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Does Meaning Matter For Reading Achievement? Untangling the Role of Phonological Recoding and Morphological Awareness in Predicting Word Decoding, Reading Vocabulary, and Reading Comprehension Achievement for Spanish-Speaking English Language Learners

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DOES MEANING MATTER FOR READING ACHIEVEMENT?
UNTANGLING THE ROLE OF PHONOLOGICAL RECODING AND
MORPHOLOGICAL AWARENESS IN PREDICTING WORD DECODING,
READING VOCABULARY, AND READING COMPREHENSION ACHIEVEMENT
FOR SPANISH-SPEAKING ENGLISH LANGUAGE LEARNERS

By

Amanda P. Goodwin

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DOES MEANING MATTER FOR READING ACHIEVEMENT? UNTANGLING THE ROLE OF PHONOLOGICAL RECODING AND MORPHOLOGICAL AWARENESS IN PREDICTING WORD DECODING, READING VOCABULARY, AND READING COMPREHENSION ACHIEVEMENT FOR SPANISH-SPEAKING ENGLISH LANGUAGE LEARNERS

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This study examined the unique contributions of morphological awareness and phonological recoding to word decoding, reading comprehension, and reading vocabulary for 197 Spanish-speaking English language learners enrolled in the fifth grade. The study also explored the contribution of phonological recoding, measured by accuracy on a pseudo-word decoding task, to the prediction of the same components of reading achievement. Specifically the study explored whether the contribution of phonological recoding changed when morphological awareness and oral vocabulary (a mediator of reading achievement) were added as predictors. To examine unique contributions, morphological awareness was separated from phonological and orthographic confounds present in opaque morphological relationships by using structural equation modeling to construct a latent variable stemming from the shared variance of four morphological tasks with different levels of morphological transparency, and therefore different phonological and orthographic processing demands. A latent variable of phonological recoding was also created. Findings indicated that when controlling for phonological recoding, morphological awareness made a significant and meaningful contribution to passage comprehension and reading vocabulary, but not word decoding with oral vocabulary.
acting as a significant mediator of this relationship. The study also found that phonological recoding was a significant predictor of each reading outcome when morphological awareness was not included as a predictor, but only significantly predicted word reading when controlling for morphological awareness. Significance of these findings to research and the need for additional morphological instruction within educational settings are discussed.
Dedication

I would like to dedicate this work to my family, who have supported, critiqued, loved, laughed, and listened to the many versions of this manuscript. After three years, who can believe that morphological awareness is discussed at dinner with the same familiarity as football scores. Thank you!

I would also like to dedicate this work to all my students, both past and future, for whom this manuscript is written. I am passionate about education and truly believe that morphology has the potential to support student learning. If this work can make a difference to any one of you, then I will believe this journey will have been worthwhile.

Lastly, I would like to dedicate this work to my advisor Maria Carlo and my colleagues Dr. Soyeon Ahn, Mrs. Miriam Lipsky, and Ms. Corinne Huggins. This work is the culmination of three years of studying the impact of morphological awareness at the process and instructional level. You each have been instrumental in exploring various aspects of how morphological awareness relates to literacy achievement. Together, we are starting to build a persuasive rationale for both the contribution of morphological awareness to literacy achievement as well as the need for more morphological instruction within classroom settings. Thank you for thinking through these challenging issues with me.
Acknowledgment

I would like to thank Diane August, Maria Carlo, and the Center for Applied Linguistics for providing the data for this analysis and supporting my quest to understand the role of morphological awareness in reading achievement for Spanish-speaking English language learners.
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Chapter 1: Introduction

In recent years reading researchers have worked to clarify the role of morphological awareness in the complex process of reading, which has been made more difficult by the many linguistic demands involved in morphological tasks. In order to understand how morphological awareness contributes to reading achievement, its involvement must be separated from that of phonological awareness, which is a well established predictor of reading achievement (Adams, 1990; National Institute of Child Health and Human Development, 2000; Snow, Burns, & Griffin, 1998; Stanovich, 1990). Correlations between morphological and phonological awareness range between .15 to .76 depending on the measures used and the age of participants (Carlisle, 1995; Carlisle & Nomanbhoy, 1993; Deacon & Kirby, 2004; Kieffer & Lesaux, 2008; Mahony, Singson, & Mann 2000; Shankweiler et al., 1995; Siegel, 2008; Singson, Mahony, & Mann, 2000). Researchers have used statistical techniques to try to isolate the contributions of these constructs, and while the majority of studies suggest a unique role for morphological awareness and phonological awareness in contributing to various measures of reading achievement (Carlisle, 1995; Carlisle & Nomanbhoy, 1993; Deacon & Kirby, 2004; Mahony et al., 2000; Nagy, Berninger, & Abbot, 2006; Siegel, 2008; Singson et al., 2000), questions remain because of limitations in statistical methods applied in the analyses. The current study used structural equation modeling techniques and measures with varying degrees of morphological transparency to more accurately isolate the contributions of morphological awareness and phonological recoding.

The role of morphological awareness in reading achievement has received greater focus over the past thirty years. When searching the ERIC database using morpholo*,
read*, and vocabulary as keywords, only 1 peer reviewed journal article (and 60 journal articles) from the 1980s vs. 73 (105) from the 1990s and 201 (217) from the 2000s were found. Although the focus on morphology is increasing, research regarding its relationship to reading and vocabulary is relatively less developed compared to other predictors of literacy as shown by a similar search using phonolo*, read*, and vocabulary which returned 1,635 peer reviewed journal articles between 2000 and 2009 alone.

How morphology has been studied in relation to reading has also changed across time. For example, in the 1970s, researchers examined correlations between morphological awareness and general reading measures (Britain, 1970). In the 1980s, researchers determined the frequency of morphologically complex words in text (Nagy & Anderson, 1984) and how morphological awareness is acquired (Carlisle, 1988; Freyd & Baron, 1982; Tyler & Nagy, 1989). By the end of the 1980s, researchers contributed models of morphological stages of development (Templeton, 1989) and studies of morphological interventions (White, Sowell, & Yanagihara, 1989; Wysocki & Jenkins, 1987). In the 1990s and 2000s, researchers examined how morphological processing supports vocabulary knowledge (Anglin, 1993) and used novel statistical models to determine how morphological awareness supports reading achievement beyond related linguistic dimensions such as phonological awareness (see studies discussed in this literature review).

The present study sought to further this progression by examining the unique contributions of morphological awareness and phonological recoding for Spanish-speaking English language learners to real word decoding, reading comprehension, and
reading vocabulary with oral vocabulary as a mediator. The study also explored whether
the contribution of phonological recoding to the prediction of components of reading
achievement changed when controlling for morphological awareness and oral vocabulary
as compared to when phonological recoding was the single predictor. To examine unique
contributions, morphological awareness was separated from phonological and
orthographic confounds present in opaque morphological relationships by using structural
equation modeling. This technique was used to construct a latent variable stemming from
the shared variance of four morphological tasks with different levels of morphological
transparency, and therefore different phonological and orthographic processing demands.
Whereas research examining morphology and reading is small yet increasing for the
fluent English population, research regarding the population of English language learners
(ELLs) and morphology is quite rare. Yet, ELLs would seem to benefit from
morphological awareness and its link to meaning because low levels of English
vocabulary, language proficiency, and cultural knowledge cause ELLs to encounter
problems in gaining meaning from academic texts. These learners tend to perform
similarly to their English fluent peers in processes that do not involve meaning such as
decoding or phonological awareness, yet perform far below such peers in comprehension
and vocabulary measures (August & Shanahan, 2006). Because the language skills at the
sublexical and lexical level involved in the reading comprehension process for ELLs are
unclear, further examination of how morphological awareness contributes to reading is
necessary.
What is Morphological Awareness?

Morphological awareness is the manipulation of units of meaning called morphemes. These morphemes can stand alone in monomorphemic words or, as in the case of affixes and stems, are bound to other morphemes in morphologically complex words. Morphological relationships fall within three linguistic categories: 1) inflectional morphology, 2) derivational morphology, and 3) compound words. Inflectional morphology contains units that vary the tense, number, possession, and depending on the language, gender of the word without changing the grammatical category. For example, adding the morpheme *s* to *dog* changes the meaning from singular to plural. Adding the morpheme *ed* to *play* changes the tense to past tense. Derivational morphology involves adding or subtracting suffixes and prefixes that change both the meaning and often the grammatical category of the word. In the word *teacher*, the morpheme *er* is added to the base word *teach* to change the meaning from a verb to a noun. Adding the morphemes *less* to *help* changes the meaning to be *without help*. Derivational morphology is more complex than inflectional morphology because of the greater number of variations involved (for example, *dark, darkness, darker, darken, and darkly* are all derivations of the base morpheme *dark*) and also tends to lead to larger changes in meaning than inflectional morphology (Verhoeven & Perfetti, 2003). The use of compound words involves words that consist of multiple component words. For example, *basketball* can be segmented into two main words: *basket* and *ball*, which together give the meaning of a ball that is shot into a basket.

Morphological awareness is complex and difficult to assess because it is related to multiple linguistic dimensions. For example, according to Jarmulowicz, Hay, Taran, &
Ethington (2008), morphological awareness is “the explicit understanding of word structure” (p. 277). Carlisle (1995) describes morphological awareness as the “conscious awareness of the morphemic structure of words and their ability to reflect on and manipulate that structure” (p. 194). Kuo and Anderson (2006) start with a simple definition, “the ability to reflect upon and manipulate morphemes and employ word formation rules” (p.161), yet explain that reading researchers assess morphological awareness as part of a larger construct covering phonological awareness, orthographic awareness, and semantic awareness. The identification and manipulation of morphemes are primary in each of these definitions, with morphemes being the smallest units of meaning. For example, the word *markers* has three morphemes: *mark* (to make a visible impression), *er* (derivational agentive suffix denoting a thing that performs the action), and *s* (shows plural). The ability to recognize the morphemes within *markers* and the relationship between *mark* and *marker* and *markers* utilizes morphological awareness.

Transparency and frequency make some morphological relationships easier to recognize than others (Carlisle, 2003). Relationships are transparent when a morphological change occurs without altering the spelling or pronunciation of the root. For example, in *grow* and *growth*, the root word’s grammatical category and meaning are changed without any differences in how the root morphemes are pronounced or spelled. Relationships become less transparent when changes in spelling or sound hide the morphological relatedness as in the example of *magic* and *magician* where the change in sound adds a phonological demand to identifying the morphological relationship. Likewise, spelling differences between *decide* and *decision* add an orthographic component to the morphological relationship. Similarly, in the example of *five* and *fifth*,

there are phonological, orthographic, and morphological demands involved in identifying the morphological relationship due to spelling and sound changes. The less transparent the relationship, the more difficult it is for students to use morphological awareness to aid decoding and meaning acquisition (Carlisle, 2003; Carlisle, 2000; Singson et al., 2000). These often simultaneous morphological, phonological, and orthographic changes are yet another reason why the contributions of morphological and phonological awareness are difficult to unravel.

Because English privileges consistency of spelling across words, close study of the history of English orthography suggests historical reasons for many of the seemingly irregular patterns found in current modern English (Venezky, 1999). For example, originally a German runic alphabet was used due to German invasions of England. As Christianity spread to England as part of the expansion of the Roman Empire, the Latin alphabet replaced the runic alphabet. After the Norman Conquest in 1066, French became the official language of England, merging many French words into the English language. As of 1400, the spoken language of Parliament was English whereas the written languages remained French and Latin. By the time English was restored as the official written language of Parliament in 1420, English spellings retained their French, Latin, German, and Anglo-Saxon roots. Within the Renaissance time period, English orthography evolved further, this time embracing reforms based on etymology and morphology.

The history of English makes it so that words follow certain morpheme patterns depending on the heritage of the word. For example, words stemming from Anglo-Saxon roots compound often, as in railroad, and affix, as in unlikely. Words borrowed from
Romance languages tend to affix only to roots that cannot stand alone, as in *disruption*. Words borrowed from Greek also tend to compound, as in *photograph* (Henry, 1988). English’s history of merging words from various languages has made it a language where morphemic structure must be acknowledged when reading. For example, sounds are pronounced or allowed to remain silent based on morphemic boundaries within words like when consonants are doubled as in *missile* versus *misspelled*, knowing the morphemic boundary can help a reader determine whether to pronounce the *ss* as */s/* or as two separate sounds. For example, in *missile*, the *ss* is found within the morpheme and therefore is pronounced */s/*. In *misspelled*, the *ss* proceeds across the morpheme boundary and therefore, it is pronounced as two separate sounds. Similarly, in the word *hothouse*, knowing the morphemic boundary allows the *t* and *h* to be pronounced separately rather than as */th /*.

**The Contribution of Morphology to Reading Achievement**

Morphological awareness contributes to both general measures and components of reading such as decoding, reading comprehension, and vocabulary development (Carlisle, 2003; Kuo & Anderson, 2006). For instance, researchers have shown that morphological awareness contributes to lexical outcomes such as decoding (Carlisle & Stone, 2005; Deacon & Kirby, 2004; Mahony et al., 2000; Siegel, 2008; Singson et al., 2000) and vocabulary knowledge (Anglin, 1993; Carlisle & Fleming, 2003; Nagy et al., 2006; Siegel, 2008). Morphological awareness also plays a role in reading comprehension for both native and second language speakers of English (Carlisle, 1995; Deacon & Kirby, 2004; Kieffer & Lesaux, 2008; Mahony, 1994; Nagy et al., 2006; Siegel, 2008). The role of morphological awareness in reading and vocabulary
achievement is found in multiple languages including French, Danish, and Chinese to name a few (Casalis, Cole, & Sopo, 2004; Casalis & Louis-Alexandre, 2000; Elbro & Arnbak, 1996; Ku & Anderson, 2003).

**Methodological Challenges in Determining the Role of Morphological Awareness**

Assessing the contribution of morphological awareness to components of reading achievement separate from other aspects of linguistic awareness is difficult. Many morphological tasks also involve phonological and orthographic demands. For example, identification of the morphological relationship between *five* and *fifth* involves phonological and orthographic processing of the differences in sound and spelling.

Researchers attempt to control for these linguistic confounds through statistical techniques such as sequential regression, comparing a taxonomy of multiple regression models, or structural equation modeling, however different levels of phonological processing between the focus and control task bring into question the success of these techniques. Further elaboration of possible confounds and statistical techniques used to address the multidimensional nature of these constructs is provided in Chapter 2.

**Role of Morphological Awareness for ELLs**

Similar obstacles are present when attempting to isolate the contributions of morphological and phonological awareness for ELLs. For example, to isolate the contributions of morphological awareness from that of phonological awareness to reading comprehension, Kieffer and Lesaux (2008) compared a baseline control model without morphological awareness to a final model with morphological awareness. The baseline model included a phoneme elision task to control for the phonological processing demands confounded within the morphological task that assessed word pairs of varying
degrees of transparency. Yet, because deleting a phoneme involves a different degree of phonological processing from that required in identifying an opaque morphological relationship such as the relationship between *magic* and *magician*, the findings of the unique contribution of morphological awareness must be interpreted in light of the fact that some phonological processing demands probably remain in the morphological awareness task.

**The Present Study**

The current study examined the contributions of morphological awareness and phonological recoding, which is “the letter-by-letter processing in sequential decoding of words” (Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001, p. 40), to components of reading achievement for Spanish-speaking ELLs. Structural equation modeling was used to isolate morphological awareness from the phonological and orthographic confounds present in opaque morphological relationships by creating a latent variable stemming from the shared variance of four morphological tasks with different levels of transparency. As part of the latent variable framework, phonological and orthographic awareness, which are confounded within the morphological task, was theoretically partitioned into the indicator error terms instead of included within the latent variable. By using this framework, contributions stemming from morphological awareness were purely morphological and unique from related linguistic constructs. To appropriately compare the contributions of this latent construct of morphological awareness, which had less measurement error than a single indicator, a latent variable of phonological recoding was created, allowing both latent variables to have low levels of measurement error.
This study followed an earlier analysis where similar methods suggested morphological awareness contributed to general reading achievement controlling for phonological recoding (Goodwin, Huggins, Carlo, & August, 2010). In the earlier study, general reading ability was defined through a latent construct of real word decoding, reading comprehension, and reading vocabulary. Because the Goodwin et al. (2010) study suggested the role of morphological awareness unique from the contribution of phonological recoding in predicting overall reading achievement, an important follow-up analysis must examine how this contribution to general reading achievement occurs by determining whether morphological awareness plays a different role within decoding, comprehension, and vocabulary knowledge. This study is positioned to further untangle morphological from phonological processing by clarifying how morphological awareness uniquely contributes to word identification, vocabulary knowledge, and reading comprehension as compared to the contribution of phonological recoding to each of these outcomes.
Chapter 2: Literature Review

The study of morphological awareness in relation to reading achievement is a relatively new development in the field of reading research. In fact, most theoretical models of the reading process do not specifically acknowledge a role for morphology. This chapter will discuss the role attributed to morphological awareness in the elaboration of theoretical models of reading and how morphological awareness contributes to the prediction of reading achievement. In doing so, the development of morphological awareness and its relationship to other contributors such as phonological awareness will be discussed. The chapter will conclude with a discussion of the current study which attempts to untangle the contributions of phonological awareness from the role of morphological awareness in predicting reading achievement for Spanish-speaking ELLs.

