Influence of Morphological Awareness on College Students' Literacy Skills: A Path Analytic Approach

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INFLUENCE OF MORPHOLOGICAL AWARENESS ON COLLEGE
STUDENTS’ LITERACY SKILLS: A PATH ANALYTIC APPROACH

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I dedicate this manuscript to my husband, Dale, whose selflessness allowed me to successfully complete this goal.
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ABSTRACT

Purpose: This study was conducted to: 1) determine the factor structure of different morphological awareness tasks of college students with no known language, hearing, vision or academic difficulties, and 2) create and examine the direct and indirect effects of a reliable and validated morphological awareness factor structure on spelling, word-level reading, and sentence comprehension abilities in this college population. Method: Three morphological awareness tasks, spelling to dictation, word reading, and sentence comprehension tasks were administered to 214 undergraduate college students. Factor analyses were conducted to determine the factor structure of the morphological awareness tasks. A validated exogenous morphological awareness measure was generated and path analysis was run to examine direct and indirect effects of morphological awareness on college students’ literacy abilities. Results: Exploratory factor analyses revealed that the morphological awareness factor structure was unidimensional. Analyses using Item Response Theory generated a 24-item, validated, exogenous measure. Path analysis revealed that the standardized path coefficients in the direct model were .77 for spelling, .62 for word reading, and .58 for sentence comprehension. Path analysis for the indirect model indicated that the standardized indirect effect of morphological awareness on sentence comprehension was .38 through spelling and .13 through word reading. Conclusion: College students’ morphological awareness can be assessed using a validated measure that reflects a unidimensional factor structure. Morphological awareness is a stronger predictor for spelling than for word reading and sentence comprehension. Both spelling and word reading mediated the effects of morphological awareness on sentence comprehension. However, spelling was a stronger mediator than word reading; this may have been due to differences in the task demands of spelling and word reading.
CHAPTER ONE

INTRODUCTION

Morphemes are the smallest meaningful parts of language and words. Complex words are created by combining morphemes in different ways. When affixes (e.g., s, ible) are combined with base words (e.g., dog) or roots (e.g., cred), multi-morpheme inflected words (e.g., dogs) and derived words (e.g. credible) are created. The conscious ability to think about and manipulate morphemes in words is called morphological awareness (Carlisle, 1995; McBride-Chang, Wagner, Muse, Chow, & Shu, 2005). One aspect of morphological awareness is the ability to recognize relations between base words and derived words (e.g., fun-funniest; Tyler & Nagy, 1989).

Much information is known about how morphological awareness contributes to early literacy development and skills. Many researchers have investigated the reading and spelling skills of children in elementary school and how morphological awareness relates to, or predicts, these literacy skills (e.g., Apel & Thomas-Tate, 2009; Carlisle, 1995, 2000; Green et al., 2003; Katz, 2004; Kemp, 2006; Mahony, Singson & Mann, 2000; Nunes, Bryant & Bindman, 2006; Singson, Mahony & Mann, 2000; Wolter, Wood, & D’zatko, 2009). Specifically, in these young students, morphological awareness moderately to strongly correlates with reading comprehension (e.g., Jarmulowicz, Haye, Taran, & Ethington, 2008). Further, it predicts 4% to 15% of the variance in word level reading abilities and approximately 7% of the variance in spelling abilities of elementary students after controlling for phonemic awareness (e.g., McCutchen, Green, & Abbott, 2008; Singson et al., 2000; Wolter et al., 2009).

Some information about the nature of the relations between morphological awareness and literacy is available for students in middle and high school, but to a lesser extent (Carlisle & Stone, 2005; Nagy, Berninger, & Abbot, 2006). In these older students, morphological awareness correlates strongly with reading comprehension, spelling and vocabulary, with associations ranging from .59 to .85 (Nagy et al.). In particular, morphological awareness moderately to strongly predicts both reading comprehension and spelling abilities in adolescents above and beyond measures of phonological memory and phonological decoding (Nagy et al.).

