsatsion**.
- b. The **obsatsion** boy went to the game.

26. \_\_\_\_\_

- a. He gave **perplisteronk** to the family.
- b. The **perplisteronk** was on the road.

27. \_\_\_\_\_

- a. The **pretudate** was very happy.
- b. The sunset **pretudates** the fireworks show.

28. \_\_\_\_\_

- a. The **prindle** ran away from the dog.
- b. The bug **prindled** the boy.

29. \_\_\_\_\_

- a. The **prophapion** was a square.
- b. The **prophapion** girl played piano.

30. \_\_\_\_\_

- a. The **prosuville** was hard to see.
- b. We **prosuville** to the movies.

31. \_\_\_\_\_

- a. The **protibional** went to the movies.
- b. The **protibional** deal went over well.

32. \_\_\_\_\_

- a. The **rekibbance** was on time.
- b. The boy felt **rekibbance**.

33. \_\_\_\_\_

- a. The girl tried to **remubtion** the dress.
- b. The **remubtion** did not help.

34. \_\_\_\_\_

- a. The **rezondacle** was hard to find.
- b. The man **rezondaced** the bike.

35. \_\_\_\_\_

- a. The runner **ropitulated** the race.
- b. The **ropitulated** man was lost.

36. \_\_\_\_\_

- a. The **skiticult** refused to pay.
- b. The cat **skiticult** up the tree.

37. \_\_\_\_\_

- a. The **suffubition** was wrong.
- b. The **suffubition** girl turned around.

38. \_\_\_\_\_

- a. The boy **tafflest** the ice cream.
- b. The man ran away from the **tafflest**.

39. \_\_\_\_\_

- a. The **thaskrel** was cold.
- b. The **thaskrel** girl fell down.

40. \_\_\_\_\_

- a. He found out the name of the **tullfactor**.
- b. He **tullfactored** the box.

## APPENDIX J

## Semantic Receptive Knowledge Acquisition Measure

1. absalcion:
  - a. the state of being poor
  - b. the release from blame or guilt
  - c. the state of existing
  - d. the solving of a problem
2. allanation:
  - a. something said in protest, objection, or disapproval
  - b. idle talk about the personal affairs of others
  - c. a statement not supported by proof
  - d. statement of a witness under oath
3. bannifer
  - a. a person who represents someone else
  - b. a dishonest or unprincipled man
  - c. a person who is compassionate and helpful
  - d. a person who does a lot of bragging

## 4. barrazon:

- a. a small store selling a specific goods
- b. a person or thing that works
- c. a bandit, one of a band of robbers
- d. a person who is skilled in magic

## 5. blonterstape:

- a. to go aimlessly
- b. to look for a deal
- c. to cut or trim closely
- d. to move clumsily or heavily

## 6. brasterer:

- a. a suitcases to pack personal belongings for traveling
- b. a small chest to hold money or treasure
- c. a border or case for enclosing a picture, mirror, etc.
- d. a band of flexible material for encircling the waist

## 7. cannarate:

- a. to put to a wrong use
- b. to snivel or complain
- c. to join as a companion, partner, or ally
- d. to smile or speak in a way that is not sincere or natural

8. comdute:

- a. to make a list
- b. to draw together
- c. to get, pull, or draw out
- d. to place in a position

9. confresation:

- a. something that makes a situation more difficult
- b. a wavelike motion
- c. something that adjusts readily to change
- d. withdrawal of a promise, statement, opinion

10. commerant:

- a. a structure two sidepieces and a series of rungs
- b. a step or set of steps for crossing a fence or wall
- c. a sloping surface connecting two levels
- d. a flat or level surface

11. commerine:

- a. clever
- b. shy
- c. angry
- d. fearful



12. condarent:

- a. being free from disturbance
- b. happening or existing at the same time
- c. having many different parts
- d. being easily understood or done

13. condravator:

- a. a person who is involved in a secret plan
- b. a person who works with another
- c. a person who is a new member of a group
- d. a person who causes some action

14. contramponist:

- a. a person who makes decisions
- b. the captain of a ship
- c. the lord of the land
- d. the owner of a business establishment

15. decompubition:

- a. to make more active
- b. the breakdown of plant or animal matter
- c. to process used goods so as to make something better than before
- d. something that is deposited

16. doppelte:

- a. to speak quickly
- b. to move away from
- c. to say noisily
- d. to split into parts

17. empliforven:

- a. a kingdom
- b. a company
- c. a city
- d. an organization

18. expispition:

- a. a quick, sudden attack
- b. a procession of persons riding on horses
- c. a journey or trip by foot
- d. an examination or survey (of a region, area, etc.)