The Role of Morphology in Models of Reading and Lexical Access

In a recent presentation, Perfetti (2009) presented a model of reading comprehension. This model, as shown in Figure 2.1, includes a role for phonological and orthographic units in word identification and shows meaning, morphology, and syntax as contributing to meaning and form selection. The Perfetti (2009) model incorporates the role of morphology as providing lexical access, which supports both word identification and accessing the meaning of the word.

Perfetti’s recent model of comprehension is a marked improvement compared to past models that have emphasized the role of phonology, orthography, or semantics rather than morphology in gaining meaning from text. To examine this trend, popular comprehensive models of reading by Gough (1972), Rummelhart and McClelland (1986), Perfetti (1986), and Adams (1994) will be briefly summarized followed by models of
Figure 2.1. Perfetti’s (2009) framework of reading comprehension. This model simplifies comprehension to include four processes (ie, decoding, meaning selection, proposition extraction, and mental model building) and four types of knowledge (ie, orthographic, linguistic, word, and nonlinguistic or conceptual knowledge) required to support those processes.

morphological processing such as Schreuder and Baayen’s hybrid theory (1995) and Taft’s activation interactive model (2004).

The absence of morphological awareness from general models of reading and lexical access is problematic because written English utilizes a morpho-phonemic system for mapping print to sound such that meaning is communicated through letters, sounds, and units of meaning (Chomsky & Halle, 1968). Changes in the spelling of different forms of words are often based more on meaning or morphology than on sound or phonology. For example, the word magician is pronounced without the hard /c/ sound,
but spelled with the *c* because the meaning of the word is based on the root morpheme, *magic*. Similarly, the word pairs *peeled* and *field* and *kissed* and *list* sound similar, but are spelled differently because only one word of the pair carries the meaning of *past tense* through the *ed* morpheme (Nunes et al., 2006). Although meaning plays a key role in the spelling, decoding, and understanding of written text, morphology continues to either be absent or play a minor role in many theories of reading.

**General Models of Reading**

The role of morphemes is absent in the major models of the reading process such as Gough’s (1972) bottom-up model, parallel distributed processing models such as the Rummelhart and McClelland’s (1986) model, and Perfetti’s verbal efficiency model (1988). In these models, processing relies on icons or patterns involving letters and sounds, but does not include a role for recognizing patterns at the morphemic level. For example, Gough suggests that readers map characters “onto a string of systematic phonemes” (p. 337) that are related to phonological rules and that lexical access is gained by combining these systematic phoneme representations. Similarly, Rummelhart and McClelland show the role of familiarity in how letters are perceived within words with visual feature detectors at the word and letter level that together provide activation of correct words and hinder other word possibilities. Perfetti’s verbal efficiency model (1988) suggests that word reading improves as the reader develops a large automatic lexicon of orthographic and phonological representations that can be accessed without background knowledge or context clues. In each of these models, the role of morphemes as patterns could be inferred, but is not stated explicitly. In addition, although Perfetti does include a role for semantic knowledge in encoding meaning information, accessing
meaning, and activating schema, the semantic activation he discusses involves the meaning of a word as a whole rather than via units of meaning.

Adams (1994) suggests a role for morphemes in connecting word recognition and reading, but it is a small component within a larger meaning processor stating that words are stored as “interassociated sets of more primitive meaning elements… that allows us to focus on one aspect or another of a word’s full meaning as appropriate in context” (p. 850-851), and while these primitive meaning elements sound similar to morphemes, Adams links these meaning elements to morphology.

**Lexical Access Models involving Morphological Processing**

Theories of morphological processing follow the dual route models of word recognition where words are stored and accessed in units and as wholes (Feldman & Basnight-Brown, 2008). Such models suggest that there are two routes to reading with each route providing information which is combined to provide the reader with the necessary data to accurately pronounce the word or pseudoword (Baron, 1977). The first route is a lexical route that involves accessing knowledge in one’s mental lexicon regarding pronunciation and meaning of the word. The second route is nonlexical and rule-based such that rules are used to relate letters to sounds and sounds to words (Coltheart, 2005). In the case of morphology, the dual route model suggests that morphologically complex words are stored in two distinct forms, as a whole word and in the separate, smaller morphemic units that make up the larger word. This differs from the phonological dual route model in that the units are morphological or meaning based in nature rather than phonological or sound based.
Two lexical access morphological processing models describe the rule-based use of morphemic units to create meaning from spoken and written words. According to Schreuder and Baayen’s hybrid theory (1995) and Taft’s activation interactive model (2004), when a stored image of the morphologically complex word is unavailable, the meaning of component morphemes are activated and combined to gain the meaning of the morphologically complex word.

Schreuder and Baayen’s (1995) model lists three stages of activation involved in gaining the meaning of words. Segmentation, or the first stage, is when the word and its parts are mapped onto already created representations that lie in the mental lexicon. These images can be both full word figures as well as images of bound morphemes such as prefixes, suffixes, or stems. For example, in this stage, the word *dogs* would activate the concept nodes of *dogs, dog* and *plural*. Feedback from these concept nodes provides syntactic and semantic information about the word. Speed of mapping depends on the activation level of the representation and the complexity of the mapping process. Representations that are accessed more often due to higher frequencies are accessed more quickly. The *teach* in *teacher* is activated with greater speed and ease than the *lecture* in *lecturer*. Changes in phonology and orthography also slow down the process by requiring greater complexity in segmentation. In the example, *explanation*, more complex processing is involved in activating *explanation, explain,* and *tion* because the changes in sound and spelling hide the base word more than in transparent examples. Eventually, high frequency morphologically complex words are used often enough to create a high-level whole word access representation.
The second and third level of Schreuder and Baayen’s (1995) morphological processing model involves information gained from the activated representations. In the second level, licensing rules are accessed to determine whether the activated representations have been put together in ‘legal’ manners. Here, decisions about the appropriateness of a word are made. For example, licensing rules determine that \textit{characteristic} is the noun form of \textit{character} rather than something like \textit{characterness}. At the third level, the processor puts the legal combination of morphemes together into a lexical representation for the morphologically complex word. This model explains effects of frequency, complexity in terms of phonology and orthography, and differences in processing monomorphemic and morphemically complex words found in research experiments.

According to these theories of morphological processing such as Schreuder and Baayen’s hybrid theory (1995) and Taft’s activation interactive model (2004), morphological processing helps retrieve the meaning and pronunciation of unfamiliar, morphologically complex words. With familiar words, the whole word trace is accessed instantaneously, but for unknown or less frequent complex words, morphological processing supports decoding and comprehension because it allows the reader to access the more familiar component morphemes and then link those meanings and pronunciations together to produce the larger morphologically complex word. Breaking unknown words into smaller component morphemes makes decoding and accessing meaning easier. With fewer resources needed for word identification and meaning detection, attention can be directed at comprehending the text (Perfetti, 1988; Stanovich, 1990). With better word knowledge, comprehension also improves because the reader has
more information with which to make inferences and construct an accurate text model (Perfetti, 1988).

**Developmental Progression of Morphological Awareness**

Morphological awareness is a developmental skill that progresses with additional exposure to language. As children experience more oral and written language, they acquire the morphological rules in a patterned manner. First they learn the rules, then overgeneralize the rule, and finally use feedback to refine the rule in order to prevent mistakes of overgeneralization (Bowerman, 1982). For example, in English, prefixes precede a root whereas suffixes follow the root word. In addition, multiple affixes can be added to a word simultaneously in a certain order with inflectional affixes coming after the derivational ending such as in the word *purifying* (Carlisle, 2003). The ability to analyze morphologically complex patterns depends on the type of morphology, task demands, transparency of the pattern, and familiarity of the morphemes involved. For example, decomposition of a word, or finding a base within a derived form of a word, is easier than producing a derived form from a base (Carlisle, 2003). Analyzing words with transparent structure is easier than evaluating word pairs involving phonological and/or orthographic changes (Fowler & Liberman, 1995). Furthermore, breaking down or combining familiar morphemes is easier than working with morphemes that are less well known (Carlisle, 2003).

In terms of the developmental progression of morphological awareness, inflectional awareness occurs before derivational awareness (Carlisle, 2003). Berko (1958) found preschoolers could correctly produce plural nouns. This inflectional morphological awareness continues to develop through early elementary school. Derivational awareness
also begins in preschool in a rudimentary form as evidenced by preschoolers using novel words with derivational affixes such as *flyable* to mean something that can fly (Clark, 1982). Overall, awareness of derivational morphemes develops later than inflectional morphological awareness with Anglin (1993) showing that first graders have only a primitive understanding of derived words, but that this knowledge increases by fifth grade. Other researchers have recorded development of more explicit awareness of derivational morphology beginning in third and fourth grade (Anglin, 1993; Tyler & Nagy 1989). For example, while first graders were able to parse apart morphemes in words with familiar bases such as *stillness*, both first and third graders had difficulty explaining the role of the suffix (Carlisle & Fleming, 2003). This understanding of the role of suffixes develops across middle school (Tyler & Nagy, 1989).

Beyond suffix knowledge, development of derivational morphological awareness seems to depend on the transparency of the morphological relationship. For early elementary-aged students, phonological information seems to take precedence over meaning information, with these younger students more likely to determine that the word *doll* comes from *dollar* (Derwing & Baker, 1979). Carlisle and Fleming (2003) showed that third graders were better able to consider the structure and meaning of words at the same time compared to first graders with few third graders reporting a relationship between words like *corn* and *corner* which have similar sound structure but no overlap in meaning. Carlisle (2000) showed that this mastery of sound structure and meaning structure is even more difficult when there are changes in both. For example, third and fifth graders performed well when the morphological relationship was transparent but had greater difficulty on “shift” words that involved either sound or spelling changes as well
(Carlisle, 2000). Fowler and Liberman (1995) also showed that producing a base from a derived word (e.g., producing *four* from *fourth*) was easier than producing the derived word from the base (e.g. producing *fourth* from *four*). Refinement of derivational awareness continues into high school (Mahoney, 1994).

Development of compounding awareness also begins later than inflectional awareness but is refined earlier than derivational awareness. In her study with preschoolers and first graders, Berko (1958) reported low levels of compounding awareness and Nagy, Berninger, Abbot, Vaughan, and Vermeulen (2003) showed that at-risk 2nd graders performed barely above chance on a compounding task. In this same study, at-risk 4th graders answered 72% of the questions on the compounding task correctly, showing both progression between 2nd and 4th grade as well as room for further growth. According to Kuo and Anderson (2006), “The acquisition of major inflectional rules is generally completed by early elementary grades, but awareness of compound and derivational morphology continues to develop through the elementary grades or even later” (p. 169).

**The Role of Morphological Awareness in Reading Achievement**

Research currently suggests that morphological awareness plays a role in overall reading achievement (Carlisle, 2003; Goodwin et al., 2010; Kuo & Anderson, 2006), but much of this research does not clearly account for the confounds between morphological awareness and other linguistic dimensions such as phonological awareness or orthographic awareness. The following section will provide a review of the methodological challenges involved in assessing the unique contribution of morphological awareness to outcomes such as vocabulary or reading achievement.
Methodological Challenges

Most measures of morphological awareness involve meta-linguistic awareness because it is difficult to untangle morphological relationships from orthographic, phonological, and even syntactic relationships. As Carlisle (1995) stated, “Analysis of the partial correlations indicates that the metalinguistic tasks share influences on reading activities [and] to some extent, the morphological and phonological awareness tasks may have tapped similar metalinguistic capabilities” (p. 203). Why is there this commonality amongst phonological and morphological awareness? Tasks such as identifying, segmenting, and combining morphemes may involve similar metalinguistic skills such as segmentation and combination aptitudes, which are also used in phonological recoding tasks that involve the segmenting and combining of phonemes (Singson et al., 2000). Furthermore, morphological processing often incorporates phonological or orthographic changes in addition to meaning changes as in the example of five and fifth. Although it is difficult to unravel morphological awareness from phonological awareness, it is also important to estimate the separate contribution of these constructs because such an understanding is necessary when designing curriculum and instruction.

Because of these possible confounds, when a measure of morphological awareness is used to predict an outcome without other linguistic predictors in the model, the variance explained by that measure may be better explained by one of the other linguistic dimensions that are required in the morphological task. To try to deal with this confound, researchers have included indicators of other types of linguistic awareness such as phonological awareness in addition to the measure of morphological awareness when predicting an outcome, often by using sequential regression or a taxonomy of
regression models. In sequential regression, researchers put in other indicators of linguistic dimensions first, allowing these indicators to explain variance within the outcome variable. Morphological awareness is entered last and only allowed to explain any remaining variance. As a result, the variance explained by morphological awareness in this statistical model is additional variance beyond the indicators entered before it, not variance explained when these indicators are compared head to head. Researchers also compare a basic regression model without morphological awareness to a more inclusive model with morphological awareness. This model has similar methodological challenges as those involved in the sequential regression model, again explaining additional variance.

Another challenge in attempting to untangle the confounds between morphological awareness and other types of linguistic awareness is that often researchers use a phoneme elision task which represents only a small component of phonological awareness and not necessarily the component that is used to support the identification of the morphological relationship when there is a change in the pronunciation of the morpheme as well as the change in meaning. As a result, even when controlling for this aspect of phonological awareness, the measure of morphological awareness may still be confounded with other aspects of phonological awareness or other types of linguistic awareness that are required by the morphological task.

The latent variable framework that is part of structural equation modeling provides a way of dealing with this challenge by creating a latent variable from the overlap in shared variance from multiple indicators of morphological awareness (Kline, 2005). For example, by using indicators of morphological awareness that have varying
degrees of transparency, the shared morphological awareness remains in the latent variable whereas the confounding linguistic awareness which is not shared between tasks are put into the error term. As a result, any contribution of the latent construct is free from confounds of other types of linguistic awareness.

Another challenge in this framework is that structural equation modeling creates latent variables with less error than single indicators (Kline, 2005). This framework must be used with care as these latent variables with less error are at an advantage when compared with single indicators that have error. In order to highlight these challenges, studies examining the contribution of morphological awareness to reading will be reviewed and possible confounds in the findings will be acknowledged in order for accurate conclusions to be drawn.

**Overall Reading Achievement**

Research suggests a role for morphological awareness in overall reading achievement. For example, a study of fifth grade Spanish-speaking ELLs by Goodwin et al. (2010) used structural equation modeling to test whether morphological awareness was a significant predictor of overall reading achievement as defined by overlap of real word decoding, reading comprehension, and reading vocabulary. Using a latent construct of morphological awareness that stemmed from overlap in indicators of morphological production with varying degrees of morphological transparency, Goodwin et al. (2010) found that when controlling for phonological recoding, morphological awareness made a moderate contribution to reading achievement such that a one standard deviation (SD)-unit increase in morphological awareness resulted in a 0.65 SD-unit increase in Reading Achievement. This study also showed the importance of including other indicators of
linguistic awareness in the model predicting the outcome variable. For example, when reading achievement was predicted with a latent measure of phonological recoding, the contribution was significant and moderate to large. This contribution from phonological recoding to reading became both smaller in magnitude and non-significant when including latent constructs of both phonological recoding and morphological awareness in the model.

Other studies suggest the role of morphological awareness in reading, but possible confounds of phonological and orthographic processing suggest potential bias. For instance, examining ninth graders, Mahony (1994) noted a positive relationship between performance on a morphological awareness task and performance on the Nelson Reading Test with correlations ranging from .51 to .68. Mahony (1994) noted a similar positive relationship between this morpheme sensitivity task and verbal SAT scores for college students, but only for the parts of the morphological measure that involved pseudowords. Because this study used a morphological measure that required participants to complete sentences with the correct morphologically related form of the word and identify morphological relationships of varying transparency, this measure confounded aspects of orthographic, phonological, and syntactic awareness and therefore, findings must be interpreted in that light. Similarly, the study included no description of what subtests of the Nelson Reading Skills Test were administered, and therefore it is unclear whether the relationship is between overall reading, reading comprehension, reading vocabulary, and/or reading decoding and morphological awareness. Also, this study had very different findings for the college population depending on whether the morphological measure involved pseudowords, and therefore, findings of the significant relationship
between morphological awareness and the SAT verbal test may be more accurately described as a correlation between pseudoword tasks and the outcome measure.

Also assessing general reading achievement, Britain (1970) reported that for seven and eight year olds and controlling for intelligence, performance inflecting pseudowords was correlated with general reading achievement as assessed by a measure that involved decoding of pseudowords and real words as well as reading comprehension. Partial correlations controlling for intelligence were .36 and .70 for first and second graders respectively. This study used a revised version of Berko’s (1958) Wug test which was adapted to include inflectional items of “a more representative sample of the final sounds and inflectional categories of English” (Britain, 1970, p. 39). Because it included inflectional allomorphs where the plural s was associated with the sounds /z/, /s/, and /iz/, as well as other allomorphs, this task confounded phonological awareness with morphological awareness. In addition, because participants were required to complete the sentence with the appropriate form of the pseudoword, syntactic awareness was also confounded and therefore, this study suggests the relationship between morphological awareness and overall reading achievement, but the possible confounds should be noted.

**Phonological Awareness**

There is also some evidence that morphological awareness may improve phonological awareness. In a longitudinal analysis that followed students from kindergarten to second grade, Carlisle (1995) reported that a morphological production task explained a significant amount, or 7%, of the variance in a word analysis task that required students to choose the word with the same sound as the target word. As this task required students to match words with identical sounds, this task assessed student’s
phonological awareness. Because one third of the items in this task had a phonological as well as morphological change, phonological awareness was confounded in this task, and therefore interpretations of these findings should take this into consideration.