The relations between morphological awareness and spelling and reading comprehension is likely due, in part, to the nature of the English orthographic system. Because the orthographic
system is morphophonemic (Templeton & Scarborough-Franks, 1985), spellers and readers may
tap into knowledge of morphemes to help spell and read more complex words that are typically
multi-morphemic in nature. For sentence comprehension during reading, the ability to
consciously think about morphemes in words may facilitate readers’ abilities to understand the
meaning of morphologically complex words. Over half of the words in English are
morphologically-complex (Anglin, 1993; Nagy & Anderson, 1984) and morphologically
complex words occur more frequently in written language than in spoken language (Chafe &
Danielewicz, 1987).

Although there is a growing body of literature relating morphological awareness to
literacy skills in children from elementary school through adolescence, there is scarce
information on the morphological awareness skills of college students and whether this skill
contributes to their reading and spelling abilities (e.g., Mahony, 1994). Information on college
students’ morphological awareness skills and its relation to their literacy skills is important for at
least two reasons. As with younger students, adequate morphological awareness abilities likely
lead to increased accuracy in spelling and reading complex, multi-morphemic words and better
comprehension of written material; however, this remains to be determined. Additionally,
although college is a time when reading and writing are crucial for academic success, there is
little to no mandatory instructional support provided to those who struggle with reading and
writing (National Center for Educational Statistics, 2004; Perin, 2002; Roueche, 1999). Because
of this, basic information is needed on underlying skills that contribute to the literacy abilities of
this population. With this information, educators and clinicians can begin to determine possible
approaches to remediating literacy deficits in college students. Thus, the purpose of this study
was twofold: 1) to examine the factor structure of morphological awareness tasks presented to
college students with no known language, hearing, vision or academic difficulties; and 2) to
create a validated latent morphological awareness measure and determine whether this measure
predicted spelling, word level reading or sentence comprehension in the college population.

**Factor Structure of Morphological Awareness**

A variety of tasks have been administered at different developmental levels to measure
morphological awareness. These tasks include word and sentence analogy tasks (e.g., *Tom sees
Mary. Yesterday, Tom ___ Mary; Kemp, 2006; Nunes et al., 2006*), sentence cloze tasks (e.g.,
farm; *My uncle is a ___; Apel & Thomas-Tate, 2009; Berko, 1958; Carlsisle, 1988, 1995, 2000;*
Nagy et al., 2006; Wolter et al., 2009), relatedness tasks (e.g., Does moth come from mother?; Kemp, 2006; Nagy et al., 2006), and definitional tasks (e.g., Tell me what the word “beastly” means; Anglin, 1993; Larsen & Nippold, 2007; Nippold & Sun, 2008). Despite the diversity of tasks that have been used, few investigators have examined whether these tasks are tapping into a unitary construct of morphological awareness or multiple dimensions.

Some information is known about the factor structure of morphological awareness in elementary and middle school students. Muse (2006) investigated different dimensions of morphological awareness in elementary-age children by administering five morphological awareness tasks to 99 fourth grade students. S/he then conducted Confirmatory Factor Analyses (CFA) to examine a two-factor structure of morphological awareness. The first two tasks measured awareness of the relations of base and derived forms; these were labeled the structural aspect of morphological awareness. In the first task, students were given a derived word (e.g., driver) and an incomplete sentence (e.g., Children are too young to ____). Students changed the given derived word to a base word (e.g., drive) to complete the sentence. The second task was similar to the first task except that students were given a base word and were asked to change the base word to a derived word to finish the sentence.

The remaining three tasks measured a second potential dimension of morphological awareness that included identification, relatedness and construction. The third task, the relatedness task, required the participants to listen to pairs of words (e.g., moth and mother) and decide whether the word pairs were related. For the fourth task, the identification task, students were presented with two pictures of a homonym (e.g., blue and blew); after listening to a phrase containing the homonym (e.g., blue in blueberries), they pointed to the picture representing the correct meaning. For the fifth task, the construction task, children were presented with stories and created novel words for objects or concepts presented in each story (e.g., moonrise).