19. fenneriser:

- a. a young woman making a debut into society
- b. a dignified elderly woman
- c. a person who is new to a situation
- d. a man who has lost his spouse by death

20. frescovent:

- a. to push quickly into
- b. to move quietly or stealthily
- c. to progress slowly
- d. to move unsteadily

21. fretification:

- a. to make a change to something
- b. to strengthen something
- c. to give back or repeat
- d. to say or do again or repeatedly

22. glisteren:

- a. a nest of a bird of prey
- b. a small shelter for a dog
- c. a place of safety
- d. a place in which a person lives

23. hampent:

- a. not very exciting
- b. not showing emotion
- c. not very bad
- d. not usual or normal

24. *happement*:

- a. to treat or speak to (someone) with rudeness
- b. to express or make clear disapproval of (someone)
- c. to drive away (someone)
- d. to ignore (someone) in a deliberate and insulting way

25. *obsation*:

- a. something that gets in the way
- b. something that distracts
- c. the act of turning aside from a course or purpose
- d. the act of confusing

26. *perplisteronk*:

- a. to speak or write in favor of
- b. to give aid to (one in need or distress)
- c. to concentrate on a particular pursuit
- d. to restore to good condition

27. *pretudate*:

- a. to move with speed
- b. to cause to happen
- c. to rely on
- d. to state as fact

28. prindle:

- a. a mischievous child
- b. a young animal that has lost its mother
- c. a student who stays away from school without permission
- d. a person of profound or extensive learning

29. prophapion:

- a. something that is equivalent
- b. something that results
- c. a part of a whole
- d. a way or means of approach

30. prosuvile:

- a. an object used to hold something
- b. a tall narrow building
- c. an object worn around the waist
- d. a body or object thrown forward

31. protibional:

- a. being loaded heavily
- b. having the effect of inspiring someone
- c. serving for the time only
- d. relating to the process of providing food

32. rekibbance:

- a. a piece of writing in a newspaper
- b. a report of an event
- c. a payment sent in
- d. an object made by a human being

33. remubtion:

- a. the act of making something less
- b. the act of people moving forward
- c. the return to a less developed state
- d. the action of making something from raw materials

34. rezondacle:

- a. a hole or cavity in the ground
- b. a deep, round dish or basin
- c. a hollow utensil used for holding liquids or other contents
- d. something used to receive and contain smaller objects

35. ropitulate:

- a. to give up
- b. to pull up
- c. to fall down
- d. to sit down

36. skiticult:

- a. a person who has failed at a job
- b. a person who builds houses
- c. a person who is a coward
- d. a person who boasts

37. suffubition

- a. an opinion or judgment based on little or no evidence
- b. manner or feeling with regard to a person or thing
- c. conduct or behavior of someone
- d. a natural disposition to act toward some point or result

38. tafflest:

- a. an evening party
- b. a confused struggle
- c. the act of sharing
- d. a special or important time

39. thaskrel:

- a. a plateau
- b. a field
- c. a stream
- d. a valley

40. tullfactor:

- a. a person who performs a service willingly and without pay
- b. a person who does good for another, especially by giving money
- c. a peson who vouches or is responsible for a person or thing
- d. a person who is a customer, client, or paying guest, especially a regular one



## APPENDIX K

## Institutional Review Board Approval Letter



January 27, 2016  
Investigator(s): Jennifer Cooper, Amy Elleman, Stacy Fields, Adam Rollins, Kelli Williams  
Department: Education  
Investigator(s) Email: [jls2cy@mtmail.mtsu.edu](mailto:jls2cy@mtmail.mtsu.edu), [amy.elleman@mtsu.edu](mailto:amy.elleman@mtsu.edu)

Protocol Title: "Examining Incidental Vocabulary Acquisition by Person and Item-Level Factors in Secondary Students"

Protocol Number: 16-2133

Dear Investigator(s),

The MTSU Institutional Review Board, or a representative of the IRB, has reviewed the research proposal identified above. The MTSU IRB or its representative has determined that the study poses minimal risk to participants and qualifies for an expedited review under 45 CFR 46.110 and 21 CFR 56.110, and you have satisfactorily addressed all of the points brought up during the review.

Approval is granted for one (1) year from the date of this letter for 100 participants.

Please note that any unanticipated harms to participants or adverse events must be reported to the Office of Compliance at (615) 494-8918. Any change to the protocol must be submitted to the IRB before implementing this change.

You will need to submit an end-of-project form to the Office of Compliance upon completion of your research located on the IRB website. Complete research means that you have finished collecting and analyzing data. **Should you not finish your research within the one (1) year period, you must submit a Progress Report and request a continuation prior to the expiration date.** Please allow time for review and requested revisions. Failure to submit a Progress Report and request for continuation will automatically result in cancellation of your research study. Therefore, you will not be able to use any data and/or collect any data. Your study expires 1/27/2017.

According to MTSU Policy, a researcher is defined as anyone who works with data or has contact with participants. Anyone meeting this definition needs to be listed on the protocol and needs to complete the required training. **If you add researchers to an approved project, please forward an updated list of researchers to the Office of Compliance before they begin to work on the project.**

All research materials must be retained by the PI or faculty advisor (if the PI is a student) for at least three (3) years after study completion and then destroyed in a manner that maintains confidentiality and anonymity.

Sincerely,

Timothy R. Graeff  
Institutional Review Board Member  
Middle Tennessee State University