Decoding

Studies also suggest that among monolingual English speakers, morphological awareness is related to decoding (Carlisle & Stone, 2005; Deacon & Kirby, 2004; Fowler & Liberman, 1995; Mahony et al., 2000; Nagy, Berninger, & Abbott, 2006; Nagy et al., 2003; Siegel, 2008; Singson et al., 2000). Perhaps the reason why morphological awareness contributes to decoding is that pronunciation often follows morphological rules (Chomsky & Halle, 1968; Henry, 2003). Therefore, morphological awareness helps readers to break words apart at the correct syllable boundary. For example, pronouncing mishandle as mis + handle rather than mi+ shandle or mish + andle occurs because the syllable break is based on the morpheme mis and its meaning of not (Kuo & Anderson, 2006). Similarly, the pronunciation of ive follows morphological rules. When it is used as a derivational suffix as in detective or reflective, it is pronounced differently than when it is used in monomorphemic words such as arrive or derive (Kuo & Anderson, 2006).

Carlisle and Stone (2005) showed the contribution of morphological awareness to decoding for second through sixth graders by isolating the role of morphology through the use of word pairs made up of a phonologically transparent, two morpheme derived word matched with a one-morpheme word of the same length, frequency, and spelling. For example, students read the two morpheme word, winner, which is made up of the morphemes win (a victory) + er (agentive ending that turns the object into a person), more accurately than the one morpheme word, dinner, which is a noun whose meaning
has nothing to do with any morpheme within the word. Another example of a word pair used is \textit{shady} and \textit{lady}. The participants in this study read two syllable words made up of familiar morphemes more accurately than two syllable words made up of one morpheme showing that recognition of the familiar base morpheme helped in the decoding of the two morpheme words. For second and third graders, speed of reading was also faster for morphologically complex words. While this study shows the role of morphological awareness in decoding words that have transparent morphemes, the study does not determine whether morphological awareness would also contribute to decoding more words with more opaque morphological relationships.

Carlisle and Stone (2005) also found that frequency of the base morpheme improved the accuracy of word reading for upper elementary students rather than 2\textsuperscript{nd} and 3\textsuperscript{rd} graders. The study used word pairs like \textit{queen} and \textit{queendom} that have a high frequency base and a low frequency derived word and because all morphological relationships were transparent, the same questions of whether similar findings would result from opaque morphological relationships remain.

In a study using structural equation modeling, Nagy et al. (2006) studied the relationship between morphological awareness and various measures of decoding then examined whether this relationship changed between across fourth through ninth grade. Nagy also examined phonological recoding as a covariate in predicting decoding. Findings showed for fourth and fifth graders, morphological awareness significantly contributed to decoding accuracy of words with a phonological shift, inflected words, words with prefixes and pseudoprefixes, affixed words with irregular stems, and sets of morphologically related words. For sixth and seventh graders, morphological awareness
was a significant predictor only of accuracy of decoding transparent words. For eighth and ninth graders, morphological awareness significantly contributed to the decoding of words with a phonological shift, prefixed words with irregular stems, suffixed words with irregular stems, and sets of morphologically related words. Although this study used structural equation modeling to create a latent construct of morphological awareness, only tasks with morphologically transparent relationships were used. Also, the latent was compared to a single indicator of phonological recoding, which has more error and therefore is at a disadvantage.

In a similar 2003 study, Nagy et al. examined the relationship between morphological awareness and decoding for a population of second and fourth graders who were at risk of developing reading difficulties. Findings showed morphological awareness did not contribute significantly to decoding measures for these students. The lack of significance in this study could stem from multiple factors. First, this study involved indicators of morphological, orthographic, and phonological awareness as predictors of decoding achievement and therefore controlled for some of the meta-linguistic awareness that measures of morphological awareness often involve. Also, this study used structural equation modeling to present a latent construct of morphological awareness stemming from overlap in three transparent tasks and therefore, we are left with the question of whether performance on similar measures with more complicated morphological relationships would make a significant contribution to decoding.

Examining inflectional morphological awareness, Deacon and Kirby (2004) also studied younger students, showing that morphological awareness scores in second grade on an 8-item measure of inflectional morphology involving regular and irregular past
tense verbs contributed significantly to word identification, explaining additional 8, 8, and 5% of the variance in grades 3, 4, and 5 controlling for intelligence and phonological awareness. It is important to note that no assessment of derivational morphological relationships occurred in this study and that the measure used confounds knowledge of irregular verb forms with the construct of morphological awareness.

Singson et al. (2000) also showed the role of morphological awareness in reading decoding for third through sixth graders, although using a derivational suffix task with items varying in terms of morphological transparency. Singson et al. used sequential regression to show that morphological awareness explained about 9% of additional variance in decoding beyond that explained by a phoneme elision task. Because the phonological demands of the control task were different than those required to identify the opaque morphological relationships, the additional variance explained is still confounded with aspects of phonological, orthographic, and syntactic awareness.

Studying a similar population, Mahony et al. (2000) showed that morphological awareness made a moderate contribution to decoding ability even when controlling for vocabulary and phonological awareness. Similar differences in phonological demands between the control task and the morphological task existed in this study. Mahony et al. also reported that better decoders were more sensitive to morphological relationships.

Siegel (2008) also examined the relationship between decoding and morphological awareness in a large sample of more than 1200 sixth grade students finding that morphological awareness explained between 8.7 to 13.8% of additional variance beyond that explained by a phonological task that involved deleting phonemes from words presented orally. Differences in phonological processing demands between
the control and focus task once again suggest the additional variance may be more metalinguistic rather than purely morphological. In addition, although Siegel (2008) suggested that these findings could be relevant for ELLs, because her sample included native English speakers, ELLs who have become fluent English speakers as determined by teacher evaluation, and children with reading disabilities, it seems more applicable to fluent English speaking students rather than ELLs.

Fowler and Liberman’s (1995) study is an example of confounding findings with task demands. Studying 7-10 year old children, these researchers showed that morphological awareness explained an additional 27.5% of variance in word identification scores beyond age and vocabulary, with the phonologically opaque base task explaining between 15-25% of the variance in word identification depending on which step it was entered within the sequential regression. Fowler and Liberman reported performance on words with phonological and morphological changes were more predictive of reading achievement, but a closer look at the findings in the study show the confound of task. Whereas the task where participants had to provide the base of phonologically complex word pairs (ie, produce farm from farmer) explained significant additional variance, the phonologically complex task requiring participants to provide the derived word (farmer from farm) did not and therefore, this study begs the question of whether it was the phonological change within the morphological relationship or the type of task that is explaining the additional variance.

**Reading Comprehension**

While some of the studies discussed in the decoding section also examined the contribution of morphological awareness to reading comprehension (Deacon & Kirby,
additional studies have also examined the role of morphological awareness in contributing to reading comprehension in school age students (Carlisle, 1995, 2000; Carlisle & Fleming, 2003; Casalis et al., 2004; Casalis & Louis Alexandre, 2000; Kieffer & Lesaux, 2008; Shankweiler et al., 1995; Windsor, 2000), but do not show how this contribution occurs. Future research should involve qualitative analyses that examine morphological processing during reading of text with a high percentage of morphologically complex words. For example, teaching low frequency morphemes or pseudomorphemes and then examining how students integrate these meanings within their understanding of the text would be helpful in clarifying how the empirical contribution of morphological awareness found in the studies listed above occurs.

Of prime importance to the current study, Kieffer and Lesaux (2008) have shown that the relationship between morphological awareness and reading comprehension also exists for Spanish-speaking fifth grade ELLs who are still progressing towards English proficiency as shown by their performance on vocabulary measures of more than one standard deviation below the mean. For these students, derivational morphological awareness had a statistically significant medium size contribution to reading comprehension when controlling for phonological awareness, fluency measures, decoding skills, and vocabulary knowledge with a one-unit increase in derivational morphological awareness resulting in a 0.39 SD-unit increase in passage comprehension and a 0.33 SD-unit increase in achievement on the Gates-MacGinites reading comprehension assessment controlling for the above measures. In fourth grade, the relationship was not significant. These researchers compared a baseline model without
morphological awareness to a final model with morphological awareness, examining additional variance explained. In fifth grade, including morphological awareness explained an additional 7.8% of variance in passage comprehension and an additional 6.1% of variance in the Gate-MacGinities test. Although these researchers attempted to untangle the linguistic confounds from morphological awareness by controlling for a phoneme elision task, because the phonological demands in the derivational morphology task were different from deleting a phoneme, the contribution of morphological awareness in this model continues to reflect a broader construct of morphological awareness that includes related linguistic components.

Although examining fluent English students, in the 2006 study, Nagy et al. also explored the role of morphological awareness in predicting reading comprehension. Examining the total effect that includes both the direct path from morphological awareness to reading comprehension and the indirect path through vocabulary knowledge, Nagy et al. reported that morphological awareness contributed to reading comprehension for fourth through ninth graders. For fourth and fifth graders, a one-unit increase in morphological awareness resulted in a 0.76 unit increase in reading comprehension with 0.74 units stemming from the direct path. For sixth and seventh graders, a one-unit increase in morphological awareness resulted in a 0.65 unit increase in reading comprehension with 0.26 units stemming from the direct path. For eighth and ninth graders, a one-unit increase in morphological awareness resulted in a 0.58 unit increase in reading comprehension with 0.24 units stemming from the direct path. Although the unexpected pattern uncovered by Nagy et al. (2006) shows that the direct effect of morphological awareness on reading comprehension decreases as students age,
this contribution remained significant across upper elementary, middle school, and early high school ages. Once again, these findings must be interpreted in light of the potential methodological challenges discussed in the decoding section.

The Nagy et al. (2003) study examining at-risk second and fourth graders showed that a latent variable made of three morphological indicators explained a significant amount of variance in second grade reading comprehension, but not in fourth grade controlling for phonological, orthographic, and oral vocabulary. In second grade, a one-unit increase in morphological awareness resulted in a 0.66 unit increase in scores on the Gates-MacGinitie reading comprehension test controlling for those measures listed above. The discussion of the confounds within in the study included in the decoding section must again help place these findings in context.

The Deacon and Kirby (2004) study also found that morphological awareness explained an additional 8% of the variance in third grade reading comprehension when second grade morphological awareness performance was entered after intelligence as part of a sequential regression analysis. Similarly, morphological awareness explained an additional 10% and 7% of variance in fourth and fifth grade reading comprehension respectively. Studying 6th graders, Siegel (2008) also demonstrated that morphological awareness explained an additional significant amount of variance, 15.8 to 16.9%, in reading comprehension above and beyond phonological awareness. Again, these findings must be understood in relation to the confounds discussed in the decoding section.

A study by Carlisle (2000) showed that for third graders, morphological awareness tasks accounted for 43% of the variance in reading comprehension scores and for fifth graders, the morphological tasks accounted for 55% of the variance in reading
comprehension showing a significant and increasing role for morphological awareness in predicting reading comprehension from third to fifth grade. This study suggests a strong role of morphological awareness in reading comprehension, but it is important to note that the study did not control for any of the linguistic confounds present in the measures of morphological awareness. This confound, and that of task demands, might help one understand the different findings of this study depending of which measure of morphological awareness was used. For example, for the third graders in this study, the derivation task made a significant contribution, whereas the base task did not. Questions remain about whether these findings are due to morphological awareness or confounds within the task.

In a study of younger students from kindergarteners until second grade, Carlisle (1995), also reported that first grade production of morphologically derived words contributed significantly to second grade reading comprehension with two morphological tasks explaining 13% of the variance in reading comprehension. The morphological tasks included a production task where students were given a base of the word and asked to complete the sentence with the correct derived form of the word. This production task accounted for the most variance in reading comprehension, explaining 10%, whereas the morphological judgment task which asked students to decide whether a word comes from another word (e.g., corn from corner) explained a non-significant 3%, and the phonological awareness task involving phoneme elision also explained a non-significant 3% of the variance. Although Carlisle (1995) controlled for participant’s ability to delete phonemes, the phonological demands on the production task were different from those controlled for. The fact that the morphological production task which had one third of its
word pairs involving a phonological change significantly contributed to reading comprehension whereas the other tasks did not suggest that it may be this more complicated construct of morphological awareness which includes other aspects of linguistic awareness that is explaining the variance in reading comprehension.

Another longitudinal study followed first and third graders for two years. In this study, Carlisle and Fleming (2003) showed that lexical analysis tasks involving breaking morphologically complex words apart to define and use the words correctly in sentences predicted reading comprehension scores two years later. Morphological awareness tasks administered in first grade explained 23% of the variance in third grade reading comprehension and morphological awareness tasks administered in third grade explained 27% of variance in reading comprehension in fifth grade. Whereas the first grade morphological tasks did not seem to involve morphological relationships that were opaque, half of the third grade morphological items involved words with a phonological change. In addition, this study did not use additional linguistic predictors of reading comprehension, and therefore, some of the variance explained by the morphological tasks may be due to other related linguistic components.

**Vocabulary Development**

Morphological awareness has also been shown to contribute to vocabulary knowledge. Vocabulary development is key to improving reading comprehension (Anderson & Freebody, 1981). In order to understand a text, students must have knowledge of word meanings. Because it has been estimated that students learn about 3,000 words per school year (Nagy & Anderson, 1984), vocabulary development is a
monumental task. It is impossible to individually teach thousands of words explicitly in a meaningful way. Morphological processing provides an alternate solution.

After third grade, 60-80% of words encountered in texts are morphologically complex derived words (Anglin, 1993). It has been suggested that by using morphological processing, the meanings of the 60% of unknown words in texts that are derived words can be determined from analysis of component morphemes and context (Nagy & Anderson, 1984). Research shows this close relationship between morphological awareness and vocabulary knowledge (Anglin, 1993; Carlisle, 2000; Carlisle & Fleming, 2003; Fowler & Liberman, 1995; Kieffer & Lesaux, 2008; Mahony et al., 2000; Nagy et al., 2003; Nagy et al., 2006; Singson et al., 2000).

Of importance to this study because of the focus on Spanish-speaking ELLs, Kieffer and Lesaux (2008) reported a significant correlation between vocabulary knowledge and morphological awareness in both fourth and fifth grade. Receptive vocabulary, which was assessed by participants choosing amongst four pictures that show the word given by the researcher, correlated to morphological awareness as measured by the participant’s ability to extract the base from a derived word or produce the derived word when given the base. In fourth grade, the correlation was $r = .53$, whereas the correlation was $r = .46$ in fifth grade.

In relation to typically achieving children, Anglin (1993) examined the vocabulary development of children across elementary school. He noted that even first graders had greater knowledge of bimorphic words than monomorphemic words and this trend continued throughout the study with fifth graders showing considerable knowledge of both bimorphemic and multimorphemic words. Anglin (1993) also noted that first
through fifth grade participants used morphological problem solving, or breaking words into component morphemes in order to gain the meaning of the word as a whole, for inflected, derived, and compound words. The greater contribution of morphological awareness to vocabulary as students age was also noted in Anglin’s (1993) study, showing that the average number of words where morphological problem solving could be used grew from 4,225 in first grade to 20,164 in fifth grade.

Carlisle and Fleming (2003) also showed the contribution of morphological awareness to vocabulary development. In this study, morphological awareness was assessed by a task where participants had to determine whether a larger word comes from a smaller word (farmer from farm) and a task where students had to describe the definition of root words, inflected words, derived words, literal compounds, and idioms and use these words in sentences. Assessed in first and third grade, these measures explained a non-significant amount of variance two years later when the first graders were third graders, but a significant 41% of the variance in reading vocabulary scores when the third graders were fifth graders. The definition task predicted a significant portion of the variance.

Studies discussed in earlier sections of the paper also examined the role of morphological awareness in reading vocabulary. For example, studying third and fifth graders, Carlisle (2000) showed that performance on morphological awareness tasks explained 41% of the variance in third grade vocabulary scores and 53% of the variance in fifth grade vocabulary scores. These findings must be interpreted in light of the discussion of possible confounds discussed within the reading comprehension section of this paper.
Nagy et al. (2006) also examined how morphological awareness contributes to vocabulary knowledge in fourth through ninth grade students finding morphological awareness contributed significantly to vocabulary knowledge across grades with a one-unit increase in morphological awareness resulting in a 0.74-unit increase in vocabulary knowledge for fourth and fifth graders. In sixth and seventh grade, a one-unit increase in morphological awareness resulted in a 0.65-unit increase in vocabulary knowledge, whereas in eighth and ninth grade, a one-unit increase in morphological awareness resulted in a 0.58-unit increase in vocabulary knowledge. These findings must be interpreted in light of the possible confounds discussed in the decoding section of this paper.

**The Present Study**

This study aimed to further understanding about the processes involved in reading for Spanish-speaking ELLs and add to the morphological awareness literature by exploring the unique contribution of morphological awareness to oral vocabulary, word decoding, reading comprehension, and reading vocabulary beyond phonological recoding. In addition, this study aspired to clarify how phonological recoding predicted components of reading achievement alone versus when controlling for vocabulary and morphological awareness.

Methodologically, this study utilized an innovative statistical approach to answer the above questions. In order to determine the unique contribution, first morphological awareness had to be distinguished from linguistic confounds. The latent variable framework of structural equation modeling allows variables to be created from the shared variance of multiple indicators measuring the same construct, and therefore, in this study,
four tasks of varying levels of morphological transparency were used to create this latent variable of morphological awareness. Because the indicators shared morphological demands but had different levels of orthographic and phonological processing, the shared variance of these indicators was morphological in nature, creating a pure morphological latent variable. A latent construct of phonological recoding was also created to set up a fair comparison where the constructs that are competing for variance in the outcome variables both have low levels of measurement error as compared to single indicators.