CFA was conducted and fit indices for the hypothesized two-factor model were compared to those for a unidimensional model. Both models yielded fit indices that suggested good models, and the two models were not significantly different. The unidimensional model was preferred due to its simplicity, suggesting that commonly used morphological awareness tasks in fourth grade students tap into a unitary construct of morphological awareness. However, the sample size of this investigation was limited to 99 participants which may not have been adequate for the type of analyses conducted. The recommended sample size for factor analyses varies according
to the degrees of freedom, but to achieve a power analysis of .80 with 40 degrees of freedom, a minimum sample size of 252 is recommended (MacCallum, Browne, & Sugawara, 1996).

Other investigators have suggested that morphological awareness may be a multidimensional construct. Morphological awareness was first discussed in multidimensional terms by Tyler and Nagy (1989). Specifically, Tyler and Nagy suggested that there may be three aspects to derivational morphological awareness. The investigators administered three different, written tasks to examine knowledge of the acquisition of three underlying aspects of morphological awareness to 100 fourth, sixth and eighth grade students. The authors hypothesized that recognition of the internal structure of multimorpheme words into bases and affixes may be the earliest developing aspect (i.e., relational knowledge). To assess relational knowledge, participants were presented with 24 sentences containing italicized, multimorpheme words (e.g., “I’m in a celebratory mood,” Mary announced.) and were asked to select from a field of five multiple choice possibilities the correct definitions of the italicized, multimorpheme words (e.g., Mary felt like (a) having a party, (b) being alone, (c) going to sleep, (d) having a fight, and (e) don’t know).

The investigators suggested that a possible second component of morphological awareness may be the syntactic restrictions on various morphemes (i.e., syntactic knowledge). For example, multimorpheme words ending with the suffix “ness” (e.g., loudness) indicate that the grammatical part of speech of this particular category of multimorpheme words is likely to be a noun. To measure syntactic knowledge, the participants were presented with 32 cloze sentences (e.g., I wish Dr. Who would just ___ and get it over with.) and four possible words to fit the sentence which differed only according to the suffix (e.g., transumption, transumpative, transumpate, and transumpatic); participants chose the word that best fit the sentence. Sixteen of the targets contained real words and sixteen contained nonsense words.

A third aspect of morphological awareness may be awareness of the constraints imposed on combinations of morphemes (i.e., distributional knowledge; e.g., the suffix “ness” can be attached only to adjectives such as “happy”). Distributional knowledge was measured using a 171 item task; participants were presented with a list of words and nonsense words and indicated by circling either a “yes” or “no” whether they knew the meaning of the target item.

The results for each of these tasks by grade level suggested these three different types of knowledge are acquired at different ages; relational knowledge appears earliest in development
and may be in place by fourth grade. Syntactic knowledge develops more slowly across the grades, and distributional knowledge is the last and most complex aspect of morphological awareness to be acquired. Although Tyler and Nagy’s results suggested the existence of three underlying aspects to morphological awareness, the overall purpose of their investigation was to discover at which grade levels the different morphological awareness aspects developed. Thus, sophisticated analyses using structural equation modeling (SEM) were not conducted to determine whether a multidimensional factor structure existed in upper elementary and middle school students.

Findings from other studies with school-age children using regression analyses suggest that morphological awareness is a multidimensional construct (e.g., Carlisle, 2000; Katz, 2004; McBride-Chang, et al., 2005; Jarmulowicz, et al., 2008). For example, Carlisle (2000) administered three morphological awareness tasks to third- and fifth-grade children and found that the individual tasks predicted unique variance in reading. Additionally, a combination of the three tasks predicted reading comprehension more strongly than each of the individual tasks. Taken together, these findings suggest that each morphological awareness task may be tapping into a different aspect of morphological awareness. However, the dimensionality of morphological awareness was not directly examined with Structural Equation Modeling (SEM). Factor analyses using SEM are necessary to determine the underlying nature of the morphological awareness construct (Kline, 2005).

There is no agreement in the literature whether morphological awareness represents a unidimensional or a multidimensional construct (Katz, 2004; Tyler & Nagy, 1989). Multiple and diverse tasks have been administered across development to measure morphological awareness. Further, no studies have examined the underlying nature of morphological awareness in college students. Knowledge of the dimensionality of morphological awareness is necessary to understand the best tasks and items to use in the assessment of morphological awareness (Petscher & Schatschneider, 2010). Thus, the first research aim of this investigation was to determine the factor structure underlying morphological awareness in college students.

Morphological Awareness Abilities of College Students

Very few studies have examined the morphological awareness skills of college students (Deacon, Parrila & Kirby, 2006; Gaustad & Kelly, 2006; Kaye, Sternberg, & Fonseca, 1987; Kelly & Gaustad, 2007; Leikin & Hagit, 2006; Mahony, 1994; Schiff & Raveh, 2006). Of these
investigations, only two have measured morphological awareness abilities of college students with typical language skills and examined the relation or predictive ability of morphological awareness to reading abilities (Mahony; Leikin & Hagit). Other studies have examined the morphological awareness abilities of students who were deaf (Gaustad & Kelly; Kelly & Gaustad) or more implicit knowledge of morphology which is not the focus of this investigation (Deacon et al.; Kaye et al.; Schiff & Raveh).

Mahony (1994) examined the relation between morphological awareness and reading comprehension in 26 English-speaking, undergraduate college students who were native speakers of English. The measure of reading comprehension was the verbal Scholastic Aptitude Test (SAT) which Mahony claimed was an indirect measure of reading comprehension. Morphological awareness was measured using four tasks, three of which were administered in writing. Two tasks represented measures of syntactic morphological awareness. The first task consisted of 27 written sentences representing a cloze task (e.g., The cost of ____ keeps going up.). Participants selected a target derived real word from an array of four multiple choice answers, all of which were derivations of the same stem (e.g., electric, electrify, electricity, electrical). The second task was nearly identical. However, the choices for the cloze task consisted of nonsense words made up of nonsense stems and real suffixes (e.g., The meeting was highly _____ and invigorating; loquarial, loquarify, loquarialize, loquarianism). These first two tasks appeared to require the participants to consider the syntactic aspects of the words to complete the sentences.

The third task, a measure of relational morphological awareness, consisted of 42 pairs of written words, 25 of which were related morphologically (e.g., happy-happiness) and 17 of which were not related (e.g., sin-syntax). Participants determined whether the word pairs were semantically related. The fourth task required reading aloud three sets of seven sentences. Within each set, each sentence contained a nonsense verb stem containing a silent letter (e.g., pemb). Across those sentences, the nonsense verb stem was presented in one of seven forms: the infinitive (i.e., pemb), three inflectional forms (i.e., pemb, pembed, pembing) and three derivational forms (i.e., pember, pembive, pembation). Correct responses required participants to recognize and pronounce the silent letter in the derived words and to maintain the silent letter when producing the inflected words. Mahony’s results suggested that the second and fourth tasks were significantly correlated with students’ SAT scores (r’s = .34 and .37, respectively).
Leikin and Hagit (2006) examined whether morphological awareness predicted word reading in 42 male, Hebrew-speaking, college students, half of whom were diagnosed with dyslexia. To measure morphological awareness, the investigators administered a set of three morphological awareness tasks. First, the morphological production task required participants to verbally generate in 30 seconds as many words as possible within the same word family or within the same affix family as a given target word. For example, in English, responses for the word family task when given the word ‘comfort’ might include the morphologically-complex words ‘comforting, comfortable, discomfort and uncomfortable.’ Examples of responses in English for the affix family task when given the affix ‘ion’ might include the words ‘recognition, decomposition, and falsification.’ In the second verbal task, participants decided whether pairs of words were morphologically-related (e.g., clumsy-rainy). The third task was presented both verbally and in print. In this task, participants were given a sentence containing a nonword (i.e., a nonsense root word with a real affix) and were asked to change the nonword into a verb to fit the sentence. Leikin and Hagit created a composite score based on the three tasks. They measured word reading using a word recognition task. The composite for the three morphological awareness tasks predicted 8% of variance in word reading in both groups of students after controlling for phonological awareness. Further, the students with dyslexia scored significantly lower on all three tasks than the students with typical skills on all three tasks.