The present study followed an earlier analysis (Goodwin et al., 2010) which used a similar approach but focused on predicting general reading achievement defined as a latent construct of word reading, reading comprehension, and reading vocabulary. The finding that morphological awareness made a moderate and significant contribution to overall reading achievement for ELLs beyond phonological recoding were the inspiration for this study, begging the question as to how morphological awareness and phonological recoding contribute to the subcomponents of reading such as decoding, reading comprehension, and/or reading vocabulary for Spanish-speaking ELLs.

Using a longitudinal sample, the following research questions were addressed:

1. Does phonological recoding make a unique contribution to the prediction of word decoding, reading comprehension, and/or reading vocabulary for Spanish- speaking ELLs when controlling for morphological awareness and oral vocabulary knowledge?

2. Does the contribution of phonological recoding to the prediction of word decoding, reading comprehension, and/or reading vocabulary for Spanish-speaking ELLs change in a meaningful way when controlling for
morphological awareness and oral vocabulary knowledge as compared to being included as the sole predictor?

3. Does morphological awareness make a unique contribution to the prediction of word decoding, reading comprehension, and/or reading vocabulary for Spanish-speaking ELLs either directly or indirectly through oral vocabulary knowledge when controlling for phonological recoding?

4. Does morphological awareness contribute to oral vocabulary knowledge for Spanish-speaking ELLs?
Chapter 3: Methods

Participants

The participants were fifth grade ELL students who speak Spanish as a first language. These students were part of a longitudinal study on the reading development of ELLs in grades 2 through 5 (August & Carlo, DELSS, Center for Applied Linguistics). Fifty-three percent, or 104 participants, were female and 47%, or 93 participants, were male. The participants attended schools implementing the *Success for All* model of instruction in Chicago, Boston, or El Paso. These schools were 49-69% ELL students and 75-99% students who received assistance through the free or reduced lunch program. Median household income ranged from $26,125 to $55,625, although such values do not control for family unit size, which is taken into consideration by the free and reduced lunch program.

Of the participants whose parent reported the language spoken by the child (139 participants or 70% of the sample), 36 participants (26% of those reporting, 18% of entire sample) reported speaking only Spanish, 43 (31% of those reporting, 22% of entire sample) reported speaking mostly Spanish, 52 (37% of those reporting, 26% of entire sample) reported speaking both Spanish and English, 2 (1% of those reporting, 1% of entire sample) reported speaking mostly English, and 6 (4% of those reporting, 3% of entire sample) reported speaking only English. Parents also reported on language spoken when the child entered school, language used by the child most frequently at home, and language used by the parent most often at home. Table 3.1 elaborates on this language environment information.
Table 3.1

Participant Language Environment Information.

<table>
<thead>
<tr>
<th>Language Information</th>
<th>N (% sample)</th>
<th>Only Spanish N (%)</th>
<th>Mostly Spanish N (%)</th>
<th>Both N (%)</th>
<th>Mostly English N (%)</th>
<th>Only English N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language spoken by child</td>
<td>139 (70.6%)</td>
<td>36 (25.9%)</td>
<td>43 (30.9%)</td>
<td>52 (37.4%)</td>
<td>2 (1.4%)</td>
<td>6 (4.3%)</td>
</tr>
<tr>
<td>Language spoken by child when first entered school</td>
<td>177 (89.8%)</td>
<td>58 (32.8%)</td>
<td>39 (22%)</td>
<td>43 (24.3%)</td>
<td>19 (10.7%)</td>
<td>18 (10.2%)</td>
</tr>
<tr>
<td>Language used most frequently by child at home</td>
<td>177 (89.8%)</td>
<td>47 (26.6%)</td>
<td>26 (14.7%)</td>
<td>50 (28.2%)</td>
<td>30 (16.9%)</td>
<td>24 (13.6%)</td>
</tr>
<tr>
<td>Language used by parent most frequently at home</td>
<td>177 (89.8%)</td>
<td>74 (41.8%)</td>
<td>31 (17.5%)</td>
<td>44 (24.9%)</td>
<td>11 (6.2%)</td>
<td>17 (9.6%)</td>
</tr>
</tbody>
</table>

Note: Percentages are % of participants who reported information on that variable.

In terms of language of instruction, some students received English-only instruction and others received various amounts of formal Spanish instruction as part of different bilingual programs. Because it was a longitudinal sample and therefore, experienced some level of attrition over the five waves of data collection, only 73 fourth grade participants (37.1% of the sample which is included in this analysis) reported language of instruction. Of these students, only 1 received K-5 instruction in Spanish only, 48 received instruction in both Spanish and English at some point during K-5th grade, and 24 received instruction in English only from K-5th grade. By fifth grade, 32 were receiving instruction in English only, 40 were receiving Spanish and English instruction, and 1 was receiving only Spanish instruction. Students were receiving The
Success for All model of instruction, or the equivalent curriculum in Spanish called Exito para Todos. The students in this sample were strong word readers, but weak comprehenders and particularly poor in vocabulary knowledge. See Table 3.2 for achievement data for the participants containing means and standard deviations on measures of reading and vocabulary.

Table 3.2.

Participant Achievement on Reading and Vocabulary Measures

<table>
<thead>
<tr>
<th>Measure (Grade)</th>
<th>Mean (Standard Deviation)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAAS Nonword Accuracy (4)</td>
<td>73.18 (19.79)</td>
<td>168</td>
</tr>
<tr>
<td>Word Attack (4)</td>
<td>104.23 (15.20)</td>
<td>149</td>
</tr>
<tr>
<td>Picture Vocabulary (4)</td>
<td>72.07 (23.92)</td>
<td>149</td>
</tr>
<tr>
<td>Letter- Word ID (5)</td>
<td>105.74 (16.07)</td>
<td>167</td>
</tr>
<tr>
<td>Passage Comprehension (5)</td>
<td>93.31 (12.64)</td>
<td>166</td>
</tr>
<tr>
<td>Reading Vocab (5)</td>
<td>91.64 (11.35)</td>
<td>163</td>
</tr>
</tbody>
</table>

Measures

Four constructs were assessed in this study with three of the constructs represented by two or more indicators. Indicators are organized by construct, with the first two indicators assessing phonological recoding, the next four indicators measuring morphological awareness, and the next three indicators assessing components of reading achievement. In addition, oral vocabulary knowledge was measured as a single indicator. Details of the measures involved in this study including psychometric properties are included in Table 3.3.
Phonological recoding. The construct of Phonological Recoding, which involves applying phonological rules to decode pseudowords, was assessed in fourth grade by two individually administered pseudoword tasks.

Task 1: Word attack. The first task, the Word Attack subtest of the Woodcock Language Proficiency Battery (WLPB, Woodcock, 1991), is part of a commercially available battery of tests that measure different components of language and reading performance for non-native speakers of English in preschool through adulthood. The WLPB-Word Attack subtest assesses skills in decoding pseudo-words by providing participants with visual representations of nonsense words and asking the participant to use phonological rules to pronounce the pseudoword. For example, participants were shown targets such as nat, ib, and splaunch and asked to read the targets aloud. Scores were determined by the researcher based on accuracy of pronunciation. The 30 items were scored as correct or incorrect, with one point allotted for correct answers. According to basal and ceiling guidelines found in the manual, all participants began with the first item and continued testing until the six highest-numbered items given were incorrect. Scores were then standardized with a mean of 100 and a standard deviation of 15 according to test instructions. The scores on this subtest have a reported split-half reliability of 0.91 according to the Spearman-Brown formula. This reliability is calculated from the scores of nine year old students in the norming sample (WLPB, Woodcock, 1991).

Task 2: CAAS Nonword accuracy. The second task assessing phonological recoding is the CAAS Nonword Accuracy task, which is from the Computer Based Academic Assessment System (CAAS, Sinatra & Royer, 1993). CAAS Nonword accuracy
measures how accurate participants are in applying phonological rules to decode nonwords and, along with a response time measure, has been shown to classify grade 2-5 skilled and poor readers and predict reading comprehension achievement over time (Sinatra & Royer, 1993). The task involved presentation of 30 pseudowords with equal numbers of monosyllabic and bisyllabic targets. For example, participants were provided with targets such as tet or flantic and asked to read the target aloud. Items were scored as correct or incorrect. Scores were reported as percent correct. Based on a smaller sample of students from the larger study from which these participants were drawn, the test-retest reliability of the scores on this measure is 0.69, \( p < .001 \). See Appendix 1 for a copy of this measure.

**Morphological awareness.** The second main construct measured was morphological awareness, which was assessed in fourth grade by a derivational morphological production task adapted from Carlisle (1988) named the Extract the Base task. See Appendix 2 for a copy of this measure and Appendix 3 for further details on scoring.

**Tasks 3-6: Extract the base (ETB) no change, phonological change, orthographic change, and both change.** Four indicators were created from this group administered, written task, where participants were provided with the task in writing and orally, a participant would be provided with the derived form and asked to extract the base to complete the sentence as in this example: “Farmer. The cows and pigs were located on the ________.” Answers were scored as 0-2 points based on the student’s level of accuracy. Appendix 3 has additional scoring details. For example, if a student just copied the given form, provided a translation of that form, or wrote a random letter string, the student received a score of 0. A score of 1 was assigned to responses that were
incorrect but showed evidence of extracting the base. A score of 2 was assigned to answers that were correct. Raw scores were used for these analyses. Reliability in the form of Cronbach’s alpha of the test as a whole was 0.85 for this sample of students. This task was recently validated using Item Response Theory (IRT), and results showed the Extract the Base Test task produces valid and reliable scores for students from third to fifth grade and for Spanish-speaking language minority students and fluent English students (Goodwin, Huggins, Carlo, Malabonga, Kenyon, August, & Louguit, 2010).

The 28 items on the Extract the Base measure were split into four subtests based on the type of morphological relationship. Whereas all items involved morphological changes, some items involved phonological, orthographic, or both types of additional changes. The four subtests were ETB-No Change, ETB-Phonological Change, ETB-Orthographic Change, and ETB-Both Change. The first subtest, ETB-No Change, included 6 word pairs with no phonological or orthographic changes such as danger and dangerous. The second subtest, ETB-Phonological Change, included 7 word pairs that have both a phonological and morphological change such as courage and courageous. The third subtest, ETB-Orthographic Change, consisted of 7 items that have both an orthographic and morphological change such as decide and decision. The fourth subtest, ETB-Both Change, is made up of 8 items that have morphological, phonological, and orthographic changes such as muscle and muscular.

**Oral vocabulary.** The third main construct measured in this study was Oral Vocabulary which is a participant’s ability to access the lexicon to match meaning to terms describing that meaning. Participants share the term orally.
**Task 7: Picture vocabulary.** Breadth of oral vocabulary was measured in fourth grade by the WLPB- Picture Vocabulary subtest (WLPB, Woodcock, 1991). This test assesses a participant’s ability to name objects. According to the manual, “This is primarily an expressive semantic task, at the single-word level, that presents familiar to less familiar vocabulary in a gradual manner. As in any naming task, word retrieval is a component” (Woodcock, 1991, p. 10). For example, participants were shown pictures such as a star, a stagecoach, and an epitaph and asked to name the picture. As suggested by basal and ceiling guidelines found in the manual, all participants began at item 17, receiving credit for items 1-16, and continued testing until the six highest-numbered items given were incorrect or the participant reached the last item, item 58. Items were scored as correct or incorrect, and scores were then standardized with a mean of 100 and a standard deviation of 15 according to test instructions. The scores on this subtest have a reported split-half reliability of 0.85 according to the Spearman-Brown formula. This reliability is calculated from the scores of nine year old students in the norming sample (WLPB, Woodcock, 1991).

**Reading achievement.** The third major construct assessed was reading achievement, which was measured in fifth grade by three subtests which were all part of the Woodcock Language Proficiency Battery (WLPB, Woodcock, 1991). The three subtests included were the Letter-word Identification subtest, the Passage Comprehension subtest, and the Reading Vocabulary subtest. Standard scores were calculated for these subtests with a mean of 100 and a standard deviation of 15 according to test guidelines. Each of these subtests was administered individually in a quiet setting with scores showing the number of items the participant correctly answered.
**Task 8: Letter-word identification.** The first task that assessed reading achievement was the WLPB- Letter-word Identification subtest (WLPB, Woodcock, 1991), which measured a participant’s skills in decoding real words. For this task, participants were shown increasingly difficult words and asked to pronounce the given word accurately. For example, participants were shown words such as *about, part,* and *ubiquitous* and asked to read each target aloud. Following basal and ceiling guidelines, all participants began with the item 24, receiving credit for items 1-23, and continued testing until the six highest-numbered items given were incorrect or the last item, item number 57, was answered. Items were scored as correct or incorrect and scores were then standardized. The scores on this subtest have a reported split-half reliability of 0.94 according to the Spearman-Brown formula, which was calculated from the scores of nine year old students in the norming sample (WLPB, Woodcock, 1991).

**Task 9: Passage comprehension.** The second reading achievement task was the WLPB- Passage Comprehension subtest (WLPB, Woodcock, 1991), which measured reading comprehension skills. In this cloze task, participants were presented with a short passage or sentence and asked to state the word that best completed the passage. For example, participants were shown the statement, “The leaf is the main food-producing structure of a plant. Nearly all kinds of ______ have this same basic job.” Participants must read the sentence and provide a word such as *leaves* that correctly completes the statement. Items were scored as correct or incorrect. Basal guidelines dictated that participants begin with item 6, receiving credit for items 1-5, and then testing continued until the six highest items were answered incorrectly or the participant answered number 43, which was the last item. Scores were then standardized. The scores on this subtest
have a reported split-half reliability of 0.88 according to the Spearman-Brown formula. This reliability is based off of the scores of nine year old students in the norming sample (WLPB, Woodcock, 1991).

**Task 10: Reading vocabulary.** The third task that contributed to assessing reading achievement was the WLPB- Reading Vocabulary subtest (WLPB, Woodcock, 1991), which measures a participant’s ability to integrate vocabulary knowledge within reading of text. This task is included within reading achievement separate from the measure of picture vocabulary because it is a measure of a participant’s ability to read a word, access that words meaning, and then provide a word with either the same or opposite meaning depending on whether the question is in the synonym or antonym subtest. For example, a participant is shown the word *speak* and then asked to read the word out loud and to provide a word that means the same such as *talk, say, orate,* or *utter.* Items were scored as correct or incorrect. Participants began with item 1 and continued until the four highest items were answered incorrectly or the participant completed the 79 items on the test. Scores were standardized. The scores from the Reading Vocabulary subtest have a reported Spearman-Brown split-half reliability of 0.93 according to scores of nine year old students in the norming sample (WLPB, Woodcock, 1991).
**Table 3.3.**

*Information on Measures used including Construct and Skill Assessed, Grade, Score, Scale, Number of Items, and Reliability*

<table>
<thead>
<tr>
<th>Construct Assessed</th>
<th>Subtest</th>
<th>Test</th>
<th>Abbreviation</th>
<th>Grade</th>
<th>Skill Assessed</th>
<th>Score</th>
<th>Scale</th>
<th># items</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phonological Recoding</td>
<td>Word Attack</td>
<td>Woodcock Language Proficiency Battery</td>
<td>Word Attack</td>
<td>4</td>
<td>Pseudo-word decoding accuracy</td>
<td>Standard Scores Mean=100, SD=15</td>
<td>Correct/Incorrect</td>
<td>30</td>
<td>.91&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Phonological Recoding</td>
<td>Nonword Accuracy</td>
<td>Computer Based Academic System</td>
<td>CAAS Non-Word Acc</td>
<td>4</td>
<td>Pseudo-word decoding accuracy</td>
<td>Percent of 30 total trials</td>
<td>Correct/Incorrect</td>
<td>30</td>
<td>.69&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Morphological Awareness</td>
<td>No Change</td>
<td>Extract the Base</td>
<td>ETB-No</td>
<td>4</td>
<td>Provide base of derived word to complete sentence</td>
<td>Raw Scores out of 12 points</td>
<td>0 (incorrect)/1(partial credit)/2 (correct)</td>
<td>6</td>
<td>.85&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Morphological Awareness</td>
<td>Phonological Change</td>
<td>Extract the Base</td>
<td>ETB- Phon</td>
<td>4</td>
<td>Provide base of derived word to complete sentence. Word pairs are phonologically opaque.</td>
<td>Raw Scores out of 14 points</td>
<td>0 (incorrect)/1(partial credit)/2 (correct)</td>
<td>7</td>
<td>.85&lt;sup&gt;4&lt;/sup&gt;</td>
</tr>
<tr>
<td>Morphological Awareness</td>
<td>Orthographic Change</td>
<td>Extract the Base</td>
<td>ETB- Orth</td>
<td>4</td>
<td>Provide base of derived word to complete sentence. Word pairs are orthographically opaque.</td>
<td>Raw Scores out of 14 points</td>
<td>0 (incorrect)/1(partial credit)/2 (correct)</td>
<td>7</td>
<td>.85&lt;sup&gt;4&lt;/sup&gt;</td>
</tr>
<tr>
<td>Morphological Awareness</td>
<td>Both Change</td>
<td>Extract the Base</td>
<td>ETB-Both</td>
<td>4</td>
<td>Provide base of derived word to complete sentence. Word pairs are phonologically and orthographically opaque.</td>
<td>Raw Scores out of 16 points</td>
<td>0 (incorrect)/1(partial credit)/2 (correct)</td>
<td>8</td>
<td>.85&lt;sup&gt;5&lt;/sup&gt;</td>
</tr>
<tr>
<td>Oral Vocabulary</td>
<td>Picture Vocabulary</td>
<td>Woodcock Language Proficiency Battery</td>
<td>Picture Vocab</td>
<td>4</td>
<td>Naming pictured objects</td>
<td>Standard Scores Mean=100, SD=15</td>
<td>Correct/Incorrect</td>
<td>58</td>
<td>.85&lt;sup&gt;6&lt;/sup&gt;</td>
</tr>
<tr>
<td>Reading Achievement</td>
<td>Letter-Word Identification</td>
<td>Woodcock Language Proficiency Battery</td>
<td>Letter-Word ID</td>
<td>5</td>
<td>Real word decoding accuracy</td>
<td>Standard Scores Mean=100, SD=15</td>
<td>Correct/Incorrect</td>
<td>57</td>
<td>.94&lt;sup&gt;7&lt;/sup&gt;</td>
</tr>
<tr>
<td>Reading Achievement</td>
<td>Passage Comprehension</td>
<td>Woodcock Language Proficiency Battery</td>
<td>Passage Comp</td>
<td>5</td>
<td>Ability to read a passage and identify the word that best completes the passage</td>
<td>Standard Scores Mean=100, SD=15</td>
<td>Correct/Incorrect</td>
<td>43</td>
<td>.88&lt;sup&gt;8&lt;/sup&gt;</td>
</tr>
<tr>
<td>Reading Achievement</td>
<td>Reading Vocabulary</td>
<td>Woodcock Language Proficiency Battery</td>
<td>Reading Vocab</td>
<td>5</td>
<td>Ability to read words and supply a correct synonym or antonym</td>
<td>Standard Scores Mean=100, SD=15</td>
<td>Correct/Incorrect</td>
<td>79</td>
<td>.93&lt;sup&gt;9&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup> Number of items administered varied depending on the child’s performance due to basal and ceiling guidelines, <sup>2</sup>Spearman-Brown split-half reliability; <sup>3</sup>Test-retest reliability; <sup>4</sup>Cronbach’s α reported for the Extract the Base (ETB) test as a whole rather than by subtest.
Data Collection