The above two studies had several limitations. Mahony’s (1994) outcome measure of verbal SAT scores was an indirect measure of reading comprehension. The sample size was small and statistical analyses did not include regressions. A stronger model would include a more direct measure of reading comprehension and a larger sample size. The use of multiple regression would allow for exploration of the predictive ability of a set of morphological awareness tasks.

Although Leikin and Hagit (2006) used regression, their investigation also had several limitations. First, their sample did not include females and, thus, was not representative of all college students. Second, the timed verbal morphological production task may have been more a measure of vocabulary and/or working memory rather than explicit morphological awareness as it did not tap into awareness of the relations between base words and affixes. Third, there are differences in morphology between Hebrew and English languages (Leikin & Hagit). In contrast to English, Hebrew morphology is non-concatenative; thus, unlike English, affixes and roots
may not be combined sequentially. Morphological awareness studies in Hebrew may not generalize well to English-speaking, college students. Fourth, neither investigation examined the relation between morphological awareness and spelling or sentence comprehension in college students. Like reading comprehension, spelling and sentence comprehension are important for success in academia and in real life (e.g., Apel & Masterson, 2001; Kintsch & Rawson, 2007; Mehta, Foorman, Branam-Martin, & Taylor, 2005; Scott, 2009).

One final limitation involves the reliability and validity of the tasks used to measure morphological awareness. Neither Mahony (1994) nor Leikin and Hagit (2006) reported measures of reliability for their morphological awareness tasks. Without an indication of reliability, it is unclear whether the reported findings would be obtained again (Kline, 2005). Thus, it is critical to develop a reliable and valid measure of morphological awareness for college students that can be used to determine the relations between morphological awareness and literacy abilities. Item Response Theory (IRT) is a framework for measurement that has been shown to produce reliable and valid measures and that provides useful information about the tasks and items that comprise the measure (Petscher & Schatschneider, 2010; Schatschneider, Francis, Foorman, Fletcher, & Mehta, 1999).

Current Study

Despite accumulating evidence of the strong association between morphological awareness and literacy skills in elementary, middle and high school students and the use of morphological awareness to predict these literacy skills, only two studies have investigated morphological awareness abilities of college students. Literacy in college is critical for academic success (e.g., Burrell, Tao, Simpson, & Mendez-Berrueta, 1997; Caverly, Nicholson, & Radcliffe, 2004; Simpson & Nist, 2000; Sparks & Lovett, 2009). Given the high demands for adequate literacy ability at the college level, it is important to investigate factors that contribute to literacy skills. Morphological awareness ability may be one underlying linguistic skill that predicts college students’ literacy skills. However, it is not known whether morphological awareness in this population is a unidimensional linguistic construct or whether it contains multiple dimensions. Knowledge of the underlying nature of morphological awareness is necessary to develop a reliable and valid morphological awareness measure (Petscher & Schatschneider, 2010). No investigations of morphological awareness in college students, to date, have established a reliable and valid measure of morphological awareness. Thus, the
The purpose of the study was twofold: 1) to determine whether morphological awareness in college students is a unidimensional or multidimensional construct, and 2) to create and explore the ability of a reliable and validated factor structure of morphological awareness to predict word and sentence level literacy skills.