This study was part of a larger study where data was collected in five waves with the first wave occurring at the beginning of second grade, the second wave occurring at the end of second grade, the third wave occurring at the end of third grade, the fourth wave occurring at the end of fourth grade, and the fifth wave occurring at the end of fifth grade. For this study, only data from waves four and five were used. For each of these waves of data collection, the measures were administered by trained research assistants on two separate days with all WLPB tests administered individually on the same day, and the remaining assessments administered on a different day. The morphological awareness task, Extract the Base, was administered to groups on a separate day.

Data Analysis

Descriptive statistics were obtained using SPSS 17.0 and Mplus 5.1 was used to obtain the correlation/covariance matrices, test the proposed models, and obtain the coefficients and their associated standard errors. Like other longitudinal studies, missing data was present in this analysis with 85 participants having data missing on at least one variable. Full information maximum likelihood (FIML) estimates was used to impute missing values using Mplus 5.1.

All models are shown in Figure 3.1.

Measurement models and latent variables. Two measurement models were constructed to form the latent variables for this study.

The first measurement model represented 4th grade Phonological recoding. The exogenous latent variable consisted of Word Attack and CAAS accuracy. The metric of Phonological Recoding was set to the metric of Word Attack.
Figure 3.1. Models to be investigated determining 1) the changing contribution of phonological recoding to reading outcomes depending on covariates and 2) the unique contribution of morphological awareness to reading outcomes.
The second measurement model represented 4th grade Morphological awareness. This exogenous latent variable was made up of ETB-No Change, ETB-Orthographic Change, ETB-Phonological Change, and ETB-Both Change. ETB-Phonological change and ETB-No Change as well as ETB-Phon Change and ETB-Both were allowed to correlate based on theory. The metric of the latent variable was set to ETB-Orthographic change. The construction of this latent variable created a theoretically pure construct of morphological awareness because it was created from indicators of varying orthographic and phonological transparency, and therefore, the only shared variance amongst tasks stemmed from morphological changes. Other linguistic confounds present within the ETB tasks were theoretically separated into the error terms.

**Structural models.** Three structural models were compared. First, as shown in Figure 3.1., a structural model with phonological awareness as the exogenous predictor of the components of reading achievement was defined as

\[
\text{Word Reading}_5 = \alpha + \gamma_1 \text{ (Phon)} + \zeta_1.
\]

\[
\text{Reading Comprehension}_5 = \alpha + \gamma_2 \text{ (Phon)} + \zeta_2.
\]

\[
\text{Reading Vocabulary}_5 = \alpha + \gamma_3 \text{ (Phon)} + \zeta_3.
\] (1)

This model represented a multiple regression of the word reading (WLPB-Letter Word Identification), reading comprehension (WLPB-Passage Comprehension), and reading vocabulary (WLPB-Reading Vocabulary) indicators on the Phonological Recoding Latent variable and investigated the contribution of phonological recoding to word reading, reading comprehension, and reading vocabulary achievement without controlling for other variables, which is similar to models used in previous studies that establish phonological awareness as an accepted predictor of reading achievement.
Second, as shown in Figure 3.1., the contribution of phonological recoding controlling for vocabulary was determined through the model defined below

\[
\text{Word Reading}_5 = \alpha + \gamma_1 \text{ (Phon)} + \gamma_2 \text{ (Picture Vocab)} + \zeta_1.
\]

\[
\text{Reading Comprehension}_5 = \alpha + \gamma_3 \text{ (Phon)} + \gamma_4 \text{ (Picture Vocab)} + \zeta_2.
\]

\[
\text{Reading Vocabulary}_5 = \alpha + \gamma_5 \text{ (Phon)} + \gamma_6 \text{ (Picture Vocab)} + \zeta_3.
\]

\[
\text{Picture Vocab}_4 = \alpha + \gamma_7 \text{ (Phon)} + \zeta_4. \tag{2}
\]

This second model represented a multiple regression of the word reading (WLPB-Letter Word Identification), reading comprehension (WLPB-Passage Comprehension), and reading vocabulary (WLPB-Reading Vocabulary) indicators on the Phonological Recoding Latent variable and Picture Vocabulary. This model examined the contribution of phonological recoding to word reading, reading comprehension, and reading vocabulary achievement controlling for vocabulary knowledge, which is also similar to models used in previous studies to establish phonological awareness as an accepted predictor of reading achievement.

Lastly, Model 3 was created as shown in Figure 3.1. to determine the unique contributions of phonological recoding and morphological awareness to vocabulary and each reading component as defined below

\[
\text{Word Reading}_5 = \alpha + \gamma_1 \text{ (Phon)} + \gamma_2 \text{ (Morph)} + \gamma_3 \text{ (Picture Vocab)} + \zeta_1.
\]

\[
\text{Reading Comprehension}_5 = \alpha + \gamma_4 \text{ (Phon)} + \gamma_5 \text{ (Morph)} + \gamma_6 \text{ (Picture Vocab)} + \zeta_2.
\]

\[
\text{Reading Vocabulary}_5 = \alpha + \gamma_7 \text{ (Phon)} + \gamma_8 \text{ (Morph)} + \gamma_9 \text{ (Picture Vocab)} + \zeta_3.
\]

\[
\text{Picture Vocab}_4 = \alpha + \gamma_{10} \text{ (Phon)} + \gamma_{11} \text{ (Morph)} + \zeta_4. \tag{3}
\]

This third model represented a multiple regression of the word reading (WLPB-Letter Word Identification), reading comprehension (WLPB-Passage Comprehension),
and reading vocabulary (WLPB-Reading Vocabulary) indicators on the Phonological Recoding Latent variable, the Morphological Awareness Latent variable, and the oral Picture Vocabulary indicator. This model investigated the distinct contributions of phonological recoding and morphological awareness to word reading, reading comprehension, and reading vocabulary achievement controlling for oral vocabulary knowledge and therefore determines whether morphological awareness made a unique contribution to word reading, reading comprehension, and reading vocabulary achievement above and beyond the contribution made by oral vocabulary breadth and phonological recoding. The second part of model 3 represented a multiple regression of the Oral Picture Vocabulary variable on Phonological Recoding and Morphological Awareness, showing the contribution of morphological awareness and phonological recoding to oral vocabulary breadth.
Chapter 4: Results

Table 4.1 provides descriptive statistics of the variables of interest. All indicators have acceptable skewness and kurtosis for the normal distribution, which range from -1 to +1, with few exceptions consisting of CAAS Non-Word Acc (skewness = -1.12), ETB-No (skewness = -1.77; kurtosis=3.80), ETB-Phon (skewness = -1.28; kurtosis=1.20), WLPB-Passage Comp (kurtosis=2.41), and WLPB- Reading Vocab (kurtosis=2.57). Although these indicators have larger skewness and kurtosis values than desired, the maximum likelihood estimation methods used in estimating coefficients and their associated errors were known to be robust for non-normality (Muthén, 2008). In addition, multicollinearity was not a challenge in this study with the largest correlation amongst indicators being .67 (i.e., correlation between Word Attack and CAAS Non-Word Acc) as shown in Table 4.2, which provides covariance and correlations amongst variables.

Table 4.1

Descriptives of Observed Variables including Means, Standard Deviations, and N

<table>
<thead>
<tr>
<th>Measure</th>
<th>Word Attack</th>
<th>CAAS Non-Word Acc</th>
<th>ETB-No</th>
<th>ETB-Phon</th>
<th>ETB-Orth</th>
<th>ETB-Both</th>
<th>Picture Vocab</th>
<th>Letter Word</th>
<th>Passage Comp</th>
<th>Reading Vocab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>104.23</td>
<td>73.18</td>
<td>10.35</td>
<td>11.34</td>
<td>7.40</td>
<td>6.45</td>
<td>72.07</td>
<td>105.74</td>
<td>93.31</td>
<td>91.64</td>
</tr>
<tr>
<td>SD</td>
<td>15.20</td>
<td>19.79</td>
<td>1.97</td>
<td>2.78</td>
<td>2.36</td>
<td>3.02</td>
<td>23.92</td>
<td>16.07</td>
<td>12.64</td>
<td>11.35</td>
</tr>
<tr>
<td>N</td>
<td>149</td>
<td>168</td>
<td>176</td>
<td>176</td>
<td>176</td>
<td>149</td>
<td>167</td>
<td>166</td>
<td>163</td>
<td></td>
</tr>
</tbody>
</table>
Table 4.2

*Covariance (Correlation) Structure of Observed Variables*

<table>
<thead>
<tr>
<th>Measure</th>
<th>WLPB - Word Attack</th>
<th>CAAS Non-Word Accuracy</th>
<th>ETB - No Change</th>
<th>ETB - Phon Change</th>
<th>ETB - Orth Change</th>
<th>ETB - Both Change</th>
<th>WLPB - Picture Vocab</th>
<th>WLPB - Letter Word</th>
<th>WLPB - Passage Comp</th>
<th>WLPB - Reading Vocab</th>
</tr>
</thead>
<tbody>
<tr>
<td>WLPB - Word Attack</td>
<td>257.7</td>
<td></td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAAS Non-Word Accuracy</td>
<td>204.1</td>
<td>392.29</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.67)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ETB - No Change</td>
<td>12.98</td>
<td>15.5</td>
<td>3.81</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.43)</td>
<td>(.40)</td>
<td>(1.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ETB - Phon Change</td>
<td>19.56</td>
<td>31.79</td>
<td>3.26</td>
<td>7.52</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.46)</td>
<td>(.59)</td>
<td>(.61)</td>
<td>(1.00)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>ETB - Orth Change</td>
<td>19.50</td>
<td>26.86</td>
<td>2.07</td>
<td>3.92</td>
<td>5.45</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>(.54)</td>
<td>(.58)</td>
<td>(.46)</td>
<td>(.61)</td>
<td>(1.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ETB - Both Change</td>
<td>24.50</td>
<td>31.81</td>
<td>2.79</td>
<td>4.07</td>
<td>4.69</td>
<td>8.95</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.53)</td>
<td>(.54)</td>
<td>(.48)</td>
<td>(.50)</td>
<td>(.67)</td>
<td>(1.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WLPB - Picture Vocab</td>
<td>81.64</td>
<td>192.58</td>
<td>13.57</td>
<td>28.62</td>
<td>27.79</td>
<td>30.24</td>
<td>566.71</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.22)</td>
<td>(.41)</td>
<td>(.29)</td>
<td>(.44)</td>
<td>(.50)</td>
<td>(.43)</td>
<td>(1.00)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WLPB - Letter Word</td>
<td>137.8</td>
<td>211.16</td>
<td>11.48</td>
<td>20.96</td>
<td>18.23</td>
<td>17.18</td>
<td>150.55</td>
<td>257.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>(.66)</td>
<td>(.37)</td>
<td>(.48)</td>
<td>(.49)</td>
<td>(.36)</td>
<td>(.39)</td>
<td>(1.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WLPB - Passage Comp</td>
<td>91.21</td>
<td>137.79</td>
<td>12.44</td>
<td>20.53</td>
<td>15.37</td>
<td>17.84</td>
<td>185.35</td>
<td>122.77</td>
<td>155.49</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.47)</td>
<td>(.56)</td>
<td>(.51)</td>
<td>(.60)</td>
<td>(.53)</td>
<td>(.48)</td>
<td>(.62)</td>
<td>(.61)</td>
<td>(1.00)</td>
<td></td>
</tr>
<tr>
<td>WLPB - Reading Vocab</td>
<td>75.53</td>
<td>113.63</td>
<td>8.92</td>
<td>14.59</td>
<td>13.53</td>
<td>18.91</td>
<td>171.79</td>
<td>89.51</td>
<td>102.07</td>
<td>123.37</td>
</tr>
<tr>
<td></td>
<td>(.44)</td>
<td>(.52)</td>
<td>(.41)</td>
<td>(.48)</td>
<td>(.52)</td>
<td>(.57)</td>
<td>(.65)</td>
<td>(.50)</td>
<td>(.74)</td>
<td>(1.00)</td>
</tr>
</tbody>
</table>

**Model 1**

Model 1 showed good fit to the data according to multiple fit indices as shown in Table 4.3 ($X^2(2) = 0.185$, $p = 0.91$, $CFI = 1.00$, $TLI = 1.00$, $RMSEA \leq 0.001$, and $SRMR \leq 0.004$). These all met the guidelines of acceptable model fit as suggested by Kline (2005).
Table 4.3

*Fit Statistics of Structural Models 1, 2, and 3*

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$ (df), $p$</th>
<th>CFI</th>
<th>TLI</th>
<th>RMSEA (UB, LB)</th>
<th>SRMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>0.185 (2), 0.911</td>
<td>1.00</td>
<td>1.02</td>
<td>0.00 (0.00, 0.06)</td>
<td>0.004</td>
</tr>
<tr>
<td>Model 2</td>
<td>7.07 (3), 0.07</td>
<td>0.99</td>
<td>0.96</td>
<td>0.08 (0.00, 0.17)</td>
<td>0.02</td>
</tr>
<tr>
<td>Model 3</td>
<td>43.20 (21), 0.003</td>
<td>0.98</td>
<td>0.95</td>
<td>0.07 (0.04, 0.10)</td>
<td>0.03</td>
</tr>
</tbody>
</table>

*Figure 4.1.* Results of model 1 showing the contribution of phonological recoding to reading outcomes.

Model 1 showed similar findings to prior studies that examined the role of phonological recoding as a predictor of reading achievement (for a review of studies, see Scarborough, 1998). Results from this model do not directly answer any particular research question from this study, although comparing the results of this model with subsequent models tested for Research Question 2 which examines whether the contribution of phonological recoding as a single predictor of these components of...
reading changes when other predictors such as Picture Vocabulary and Morphological Awareness are included in alternative models.

The results of Model 1, as displayed in Figure 4.1 and Table 4.4, show that the latent Phonological Recoding variable significantly predicted Letter-Word ID ($b = 1.06, SE = 0.13, p < .001, \beta = .75$), Passage Comprehension ($b = 0.71, SE = 0.10, p < .001, \beta = .64$), and Reading Vocabulary ($b = 0.58, SE = 0.09, p < .001, \beta = .59$). When examining the contributions of Phonological Recoding to the reading outcomes, only direct paths will be examined for Model 1 because no mediators were present in this model. For example, a one-unit increase in Phonological Recoding predicts a .75 SD-unit increase in Letter-Word ID, a .64 SD-unit increase in Passage Comprehension, and a .59 SD-unit increase in Reading Vocabulary. These contributions are moderate in magnitude (Cohen, 1988) and therefore, these results confirm the findings of previous research that phonological awareness is an important predictor of word reading achievement.

Table 4.4

*Results for Model 1 showing the Contribution of Phonological Recoding to Reading Outcomes*

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Direct $b$ (SE), $\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter-Word ID</td>
<td>1.06 (0.13), .75***</td>
</tr>
<tr>
<td>Passage Comprehension</td>
<td>.71 (0.10), .64***</td>
</tr>
<tr>
<td>Reading Vocabulary</td>
<td>.58 (0.09), .59***</td>
</tr>
</tbody>
</table>

***p<.001
In terms of amount of variance explained in each reading outcome, according to Model 1, the phonological recoding latent variable was able to explain 56.4% of the variance in Letter-Word ID, 40.6% of the variance in Passage Comprehension, and 34.6% of the variance in Reading Vocabulary.