Given that a variety of morphological awareness tasks have been found to predict the reading and spelling abilities of students from early elementary through college, three morphological awareness tasks were administered to determine the factor structure of morphological awareness in college students. These three tasks were chosen because they have been shown to relate to or predict literacy skills in other investigations with college and/or younger students. Consistent with the theoretical construct that morphological awareness is multidimensional, we hypothesized that different domains of morphological awareness would represent two factors: a factor measuring relational morphological awareness and a factor measuring syntactic morphological awareness. This prediction was based on Tyler and Nagy’s (1989) conceptualization of morphological awareness as multidimensional, as well as other studies of school-age students with findings that different morphological awareness tasks predicted unique variance in literacy abilities (e.g., Carlisle, 2000; McBride-Chang et al., 2005; Jarmulowicz et al., 2008). We further hypothesized that a reliable and valid morphological awareness measure would significantly predict college students’ word level reading and spelling abilities and sentence comprehension abilities.

**Theoretical underpinnings for influence of morphological awareness on literacy abilities.** According to Perfetti’s (2007) Lexical Quality Hypothesis, representations of words are stored in a mental lexicon. These stored representations of words develop over time and include specific information about a word’s meaning, pronunciation, and spelling. For example, a lexical representation of the word ‘moon’ might include awareness that it contains three sounds (i.e., phonological awareness), that each sound is represented by a specific grapheme or combination of graphemes (i.e., orthographic awareness), and that the word contains one morpheme that refers to a celestial body in the sky (i.e., morphological awareness and meaning). With multiple exposures to the information provided by these underlying linguistic processes, the printed word ‘moon’ becomes consolidated in the mental lexicon into one solid lexical representation.

College students are exposed to a large number of written words in print across their school years and into college (Nagy & Anderson, 1984). Perfetti’s (2007) Lexical Quality
Hypothesis suggests that college students with strong underlying linguistic awareness of phonology, orthography and meaning (morphology or semantics) may have higher quality lexical representations due to strong and accurate integration of these underlying linguistic processes. Higher quality lexical representations may be more accurately and efficiently retrieved from the mental lexicon, together with the detailed information that is stored regarding each representation’s phonology, orthography and meaning, thus facilitating reading and spelling words. Similar to Share’s self-teaching hypothesis (1995, 1997), exposure in print to complex, unfamiliar words that are related in morphology to known written words may provide an opportunity to strengthen the underlying linguistic morphological knowledge; in turn, this process may strengthen the quality of the lexical representations for both new and familiar words.

Perfetti (2007, 2010) further suggests that accurate word recognition in text is critical to understanding a word’s meaning, and that understanding the meaning of a word is critical to sentence and text comprehension (Perfetti, Landi & Oakhill, 2005). The process of obtaining meaning in sentences and text is complex and involves (1) identifying words and their meanings, (2) using syntax to form their meanings into propositions, and (3) integrating the meaning of the text with prior knowledge to produce overall knowledge of the sentence (Kintsch, 1988; Perfetti, 1985). Morphological awareness likely facilitates understanding of the meanings of an individual written word and signals the grammatical category to which the word belongs (e.g., the suffix ‘ion’ signals that the morphologically complex word to which it is attached is a noun).

**Proposed causal model.** The proposed causal model contains one exogenous variable (morphological awareness) and three endogenous variables (spelling, word reading, and sentence comprehension). To investigate the degree of influence of morphological awareness on the endogenous variables, a path analysis was conducted within a causal framework. Prior to the investigation, the relative strength of the influence of morphological awareness on the endogenous variables was not known, nor was it known whether the relations between morphological awareness and sentence comprehension would be mediated by spelling or word reading. The path analysis was conducted to determine the independent contribution made by each variable.
CHAPTER TWO

METHOD

Participants

Two hundred and fourteen undergraduate college students enrolled at a research-intensive university in the southeastern U.S. participated. Participants were part of a larger study investigating the literacy and literacy-related skills of college students. Participants were recruited two ways. First, flyers were placed on university bulletin boards across campus. Second, requests via email were sent to teachers of undergraduate courses to schedule an in-class recruitment opportunity for the primary investigator. After receiving teacher authorization, the primary investigator recruited across a 4-week period in person in 17 classrooms that encompassed introductory level (e.g., Introduction to Communication) to senior level (e.g., Methods in Social Research) courses in eight departments (see Table 1 for a listing of departments, courses and number of participants recruited per course). One hundred and twenty-seven of the participants were recruited by the researcher directly from courses. The remaining 87 participants responded to advertisements placed on university sponsored bulletin boards or were referred by peers who had either participated in or had heard by word of mouth about the study.

Two hundred and eighty two participants were screened via email or telephone (see Appendix A for screening form). Participants were excluded if they reported one or more of four exclusionary criteria: 1) uncorrected problems with hearing or vision; 2) current or previous enrollment in speech, language or learning services (with the exception of enrollment in articulation services in elementary school); 3) a primary language other than English; or 4) current or previous receipt of academic accommodations from the university center for students with disabilities. Upon completion of the testing session, participants received their choice of a $25 gift card to a local restaurant or coffee house.

The participant group was composed of 143 females (67%) and 71 males (33%) with a mean age of 21 years and a range of age from 18 to 35 years. Class standing included 33 freshman (15%), 49 sophomores (23%), 68 juniors (32%), and 64 seniors (30%). The self-reported racial and ethnic mix of the sample was 58% Caucasian, 8% Spanish American, 23% African American, 2% Asian American, 7% mixed, and 2% other. Grade point averages and
majors were self-reported. Grade point averages ranged from 1.3 to 4.0 with a mean of 3.11. Forty-seven majors were reported (see Appendix B for the distribution of majors).

Procedure

Each participant was tested in one, 90-minute testing session that consisted of a group session lasting 80 minutes and an individual session lasting no more than 10 minutes. All group testing was conducted by the primary investigator in an assigned classroom on campus. Immediately following group testing, participants were tested individually in neighboring classrooms or quiet hallways by the primary investigator or one of two trained graduate students in Communication Science and Disorders. Testing occurred over a three week time frame during summer semester.

Testing sessions were scheduled to accommodate availability of the undergraduate students. Students who indicated an interest were sent the testing schedule via email and were asked to respond by indicating their top three testing sessions. The primary investigator assigned participants to their first session choice up to a maximum of 12 participants per session; when a session reached the maximum number, participants were assigned their second or third choice. Testing groups ranged in size from three participants to twelve participants. Responses to individual testing were recorded on digital recorders to calculate task scoring reliability. Prior to testing, each participant signed and submitted a consent form approved by the sponsoring university (see Appendix C).

Measures

Participants first completed a questionnaire regarding demographic information (see Appendix D). A battery of tasks was administered to measure participants’ morphological awareness, spelling, word reading, and sentence comprehension abilities. The tasks were presented in the order set forth below so that responses on tasks administered at the end of the test battery did not influence responses on tasks that were presented earlier. All tasks were administered in a group format except for the word reading task which was administered individually.

Spelling. The Test of Written Spelling-Fourth Edition (TWS-4; Larsen, Hammill, & Moats 1999), Form A, was administered to measure the ability to spell words to dictation. The TWS-4 was standardized on students from 1st grade through 12th grade; thus, raw scores were used in all analyses. Testing was administered in accordance with the testing guidelines
contained in the examiner’s manual. Participants wrote 50 words after verbal presentation of each word in isolation, followed by its use within a sentence, and a second repetition of the word. Responses were scored as correct or incorrect. The administrative manual reports Cronbach’s coefficient alphas of .94 overall and .96 for 18-year-olds. Concurrent validity with other standardized spelling tasks was reported to be .88. Cronbach’s alpha coefficient for this sample was calculated and judged to be adequate at .90 (Nunnally, 1978).

**Morphological awareness.** Morphological awareness ability was assessed using three tasks that have been found to relate to, or predict, college or adolescent students’ reading or spelling abilities (Mahony, 1994; Leikin & Hagit, 2006). They included a Relatedness Task, a Nonword Sentence Completion Task, and a Real Word Sentence Cloze task. Items for these tasks were either adapted from previously used tasks or created by the researcher. The items also were chosen based on the level of phonological and orthographic transparency and the frequency of appearance in text.