**Model 2**

The results of Model 2 report the contribution of Phonological Recoding controlling for Picture Vocabulary in predicting Letter-Word ID, Passage Comprehension, and Reading Vocabulary. These findings also support exploration of Research Question 2, which examines how the role of Phonological Recoding changes in predicting components of reading achievement when it is a single predictor versus when it is allowed to compete with other predictors to explain variance in the reading outcomes. Model 2 showed good fit to the data according to multiple fit indices as shown in Table 4.3 ($\chi^2(3)=7.07$, $p = 0.07$, CFI = 0.99, TLI = 0.96, RMSEA = 0.08, and SRMR = 0.02). These all met the guidelines of acceptable model fit as suggested by Kline (2005).

The results of Model 2, as shown in Figure 4.2 and Table 4.5, showed that the latent Phonological Recoding variable significantly predicted each component of Reading Achievement and Picture Vocabulary. When examining the contributions of Phonological Recoding to the reading outcomes and oral vocabulary, only direct paths will be examined for Model 2 because these are the paths of interest showing the direct contribution of Phonological Recoding controlling for Picture Vocabulary.

Model 2 results show that Phonological Recoding makes a significant contribution to Letter-Word ID ($b= 1.00$, $SE = 0.14$, $p < .001$, $\beta=.71$), Passage Comprehension ($b= 0.50$, $SE = 0.09$, $p < .001$, $\beta=.45$), and Reading Vocabulary ($b=$}
Figure 4.2. Results of model 2 showing the contribution of phonological recoding to reading outcomes with oral vocabulary as a mediator.

0.38, \( SE = 0.08, p < .001, \beta = .38 \) controlling for Picture Vocabulary and also makes a significant contribution to Picture Vocabulary (\( b = 0.86, SE = 0.20, p < .001, \beta = .42 \)). For example, a one-unit increase in Phonological Recoding will result in a .42 SD-unit increase in Picture Vocabulary. In addition, a one-unit increase in Phonological Recoding predicts a .71 SD-unit increase in Letter-Word ID, a .45 SD-unit increase in Passage Comprehension, and a .38 SD-unit increase in Reading Vocabulary achievement.

In terms of amount of variance explained in each reading outcome and in oral vocabulary, according to Model 2, 17% of the variance in Picture Vocabulary, 57.3% of the variance in Letter-Word ID, 57% of the variance in Passage Comprehension, and 55.2% of the variance in Reading Vocabulary was explained by the predictors included in Model 2.
Table 4.5

*Results for Model 2 showing the Contribution of Phonological Recoding to Reading Outcomes with Oral Vocabulary as a Mediator*

<table>
<thead>
<tr>
<th>Contribution of Picture Vocabulary</th>
<th>Outcome</th>
<th>Direct $b$ (SE), $\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter-Word ID</td>
<td>0.16* (0.07), .23</td>
<td></td>
</tr>
<tr>
<td>Passage Comprehension</td>
<td>0.19*** (0.04), .37</td>
<td></td>
</tr>
<tr>
<td>Reading Vocabulary</td>
<td>0.20*** (.04), .43</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contribution of Phonological Recoding</th>
<th>Outcome</th>
<th>Direct $b$ (SE), $\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture Vocabulary</td>
<td>0.86*** (0.20), .42</td>
<td></td>
</tr>
<tr>
<td>Letter-Word ID</td>
<td>1.00*** (0.14), .71</td>
<td></td>
</tr>
<tr>
<td>Passage Comprehension</td>
<td>0.50*** (0.09), .45</td>
<td></td>
</tr>
<tr>
<td>Reading Vocabulary</td>
<td>0.38*** (0.08), .38</td>
<td></td>
</tr>
</tbody>
</table>

* $p<.05$; *** $p<.001$

**Model 3**

Model 3 is the model of interest in this study because it explores the unique contributions of Morphological Awareness (Research Question 3) and Phonological Recoding (Research Question 1) to Picture Vocabulary (Research Question 4), Letter-Word ID, Passage Comprehension, and Reading Vocabulary. Model 3 fit the data reasonably well as shown in Table 4.3. Although the $\chi^2$ value was significant ($\chi^2(21)=34.2, p=0.003$), multiple fit indices (i.e., CFI = 0.98, TLI = 0.95, RMSEA = 0.07, and SRMR = 0.03) showed acceptable fit as suggested by Kline (2005).

When examining the contributions of Morphological Awareness and Phonological Recoding to the reading outcomes, total, direct, and indirect paths will be examined. Indirect paths involves the multiplication of two paths, *ie.* the path between the
independent variable and the mediator * the path between the mediator and the outcome variable. Total paths are the sum of the direct contribution and the indirect contribution of the variable through a mediator, in this case Picture Vocabulary. Direct paths from Model 3 are shown in Figure 4.3, whereas Figure 4.4 emphasizes results involving total paths. Table 4.6 displays all results also.

*Figure 4.3.* Results of direct paths for Model 3 showing the unique contribution of phonological recoding and morphological awareness to reading outcomes with oral vocabulary as a mediator.

In examining direct paths, Morphological Awareness made a significant direct contribution to Picture Vocabulary ($b = 10.46, SE = 3.44, p = .002, \beta = .81$) such that a one-unit increase in Morphological Awareness resulted in a .81 SD-unit increase in Picture Vocabulary controlling for Phonological Recoding. In contrast, Morphological
Awareness did not make a significant direct contribution to Letter-Word ID ($b = -4.03$, $SE = 2.62$, $p = .123$, $\beta = -.46$), Passage Comprehension ($b = 1.80$, $SE = 1.43$, $p = .208$, $\beta = .27$), nor Reading Vocabulary ($b = 1.54$, $SE = 1.18$, $p = .192$, $\beta = .25$) controlling for Phonological Recoding and Picture Vocabulary. On the other hand, Phonological Recoding made a significant direct contribution to Letter-Word ID ($b = 1.42$, $SE = 0.38$, $p < .001$, $\beta = 1.00$) such that a one-unit increase in Phonological Recoding resulted in a 1.00

Table 4.6

Results for Model 3 showing the Unique Contribution of Phonological Recoding and Morphological Awareness to Reading Outcomes with Oral Vocabulary as a Mediator

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Total $b$ (SE), $\beta$</th>
<th>Direct $b$ (SE), $\beta$</th>
<th>Indirect $b$ (SE), $\beta$ (via Picture Vocab)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter-Word ID</td>
<td>---</td>
<td>0.16* (0.07), .23</td>
<td>---</td>
</tr>
<tr>
<td>Passage Comp</td>
<td>---</td>
<td>0.19*** (0.04), .37</td>
<td>---</td>
</tr>
<tr>
<td>Reading Vocab</td>
<td>---</td>
<td>0.20*** (0.04), .43</td>
<td>---</td>
</tr>
</tbody>
</table>

| Contribution of Morphological Awareness |
| Picture Vocab    | 10.46** (3.44), .81    | ---                       |
| Letter-Word ID   | -2.42 (2.04), -.28     | -4.03 (2.62), -.46        | 1.62 (1.11), .19                              |
| Passage Comp     | 3.83** (1.43), .57     | 1.80 (1.43), .27          | 2.03** (0.77), .30                            |
| Reading Vocab    | 3.64** (1.23), .60     | 1.54 (1.18), .25          | 2.10** (0.78), .35                            |

| Contribution of Phonological Recoding |
| Picture Vocab    | ---                     | -.57 (0.52), -.28         | ---                                           |
| Letter-Word ID   | 1.33*** (0.34), .99     | 1.42*** (0.38), 1.00      | -0.09 (0.11), -.07                            |
| Passage Comp     | 0.17 (0.21), .16        | 0.28 (0.19), .26          | -0.11 (0.10), -.10                            |
| Reading Vocab    | 0.08 (0.19), .09        | 0.19 (0.16), .21          | -0.11 (0.11), -.12                            |

* $p<.05$; ** $p<.01$; *** $p<.001$
SD-unit increase in Letter-Word ID controlling for Morphological Awareness and Picture Vocabulary. Phonological Recoding did not make a significant direct contribution to Picture Vocabulary \( (b = -0.57, SE = 0.52, \ p = .279, \beta = -.28) \) controlling for Morphological Awareness, nor to Passage Comprehension \( (b = 0.28, SE = 0.19, \ p = .151, \beta = .26) \) or Reading Vocabulary \( (b = 0.19, SE = 0.16, \ p = .237, \beta = .21) \) controlling for Morphological Awareness and Picture Vocabulary.

Figure 4.4. Results of total contributions for Model 3 showing the unique contribution of phonological recoding and morphological awareness to reading outcomes with oral vocabulary as a mediator.
According to the total paths, Model 3 shows that Morphological Awareness significantly predicted Passage Comprehension ($b = 3.83, SE = 1.43, p = .008, \beta = .57$) and Reading Vocabulary ($b = 3.64, SE = 1.23, p = .003, \beta = .60$), but not Letter-Word ID ($b = -2.42, SE = 2.04, p = .236, \beta = -.28$) when controlling for Phonological Recoding for these fifth grade Spanish-speaking ELLs. For example, a one-unit increase in Morphological Awareness resulted in a .57 SD-unit increase in Passage Comprehension and a .60 SD-unit increase in Reading Vocabulary controlling for Phonological Recoding. On the other hand, Phonological Recoding significantly predicted Letter-Word ID ($b = 1.33, SE = 0.34, p < .001, \beta = .99$), but not Passage Comprehension ($b = 0.17, SE = 0.21, p = .434, \beta = .16$) nor Reading Vocabulary ($b = 0.08, SE = 0.19, p = .672, \beta = .09$) when controlling for Morphological Awareness. For example, a one-unit increase in Phonological Recoding results in a large and significant .99 SD-unit increase in Letter-Word ID controlling for Morphological Awareness.

Oral vocabulary knowledge was a significant mediator of the relationship between Morphological Awareness and Reading Comprehension and Reading Vocabulary due to the significant contribution of Morphological Awareness to Picture Vocabulary ($b = 10.46, SE = 3.44, p = .002, \beta = .81$) controlling for Phonological Recoding and the significant contribution of Picture Vocabulary to Letter-Word ID ($b = 0.16, SE = 0.07, p = .028, \beta = .23$), Passage Comprehension ($b = 0.19, SE = 0.04, p < .001, \beta = .37$), and Reading Vocabulary ($b = 0.20, SE = 0.04, p < .001, \beta = .43$). For example, a one-unit increase in Picture Vocabulary results in a .23 SD-unit increase in Letter-Word ID, a .37 SD-unit increase in Passage Comprehension, and a 0.43 SD-unit increase in Reading Vocabulary controlling for Morphological Awareness and Phonological Recoding. As a
result, Morphological Awareness makes a moderate significant indirect contribution to Passage Comprehension \((b= 2.03, SE = 0.77, p =.008, \beta=.30)\) and Reading Vocabulary \((b= 2.10, SE = 0.78, p =.007, \beta=.35)\) via Picture Vocabulary, although not to Letter-Word ID \((b= 1.62, SE = 1.11, p =.144, \beta=.19)\).

In contrast, oral vocabulary knowledge did not mediate the significant relationship between Phonological Recoding and Word Reading Achievement nor the non-significant relationship between Phonological Recoding and Passage Comprehension or Reading Vocabulary probably because Phonological Recoding made a non-significant contribution to Picture Vocabulary \((b= -0.57, SE = 0.52, p =.279, \beta= -.28)\) controlling for Morphological Awareness. Therefore, Phonological Recoding made a non-significant indirect contribution via Picture Vocabulary to Letter-Word ID \((b= -0.09, SE = 0.11, p =.417, \beta= -.07)\), Passage Comprehension \((b= -0.11, SE = 0.10, p =.288, \beta= -.10)\), and Reading Vocabulary \((b= -0.11, SE = 0.11, p =.288, \beta= -.12)\) controlling for Morphological Awareness.

Therefore, the majority of the moderate and significant total contribution of Morphological Awareness to Passage Comprehension and Reading Vocabulary seems to stem from the indirect contribution via Picture Vocabulary. In contrast, the significant direct contribution of Phonological Recoding to Word Reading and non-significant contribution to Passage Comprehension and Reading Vocabulary controlling for Morphological Awareness and Picture Vocabulary mirror the total contributions of Phonological Recoding to these reading outcomes due to the non-significant indirect contributions of Phonological Recoding via Picture Vocabulary.
In terms of amount of variance explained in each reading outcome and in oral vocabulary, according to Model 3, 34.5% of the variance in Picture Vocabulary, 62.2% of the variance in Letter-Word ID, 58.8% of the variance in Passage Comprehension, and 57.5% of the variance in Reading Vocabulary was explained by the predictors included in Model 3. As shown in Table 4.7, Model 3 explained the most variance in each outcome.

Table 4.7

Amount of variance explained, or $R^2$, by model

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture Vocabulary</td>
<td>&quot;&quot;</td>
<td>17%</td>
<td>34.5%</td>
</tr>
<tr>
<td>Letter-Word ID</td>
<td>56.4%</td>
<td>57.3%</td>
<td>62.2%</td>
</tr>
<tr>
<td>Passage Comprehension</td>
<td>40.6%</td>
<td>57%</td>
<td>58.8%</td>
</tr>
<tr>
<td>Reading Vocabulary</td>
<td>34.6%</td>
<td>55.2%</td>
<td>57.5%</td>
</tr>
</tbody>
</table>

Comparison of Model Results

In this study, because models are not nested, we are unable to compare model fit using a chi square difference statistic. In addition, although AIC and BIC values are often used for non-nested model comparisons, the large increase in complexity between the models prevent such a comparison. For example, although the AIC increases from 6321.23 for Model 1 to 7611.78 for Model 2 to 10487.68 for Model 3, it is important to note that Model 3 involves an additional latent variable with four indicators and multiple mediated paths, going from 2 degrees of freedom in Model 1 to 21 degrees of freedom in Model 3. More importantly, it includes a predictor, Morphological Awareness, which reading literature confirms is related to each of the reading outcomes and to the predictor Phonological Recoding, and therefore, models without Morphological Awareness violate the assumption that “No common cause of the presumed cause and the presumed effect
has been neglected” (Keith, 2005, p. 289). As a result, even though the AIC suggests
Model 1 is the preferable model, the AIC index does not take into consideration current
research which suggests Model 1 and 2 exclude a common cause, and therefore,
comparisons of fit indices between Models 1, 2, and 3 are not part of this study.

Instead, this will compare the results of Models 1, 2, and 3 in order to answer
Research Question 2, which questions whether the contribution of phonological recoding
to the prediction of word decoding, reading comprehension, and/or reading vocabulary
for Spanish- speaking ELLs changes in a meaningful way when controlling for
morphological awareness and oral vocabulary knowledge as compared to being included
as the sole predictor. As seen in Table 4.8, the contribution of Phonological Recoding to
Letter Word Identification increased from .75 SD- units to an extremely large 1.00 SD-
units when adding morphological awareness into the model. In contrast, the contribution
of Phonological Recoding to Passage Comprehension decreased from .64 SD- units to .45
SD- units when controlling for Picture Vocabulary to .26 SD- units when controlling for
both Picture Vocabulary and Morphological Awareness. Similarly, the contribution of
Phonological Recoding to Reading Vocabulary decreased from .59 SD- units to .38 SD-
units when controlling for Picture Vocabulary to .21 SD- units when controlling for both
Picture Vocabulary and Morphological Awareness. In addition, the contribution of
Phonological Recoding to Picture Vocabulary changed from positive .42 SD-units to
negative .28 SD- units when including Morphological Awareness in the model.

By comparing the results of Models 1, 2, and 3, it appears that the contribution of
Phonological Recoding to Picture Vocabulary, Passage Comprehension, and Reading
Vocabulary decreases in a meaningful way, showing that morphological awareness seems
Table 4.8

Direct contribution of Phonological Recoding, or $b (\beta)$, by Model

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture Vocabulary</td>
<td>-----</td>
<td>0.86 (.42)***</td>
<td>-.57 (-.28)</td>
</tr>
<tr>
<td>Letter-Word ID</td>
<td>1.06 (.75)***</td>
<td>1.00 (.71)***</td>
<td>1.42 (1.00)***</td>
</tr>
<tr>
<td>Passage Comprehension</td>
<td>.71 (.64)***</td>
<td>0.50 (.45)***</td>
<td>0.28 (.26)</td>
</tr>
<tr>
<td>Reading Vocabulary</td>
<td>.58 (.59)***</td>
<td>0.38 (.38)***</td>
<td>0.19 (.21)</td>
</tr>
</tbody>
</table>

***p<.001

to better explain variance that was previously allocated to Phonological Recoding when Morphological Awareness was not in the model. In fact, for these fifth grade Spanish-speaking ELLs, Phonological Recoding becomes a non-significant predictor of Picture Vocabulary, Passage Comprehension, and Reading Vocabulary when Morphological Awareness is included in the model. Because many of the models which showed Phonological Recoding as an accepted predictor of reading achievement did not include Morphological Awareness as a predictor, this study shows the importance of including both Phonological Recoding and Morphological Awareness as predictors when examining the role of sublexical processes in contributing to components of reading achievement. On the other hand, including Morphological Awareness increases the role of Phonological Recoding in explaining variance in Letter-Word ID.

General Findings

In sum, for these Spanish-speaking ELLs, Morphological Awareness as measured by the latent variable stemming from shared variance of four morphological tasks of varying degrees of transparency made a direct contribution to oral vocabulary knowledge controlling for phonological recoding, but did not make a direct significant contribution.
to Letter-Word ID, Passage Comprehension, nor Reading Vocabulary controlling for Picture Vocabulary and Phonological Recoding. When taking into consideration the indirect contribution of Morphological Awareness through oral vocabulary knowledge, Morphological Awareness made a total contribution to Passage Comprehension and Reading Vocabulary but not to Letter-Word ID. For these same students, Phonological recoding made a direct contribution to Letter-Word ID, but not to oral vocabulary knowledge, Passage Comprehension, nor Reading Vocabulary. Because oral vocabulary knowledge did not mediate the relationship between Phonological Recoding and any reading outcome, the total contributions of Phonological Recoding mirrored the direct contributions discussed above. As a result, Model 3 shows that Morphological Awareness contributes to Picture Vocabulary, Passage Comprehension, and Reading Vocabulary whereas Phonological Recoding contributes to Letter-Word ID for Spanish-speaking ELLs in 5th grade with grade-appropriate performance on word decoding measures.
Chapter 5: Discussion

According to National Assessment of Educational Progress (NAEP) data, 34% of fourth grade public school students are reading below the basic reading level (Lee, Grigg, & Donahue, 2007). Low reading scores are an even greater problem for ELLs, who must learn spoken English at the same time as they learn to read English. This additional challenge shows up in the form of lower test scores with ELLs consistently performing between 20 to 50 points lower than their native English speaking peers (Menken, 2008). With only 18.7% of ELLs performing above state-established norms for reading comprehension (Kindler, 2002) and with the United States public school system becoming increasingly more diverse in the area of language (U.S. Department of Education, 2003), improving reading achievement for ELLs is of particular importance.

In order to improve instruction for ELLs, researchers need to develop a better understanding of the linguistic factors that contribute to reading achievement. Because vocabulary knowledge is particularly challenging for ELLs, researchers should also examine skills that could improve vocabulary learning. The focus on morphological awareness as a contributor to literacy outcomes for ELLs makes sense because accessing meaning is a significant barrier to reading achievement for these students (August & Shanahan, 2006). Whether because instruction in word level skills is robust enough or because of similarities between the Spanish and English languages in phonological and orthographic patterns, word reading is less of a challenge for Spanish-speaking ELLs than accessing a lexical meaning for the phonological representation (Lesaux & Geva, 2006). If, as this study suggests, morphological awareness is indeed a predictor of components of reading achievement and vocabulary knowledge, it would stand to reason
that instruction that helps ELLs attend to units of meaning may expand their lexicon and therefore improve their ability to gain meaning from text.

This study addressed morphological awareness as an important contributor to components of reading achievement and sought to clarify the function of morphological awareness in the process of reading for this at-risk population of second language learners. As Hurry et al. (2005) states, “The role of morphology in literacy has not been extensively researched and might therefore have a relatively low profile at both levels [i.e., the national or policy level and within classrooms]” (p. 189). Because the writing system of English is morphophonemic representing units of meaning termed morphemes and units of sound called phonemes in the spelling of words (Chomsky & Halle, 1968), the role of morphological awareness in literacy achievement has important consequences for instruction and improving student reading. Currently, no studies are available detailing the prevalence and quality of morphological instruction, yet instruction in units of meaning could be embedded within classroom teaching across grade levels, allowing students to focus on meaning within text rather than isolated subskills and possibly lead to enhanced student learning.

This study builds on an earlier analysis that suggested morphological awareness contributed to general reading achievement (defined as a latent construct consisting of indicators of real word decoding, reading comprehension, and reading vocabulary) directly and indirectly through vocabulary knowledge controlling for phonological recoding skills (Goodwin et al., 2010). In addition, this earlier study found that the contribution of phonological recoding to general reading achievement was non-significant when morphological awareness was included as a predictor in the model.
Because the Goodwin et al. (2010) study suggests the unique role of morphological awareness beyond phonological recoding in predicting overall reading achievement, an important follow-up analysis must examine how this contribution to general reading achievement occurs. Hence, in this study I examined whether morphological awareness plays a different role within decoding, comprehension, and vocabulary knowledge controlling for the role of phonological recoding.

The relationship between morphological awareness and reading has been somewhat overlooked in the research literature. On the other hand, phonological processing has been carefully studied and has been accepted in the field of reading as a well-established predictor of reading achievement based on studies involving phonological awareness predicting a reading outcome alone or controlling for intelligence, verbal memory, or rapid serial naming (for a review of studies, see Scarborough, 1998). Because morphological awareness is linguistically related to phonological recoding, to understand the unique contributions of morphological awareness and phonological recoding in contributing to reading outcomes, both constructs must be included as predictors in the model, therefore competing to explain variance in the outcome.

For about the past decade, researchers have acknowledged the need to include both these constructs in models predicting reading achievement, but as argued earlier, have been unable to accurately isolate both constructs. To address this challenge, the latent variable framework within structural equation modeling was used to identify shared variance amongst tasks of varying levels of morphological transparency in order
to isolate morphological awareness from other linguistic demands within the morphological task.

**The Role of Phonological Recoding**

This study took both prior research design and the relationship between morphological awareness and phonological awareness into consideration to clarify the role of morphological awareness and phonological recoding in contributing to oral vocabulary, word reading, reading comprehension, and reading vocabulary for 5th grade Spanish-speaking ELLs. First, I examined the contribution of phonological recoding alone and controlling for oral vocabulary knowledge to each component of reading achievement in order to confirm findings from earlier studies that established phonological recoding as a predictor of reading achievement (Adams, 1990; National Institute of Child Health and Human Development, 2000; Scarborough, 1998; Snow, Burns, & Griffin, 1998; Stanovich, 1990). Following this logic, this study found that phonological recoding is a large and significant predictor of word reading, reading comprehension, and reading vocabulary for 5th grade Spanish-speaking ELLs both alone (Model 1) and when controlling for oral vocabulary (Model 2). In addition, phonological recoding was a significant predictor of oral vocabulary for these students (Model 2).

Results changed drastically when both morphological awareness and phonological recoding were allowed to compete to explain variance in each component of reading (Model 3), with phonological recoding making a unique contribution to the prediction of word decoding but not reading comprehension nor reading vocabulary for Spanish-speaking 5th grade ELLs when controlling for morphological awareness and oral vocabulary knowledge (Research Question 1). The study also found the contribution of
phonological recoding to the prediction of word decoding, reading comprehension, and reading vocabulary for these participants changed in a meaningful way when controlling for morphological awareness and oral vocabulary knowledge (Research Question 2). When included as a single predictor, phonological recoding was a significant predictor of word reading, reading comprehension, and reading vocabulary. When controlling for morphological awareness and oral vocabulary knowledge, the contribution of phonological recoding to reading comprehension and reading vocabulary decreased and became non-significant although its contribution to word reading increased. These results suggest that while phonological recoding may support word reading for Spanish-speaking 5th grade ELLs, the processing of words letter by letter and sound by sound does not support reading comprehension or the integration of lexical meanings when reading texts.

This should not be interpreted to suggest that phonological recoding is not an important sub-lexical component of the reading process, but rather that as prior research has suggested (Anglin, 1993; Carlisle, 2000; Deacon & Kirby, 2004; Kieffer & Lesaux, 2008; Nagy et al., 2006), developmentally by fifth grade, awareness of units of meaning and word structure play an important role in literacy achievement, perhaps because phonological recoding skills are approaching mastery whereas morphological awareness continued to develop through high school years. In addition, it is important to remember that phonological recoding and morphological awareness were highly correlated in this study, and although the morphological awareness measure in this study seemed to better explain variance in oral vocabulary, reading comprehension, and reading vocabulary for these 5th grade ELLs, similar processing demands were involved in manipulating sound and meaning structures such as segmentation, elision, and blending skills. Yet, the current
findings make an important contribution to the field of reading because this study suggests the need to include both morphological awareness and phonological recoding in models where these constructs are predicting vocabulary and reading outcomes.

**Role of Morphological Awareness**

Next, examination of the unique contributions of morphological awareness and phonological recoding to real word decoding, reading comprehension, and reading vocabulary occurred, similar to more recent studies that included both constructs in models predicting reading achievement (Deacon & Kirby, 2004; Fowler & Liberman, 1995; Kieffer & Lesaux, 2008; Nagy et al., 2003; Nagy et al., 2006, Siegel, 2008). Findings suggested that morphological awareness makes a moderate significant and meaningful contribution to passage comprehension and reading vocabulary controlling for phonological recoding (Research Question 3), with most of the power of that contribution stemming from the large significant contribution of morphological awareness to oral vocabulary (Research Question 4). Morphological awareness did not contribute to word reading, whereas phonological recoding was a large and significant predictor of word reading but not oral vocabulary, reading comprehension, or reading vocabulary.

**Contribution to Oral Vocabulary.** The current study found that morphological awareness significantly predicted oral vocabulary knowledge controlling for phonological recoding. In addition, oral vocabulary knowledge mediated the contribution of morphological awareness to reading vocabulary and reading comprehension. These findings highlight the importance of morphological awareness in improving oral vocabulary knowledge for Spanish-speaking ELLs, which research has suggested is a
particularly important area to develop for these students. As August and Shanahan (2006) state, “The research suggests that the reason for the disparity between word- and text-level skills among language-minority students is oral English proficiency…Specifically, English vocabulary knowledge…and the ability to handle the metalinguistic aspects of language, such as providing definitions of words, are linked to English reading and writing proficiency. These findings help explain why many language-minority students can keep pace with their native English-speaking peers when the instructional focus is on word-level skills, but lag behind when the instructional focus turns to reading comprehension and writing” (p. 4). It is easy to understand why vocabulary knowledge is such a challenge for ELLs. Because fluent English speakers must learn 10-12 words each day in order to reach the approximate 75,000 necessary for high school graduates to know, Snow and Kim (2007) have estimated that with ELLs beginning to acquire English years later, they must increase the number of words they learn each day in order to catch up with English only peers. As a result, researchers suggest that educators “target intensively” (August & Shanahan, 2006, p. 4) vocabulary development for ELLs throughout their academic development.

Because of large vocabulary needs, ELLs seemed to benefit from the contribution of morphological awareness to word learning, which has been well documented by researchers for typically achieving populations. As Nagy and Scott (2000) write, “It is hard to overstate the importance of morphology in vocabulary growth” (p.275). Similarly, Anglin (1993) states, “[Children] appear to have an increasingly powerful ability to analyze the morphological structure of complex words so as to figure out their meanings, which they can apply to words that they have not actually learned before. Thus, the
child’s vocabulary knowledge is enhanced increasingly by morphological knowledge, that is, by tacit or explicit knowledge of the rules of morphology and word formation” (p. 152). The current study found that ELLs with better awareness of the morphological features of English tended to have larger oral vocabularies, and that these larger oral vocabularies contributed to reading comprehension, reading vocabulary, and even word identification. These findings suggest that awareness of these morphemes supports the development of second language vocabulary knowledge such that by knowing the meaning of a morpheme such as \textit{plant}, a student can estimate the meaning of \textit{plants}, \textit{planted}, \textit{planting}, \textit{implant}, \textit{supplant}, \textit{plantation}, \textit{planter}, and \textit{transplant}.

In fact, morphological awareness may be particularly important in developing vocabulary knowledge for Spanish-speaking ELLs due to their low levels of English vocabulary and the many words in English and Spanish that share morphemes. In fact, Hancin-Bhatt and Nagy (1994) reported, ELLs with higher levels of morphological awareness recognized more cognates, which are words or morphemes in English and Spanish that look and/or sound alike such as \textit{audience} (English) and \textit{audiencia} (Spanish). As Kieffer and Lesaux (2008) write, “Given the evidence that only some ELLs are skilled in recognizing cognates, high levels of morphological awareness may explain the success of some ELLs in using cognate relationships to attack novel English words encountered” (p. 788). The findings of this study suggest that morphological awareness contributes to oral vocabulary knowledge, which therefore contributes to important reading outcomes.

\textbf{Contribution to Word Reading.} In this study, morphological awareness did not contribute significantly to word reading for Spanish-speaking 5\textsuperscript{th} grade ELLs neither directly nor indirectly through its contribution to oral vocabulary controlling for
phonological recoding. This lack of significance may have stemmed from the word reading task used, the Woodcock Johnson Letter-Word Identification task, which relied more on morphologically simple words than on morphologically complex words. According to Anglin (1993), as of third grade and after, 60-80% of words encountered in texts are morphologically complex derived words, yet the task used in this study did not reflect this large percentage of morphologically complex words and therefore represents a validity challenge of the WLPB Letter-Word Identification task in determining the role of morphological awareness in word decoding. Closer analysis of an earlier study (Goodwin et al., 2010) shows that when the three reading tasks in this study (WLPB-Letter-Word Identification, WLPB-Passage Comprehension, and WLPB-Reading Vocabulary) were used to create a latent variable of reading achievement, the Letter-Word Identification tasks had a lower factor loading (.66) than the other two tasks (.90 and .82 respectively), possibly suggesting the validity problem of this task.

The use of this measure may be one of the reasons why results on the contribution of morphological awareness to decoding controlling for phonological awareness or phonological recoding have been mixed with some studies reporting a significant relationship (Deacon & Kirby, 2004; Fowler & Liberman, 1995; Mahony et al., 2000; Nagy et al., 2006; Singson et al., 2000) and others reporting the lack of a significant contribution (Nagy et al., 2003). Most of the studies described above did not fully control for the phonological and orthographic processing demands required by the morphological awareness task, which may explain the different results found by this study where tasks of varying levels of morphological transparency were used to create a pure construct of morphological awareness. In addition, the studies above involved fluent English upper
elementary students, and therefore, this current finding that morphological awareness does not significantly contribute to word reading for Spanish-speaking ELLs may suggest that morphological units may play less of an important role in real word decoding for these students who, because of their low levels of vocabulary, may be paying closer attention to the orthographic rather than morphological code. Because studies involving measures comparing the decoding of morphologically complex words to the reading of morphologically simple words consistently show that participants read morphologically complex words more accurately (Carlisle & Stone, 2005), future studies should explore the contribution of morphological awareness to a decoding measure with greater than 60% of its words being morphologically complex for these language minority students.

**Contribution to Reading Vocabulary.** According to this study, morphological awareness made a significant moderate contribution to the reading vocabulary of this population of students indirectly through oral vocabulary when controlling for phonological recoding skills, but did not make a significant direct contribution to reading vocabulary achievement. This relationship between morphological awareness and reading vocabulary suggests that morphological awareness also supports the integration of meaning with the printed form of words. In fact, because many morphemes maintain their written form even when they are pronounced differently as in the pair *know* and *knowledge*, by recognizing the written form *know*, a student can use their knowledge of the meaning of *know* to estimate the meaning of *knowledge*. As Balmuth (1992) stated, “It can be helpful to readers when the same spelling is kept for the same morpheme, despite variations in pronunciation. Such spellings supply clues to the meanings of words, clues that would be lost if the words were spelled phonemically, as for example, if *know*...
and knowledge were spelled noe and nollij in a hypothetical phonemic system” (p. 207).

In addition, the finding that oral vocabulary knowledge mediated the contribution of morphological awareness to reading vocabulary is consistent with findings that students with larger vocabularies are more likely to apply their knowledge of morphemes to learning words (Freyd & Baron, 1982).

**Contribution to Reading Comprehension.** In addition to building the oral and reading vocabularies of these Spanish-speaking ELLs, this study also found that morphological awareness made a moderate unique contribution to the prediction of reading comprehension for Spanish-speaking 5th grade ELLs indirectly through oral vocabulary knowledge when controlling for phonological recoding. Again, the direct contribution of morphological awareness to reading comprehension was non-significant when controlling for oral vocabulary knowledge and phonological recoding, which again emphasizes level of oral vocabulary knowledge as a mediator for this relationship.

Because the ultimate objective of reading text is to ascertain meaning, the significant relationship between morphological awareness and reading comprehension highlights the importance of morphological awareness for accessing meaning within text for ELLs. As students get older, text demands change with greater than half of third grade and higher level text being morphologically complex (Anglin, 1993). Therefore, the potential role of morphological awareness in supporting reading comprehension is underscored. Because according to Nagy and Anderson (1984), texts from grades 3-9 involved 139,020 transparent derived words such as growth compared to 49,080 semantically opaque words such as emerge and emergency, students with higher levels of
morphological awareness are better able to estimate the meanings of morphologically related words from a known morpheme.

As stated previously in the literature review, by definition, ELLs tend to lack proficiency in English, which results in difficulties with tasks involving meaning such as vocabulary access and reading comprehension (August & Shanahan, 2006). In light of this, it is interesting to note that these areas involving meaning were the outcomes that were supported by a student’s morphological awareness. In fact, for these participants who had particularly low oral vocabulary knowledge as shown by their average performance of two standard deviations below typical populations, morphological awareness seemed to be integral in supporting reading comprehension and reading vocabulary by increasing oral vocabulary knowledge.

**Educational Significance**

In order to design instructional interventions that can help narrow the achievement gap between ELLs and their fluent English peers, researchers must determine which sublexical and lexical processes contribute to reading achievement for these linguistically diverse students and how developing knowledge may mediate these relationships. The findings that morphological awareness predicted oral vocabulary, reading vocabulary, and reading comprehension suggest that morphological instruction may improve vocabulary knowledge and reading comprehension outcomes for Spanish-speaking 5th grade ELLs.

Recent research syntheses and meta-analyses support the call for more morphological instruction (Bowers, Kirby, & Deacon, in press; Goodwin & Ahn, 2010a; Goodwin & Ahn, 2010b). For example, Bowers et al. (in press) averaged effect sizes and
standard deviations of 22 published study findings showing that morphological instruction had positive effects on sublexical, lexical, and supra-lexical literacy achievement. Similarly, a meta-analysis by Goodwin and Ahn (2010b) synthesized 119 standardized mean differences from 30 published and unpublished studies, and found that the overall effect of morphological instruction was 0.44, suggesting that children in the morphological intervention group yielded moderately higher mean scores on literacy achievement. This study found that morphological instruction had statistically significant mean effect sizes for morphological awareness ($d = 1.34$), vocabulary ($d = 1.04$), phonological awareness ($d = 0.49$), phonological recoding ($d = 0.30$), and reading comprehension ($d = 0.08$).

Such findings are consistent with the current finding that morphological awareness contributes to the prediction of vocabulary and comprehension outcomes. These results suggest that educators should aim to teach students the meaning of affixes and roots, to identify these units within morphologically complex words, and to build words from morphemic units.

**Research Significance**

In order to accurately ascertain the role of these morphological awareness and phonological recoding in promoting reading achievement, accurate assessment of constructs must occur and models must include related variables in order to prevent violations of assumptions of statistical methods. This study aimed to improve upon past methods by using structural equation modeling to create a latent variable from the shared variance of morphological tasks of varying transparency. Because the overlap in the task
is morphological in nature, other linguistic demands were relegated to the error terms and
the latent variable was theoretically purely morphological in nature.

This study also deepened our understanding of how phonological recoding
predicts reading achievement including multiple predictors that carefully assess nuances
in language skills. Because structural equation modeling assumes that no common cause
of the outcome variable is excluded from the model (Keith, 2006), leaving morphological
awareness out of the model violates such assumptions. Without such predictors, variance
may be allotted to a related construct rather than the construct that best explains it as we
see by comparing the results of Models 1, 2, and 3. Such model misspecification has
serious consequences when applying the descriptive findings to intervention plans
because when designing an intervention, different lessons would be included depending
on the language skill that you are trying to improve. For example, this study suggests that
interventions with morphological instruction might be beneficial to improving the reading
achievement of Spanish-speaking ELLs whereas studies that do not include
morphological awareness in addition to phonological awareness would incorrectly
suggest the need for phonological interventions with this population of students. While
the nature of correlational research is that not all related constructs can be included in a
model due to the infinite number of related predictors including currently used predictors
and those that will become important based on future research findings, such empirical
findings must be followed up by experimental designs such as intervention research or
meta-analyses which synthesize the findings of multiple intervention studies in order to
determine which instruction results in improved reading outcomes.

General Conclusions
Although this study suggests the important role of morphological awareness beyond that of phonological awareness in predicting oral vocabulary knowledge, reading comprehension, and reading vocabulary, further research is necessary to clarify its involvement in the reading process of ELLs. For example, while this study reported a strong relationship between morphological awareness and vocabulary knowledge, future studies should explore this relationship in order to attempt to ascertain whether the relationship between these constructs is reciprocal or unidirectional. In other words, does a student’s morphological awareness develop his or her vocabulary knowledge or does one’s knowledge of vocabulary develop morphological awareness. Future research should also examine differences between the contribution of morphological awareness and phonological recoding to components of reading achievement in a student’s native language versus a student’s second language. In addition, differences between various populations of students such as different language or dialect groups, poor readers, and high achievers should be examined as well as changes in these relationships across time such as differences between early elementary, late elementary, middle school, and high school readers.

Future studies should also examine the relationship between morphological awareness and word decoding with a task.

This study found that morphological awareness made a significant, meaningful, and large contribution to oral vocabulary for Spanish-speaking 5th grade ELLs. In addition, morphological awareness made a significant, meaningful, and moderate total contribution to passage comprehension and reading vocabulary, whereas phonological recoding did not for this population. This relationship seemed to be driven by the
contribution of morphological awareness to oral vocabulary knowledge. Morphological awareness did not make a significant contribution to word reading for these students, but future research should examine whether this changes when a task including a high percentage of morphologically complex words is included in the analysis.

The findings of this study have important implications for research and classroom instruction. Understanding how morphological awareness and phonological recoding uniquely contribute to oral vocabulary, word reading, reading comprehension, and reading vocabulary helps researchers design interventions to improve achievement. As Nunes suggests, “Some of the most important correspondences between spoken and written language are at the level of the morpheme…The system of morphemes, therefore, is a powerful resource for those learning literacy” (Nunes et al., 2006, p. 157).
Bibliography


Mplus (Version 5.1) [Computer software]. Los Angeles, CA: Muthén & Muthén.


SPSS (Version 17.0) [Computer software]. Chicago: SPSS Inc.


Appendix 1: List of 20 Pseudowords for CAAS Pseudoword Naming Assessment

The pseudowords will appear in Random Order. Please familiarize yourself with the pseudoword list prior to administering the task. The pseudoword should be read by analogy to the word in parenthesis. Use the word in parenthesis as the criterion for scoring.

<table>
<thead>
<tr>
<th>English Pseudowords</th>
<th>monosyllabic</th>
<th>Bi-syllabic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice</td>
<td>seg</td>
<td>Flantic (frantic)</td>
</tr>
<tr>
<td></td>
<td>ren</td>
<td>lirit (lyric)</td>
</tr>
<tr>
<td></td>
<td>lig</td>
<td>fented (vented)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>norried (worried)</td>
</tr>
<tr>
<td>Target Words</td>
<td>tet (met)</td>
<td>lutter (butter)</td>
</tr>
<tr>
<td></td>
<td>san (can)</td>
<td>paiter (waiter)</td>
</tr>
<tr>
<td></td>
<td>fot (lot)</td>
<td>napsin (napkin)</td>
</tr>
<tr>
<td></td>
<td>nash (rash)</td>
<td>dable (table)</td>
</tr>
<tr>
<td></td>
<td>pust (rust)</td>
<td>nire (fire)</td>
</tr>
<tr>
<td></td>
<td>fost (lost or host)</td>
<td>tinger (singer or ginger or finger)</td>
</tr>
<tr>
<td></td>
<td>taid (maid or said)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>poes (does or goes)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>vome (some or dome)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>lound (found or wound)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plent (vent)</td>
<td>Tunning (cunning)</td>
</tr>
<tr>
<td></td>
<td>Denth (tenth)</td>
<td>Rickel (nickel)</td>
</tr>
<tr>
<td></td>
<td>froud (proud)</td>
<td>Zentist (dentist)</td>
</tr>
<tr>
<td></td>
<td>Bove (dove or glove)</td>
<td>Rebamed (renamed)</td>
</tr>
<tr>
<td></td>
<td>Knile (knife)</td>
<td>Theaply (deeply)</td>
</tr>
</tbody>
</table>
**Word Form Exercise**

**Practice together.**

<table>
<thead>
<tr>
<th>a. farmer</th>
<th>a. My uncle works on a __________________.</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. careful</td>
<td>b. Handle those glasses with______________</td>
</tr>
<tr>
<td>c. happiness</td>
<td>c. My pet dog makes me very______________</td>
</tr>
</tbody>
</table>

**Practice by yourself.**

<table>
<thead>
<tr>
<th>d. worker</th>
<th>d. I have to finish all my______________</th>
</tr>
</thead>
<tbody>
<tr>
<td>e. hopeful</td>
<td>e. We___________________ we can go to the park.</td>
</tr>
<tr>
<td>f. gentleness</td>
<td>f. My grandmother is very______________</td>
</tr>
</tbody>
</table>
**Begin the exercise.**

<table>
<thead>
<tr>
<th>1. publicity</th>
<th>1. The _____________ was happy with the show.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. sensitive</td>
<td>2. Animals often ___________ storms before they come.</td>
</tr>
<tr>
<td>3. breathe</td>
<td>3. Sometimes you can see your __________.</td>
</tr>
<tr>
<td>4. musician</td>
<td>4. That is lovely _____________.</td>
</tr>
<tr>
<td>5. runner</td>
<td>5. My dog likes to _____________.</td>
</tr>
<tr>
<td>6. fearful</td>
<td>6. Do you ______________ spiders?</td>
</tr>
<tr>
<td>7. width</td>
<td>7. The river is very ______________.</td>
</tr>
<tr>
<td>8. continuous</td>
<td>8. He wants to _______________ playing.</td>
</tr>
<tr>
<td>9. bathe</td>
<td>9. After a long day, a ______ would be nice.</td>
</tr>
<tr>
<td>10. procedure</td>
<td>10. Please __________ to the playground after class.</td>
</tr>
<tr>
<td>11. dangerous</td>
<td>11. There is no _______________ that you will fall.</td>
</tr>
<tr>
<td>12. cleanliness</td>
<td>12. She likes to ______________ her bicycle.</td>
</tr>
<tr>
<td>13. emptiness</td>
<td>13. The cereal box is _______________.</td>
</tr>
<tr>
<td>15. warmth</td>
<td>15. The room is not _________________.</td>
</tr>
<tr>
<td>16. recognition</td>
<td>16. Did she ______________ the boy?</td>
</tr>
<tr>
<td>17. reduction</td>
<td>17. We need to ______________ the picture.</td>
</tr>
<tr>
<td>18. extension</td>
<td>18. She wants to ______________ her vacation.</td>
</tr>
<tr>
<td>19. remarkable</td>
<td>19. Did you hear his ______________ ?</td>
</tr>
<tr>
<td>20. discussion</td>
<td>20. What did she want to ________________?</td>
</tr>
<tr>
<td>21. assistance</td>
<td>21. Are you able to ______________ me?</td>
</tr>
<tr>
<td>22. height</td>
<td>22. The box is too __________.</td>
</tr>
<tr>
<td>23. foggy</td>
<td>23. On some mornings you can see _________________.</td>
</tr>
<tr>
<td>24. combination</td>
<td>24. Which chemicals should I ______________?</td>
</tr>
<tr>
<td>25. division</td>
<td>25. Will you ______________ it into thirds?</td>
</tr>
<tr>
<td>26. employment</td>
<td>26. The circus should ______________ the magician.</td>
</tr>
</tbody>
</table>
27. In the rain forest the plants are ________________.

28. How many women did they ________________?
## Appendix 3: Scoring Guide for English

### Extract the Base Task

A. These responses will get an Incorrect (0):

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copying derived word instead of giving the base word.</td>
<td><em>publicity, sensitivity, breathe, musician, runner, fearful, width, continuous, bathe, procedure, dangerous, cleanliness, emptiness, assumption, warmth, recognition, reduction, extension, remarkable, discussion, assistance, height, foggy, combination, division, employment, density, election</em></td>
</tr>
<tr>
<td>Providing derived word instead of the base word, and misspelling the derived word.</td>
<td><em>publycy, clenliness, emptyness, assumption, density, width, fearful</em></td>
</tr>
<tr>
<td>Providing a word that is phonologically and/or orthographically more similar to the derived word than the base word.</td>
<td><em>assistan, asistan, asump,</em></td>
</tr>
<tr>
<td>Lopping off end of word at a phonologically and/or orthographically illogical place.</td>
<td><em>publici, sensit, sensi, brea, interr, musici, proce, cleanli, emptin, assum, recog, reduct, extensi, remarka, discussi, assistanc, combinati, divisi, densi, continuou, continuo, empt</em></td>
</tr>
<tr>
<td>Lopping off end of word at a phonologically and/or orthographically illogical place, and misspelling remainder of the lopped-off word.</td>
<td><em>publycy for public (base) and publicity (derived), senti for sense (base) and sensitive (derived), wid for wide (base) and width (derived), continuou, cotinou, continuoe for continue (base) and continuous (derived), aeigh for high (base) and height (derived), denn (dense and density)</em></td>
</tr>
<tr>
<td>Providing lopped off part of the derived word as base word.</td>
<td><em>licity for public (base) and publicity (derived); nation for combine (base) and combination (derived), dect, lect (elect)</em></td>
</tr>
<tr>
<td>Providing a word, pseudoword or random letter string that is not the base word and is not phonologically or orthographically similar to the base word.</td>
<td><em>pubshler for public (base) and publicity (derived), assing (assume), cotise (continue), empy (employ), epeny, antie (empty), reconus, reginate (recognize) white (wide), dance (dense)</em></td>
</tr>
<tr>
<td>Providing a word that semantically fits the context of the sentence but is not the base word.</td>
<td><em>density. In the rainforest, the plants are dead (dense).</em></td>
</tr>
<tr>
<td>Providing a word that is either a synonym or an antonym of the base word.</td>
<td><em>hot for warm (synonym); cold for warm (antonym) extension for reduce (antonym)</em></td>
</tr>
</tbody>
</table>
Addition of affixes, e.g., *er*, *or*, *tion*, *ment*, *ing* to the base word, resulting in real or pseudoword that does not semantically or syntactically fit the sentence.

<table>
<thead>
<tr>
<th>like for fear (antonym)</th>
<th><em>employment</em>. The circus should <em>employer</em> (employ) the magician.</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>divide</em> for combine (antonym)</td>
<td><em>breathe</em>. Sometimes you can see your <em>breathing</em>, <em>breathing</em> (breath).</td>
</tr>
</tbody>
</table>

Addition of consonants or vowels that add another sound to the base word (not a silent *e*) or makes it the Spanish equivalent of the word or makes the base unclear or unrecognizable.


Deletion of two or more consonants or vowels in the middle of the word or flipping the middle sounds or letters so that the base becomes unclear or unrecognizable.

| *recoize*, *recogis*, *recnoos*, *reconez*, *reconze* (recognize), *asstt*, *astist*, *atscie* (assist), *muisc* (music), *wram* (warm), *dissuc*, *dissus*, *disus*, *duss*, *dussis* (discuss), *assme* (assume), *beath* (breath), *reduce* (reduce), *beath*, *beath* (breath), *contume* (continue), *posead* (proceed), *exen* (extend), *ramar*, *remar* (remark), *emyoy* (employ) |

B. These responses will get Partial Credit (1):

| **Constrained error:** Every sound is represented and spelling is logical when considering the rules of English. | *publik* (public), *empti* (empty), *reduce* (reduce), *wied* (wide), *dence*, *dens* (dense) |
| **Unconstrained error:** Every sound is represented, but word does not reflect the rules of English spelling. This category may include deletion or addition of silent sounds or doubling of consonants. | *clen* (clean), *assum* (assume), *dens*, *denss* (dense), *continu* (continue), *combin* (combine), *wid*, *widh* (wide), *prcede* (proceed), *divid*, *divaid*, *divde* (divide), *elake* (elect) |
| The base is clear but characterized by 1-2 orthographical errors that may be a **developmental effect:** Sounds are replaced with other similar sounds (e.g., *d* for *th* or *t*, *c* for *th*, *c* or *s* for *z* or vice versa, *b* for *d* or vice versa, *m* for *n* or vice versa,) Also, silent *e* is omitted or added unnecessarily. | *inpy* (empty), *inploy*, *enploy* (employ), *music musik* (music), *brecht*, *breart*, *bred* (breath), *recognize or recognise* (recognize), *recognis* (recognize), *publice* (public), *rum* (run), *proceat* (proceed) |
| A correct extraction of the derived word using the same part of speech as the base | *runner*. My dog likes to *ron* (run). *discusst*, *discast* (discuss), *elects* (elect) |
| The base is clear, the word or pseudoword is the same part of speech as the base and demonstrates understanding of derivational patterns in English. Or the child spells the word as it is used in speech/pronounced by native English speakers. | countinyou (continue)  
dnger, dainger, dangeor, denger (danger)  
emti, emty (empty)  
feer ( fear)  
precede, proseed (proceed)  
assumsed (assume)  
reduuce (reduce) |
|---|---|
| Bilingual/PR/MX children’s errors:  
Not every sound is represented, but the missing sound is logical considering the rules of Spanish (i.e., In Spanish, there are no consonant clusters at the end of the syllable). | interrup (interrupt), assis, asis (assist), elec, eleck, elek (elect), brith (breath), sese (sense), cotiue (continue) |
| Potential Spanish Influence: spelling that reflects use of Spanish phoneme/grapheme correspondence. | proced (proceed), fier (fear), miusic, musik (music), proced, procede (proceed), combain, combayn, kombatn (combine), elake (elect), dibayd (divide), dins (dense) |
| Sounds that don’t exist in Spanish are replaced by similar sounds or Spanish equivalent | bat (bath), breat (breath), recognise (recognize), ran (run), discas (discuss), |
| Regional or dialectical influence in Spanish (PR) or English (African-American), e.g., consonant deletion at the end of a syllable | muci, miuci (music), continiu, cotiue (continue), sese (sense), dese (dense) |

C. These responses will get Full Credit (2):

<table>
<thead>
<tr>
<th>Exact base word.</th>
<th>public, sense, breath, music, run, fear, wide, continue, bath, proceed, danger, clean, empty, assume, warm, recognize, reduce, extend, remark, discuss, assist, high, fog, combine, divide, employ, dense, elect</th>
</tr>
</thead>
</table>
| A word that is a correct extraction of the base word and syntactically and semantically fits the sentence, e.g., past tense or other inflection of the base word. | assumption. I assumed (assume) you did your homework.  
warmth. The room is not warmer (warm).  
remarkable. Did you hear his remarks? (remark) |