Previous research provides evidence that literacy skills may be influenced by two aspects of morphologically complex words. First, literacy skills may be influenced by phonological or orthographic shifts from base word to derived word (Carlisle & Stone, 2005). Morphologically-complex words that contain shifts in both phonology and orthography are more challenging to read; words that contain no shifts between base and derived words are easier to read (Carlisle & Stone). For example, when the base word mature shifts to the derived word maturation, both the phonology and the orthography of the base word change (i.e., a two-shift item) and the morphologically-complex word is considered to be more challenging for a reader. In contrast, when the base word suit shifts to the derived word suitable, there are no changes in phonology or orthography between the base and derived word (i.e., a no-shift item) and the derived word is considered to be easier for a reader. Other morphologically-complex words contain only one change from base to derived word, either a shift in phonology (e.g., sign-signature) or a shift in orthography (e.g., pity-piteous; i.e., one-shift items). These one-shift items are considered to be more challenging than the no-shift items and less challenging than the two-shift items (Carlisle & Stone). To ensure a range of item difficulty on the morphological awareness tasks, the two morphological awareness tasks that targeted real words (i.e., Relatedness Task and Derivational Suffix Task) were constructed to include an equal number of no-shift, one-shift and two-shift items.
Second, there is evidence that literacy abilities also may be influenced by measures of frequency of appearance of words in text. Frequency of appearance of words in text serves as a proxy for a reader’s familiarity with words. Many investigators report frequency using a standard frequency index (SFI; i.e., a measure of how often a word appears in a specific corpus). Words with an SFI of 60 or more occur more frequently (i.e., 100 times per one million words; Kucera & Francis, 1967) than words with an SFI of 40 or less (i.e., one time per one million words; Kucera & Francis). Several investigators have provided evidence that the ability to read morphologically-complex words is influenced by the average frequency with which a base word appears in morphologically-complex words (i.e., average family frequency; AFF; Carlisle & Katz, 2006; Ford, Davis, & Marlsen-Wilson, 2010). For example, the base word operate appears in 20 morphologically-complex words (i.e., family size) that range in frequency from 13.2 SFI (inoperable) to 56.9 SFI (operation), with an AFF of 38.55 SFI; AFF was calculated by summing the SFI for each word in the family of the base word and dividing by the size of the family. Derived words with higher AFF (i.e., 50 SFI or greater) were read with higher speed and accuracy than derived words from families with smaller AFF (i.e., 42.7 SFI). To minimize the potential effects of frequency of appearance of the target items and to include target items with an appropriate difficulty level for college students, items for two of the morphological awareness tasks (i.e., Relatedness Task and Derivational Suffix Task) were selected that had an AFF of between 30 and 40 SFI. SFI data were obtained from The Educator’s Word Frequency Guide, a word frequency data base of more than 17,000,000 words taken from a range of reading materials designed for school-age children through adulthood (Zeno, Ivens, Millard, & Duvvuri, 1995).

**Relatedness task.** The first morphological awareness task, the relatedness task, was adapted from Mahony et al. (2000) and Mahony (1994). Specifically, eight of the target items were taken from Mahony (1994); the remaining 28 of the target items were created by the primary researcher. The participants were presented with 36 word pairs (e.g., spatial-space) in writing at the same time that the examiner read the word pairs aloud, and were asked to determine whether the second, smaller word was related semantically to the first, longer word (see Appendix E).
One half of the word pairs were semantically related (true relations) and one half of the items were not related semantically (false relations). Six of the items with true relations (e.g., creature-create) and six of the items with false relations (e.g., infinitesimal-infant) were two-shift items. Six of the items with true relations (e.g., murderous-murder) and six of the items with false relations (e.g., entanglement-angle) were no-shift items. Six each of the items with true and false relations were one-shift items. Three of the true relations (e.g., piteous-pity) and three of the false relations (e.g., whaler-wail) shifted in orthography only; three of the true relations (e.g., health-heal) and three of the false relations (e.g., numbers-numb) shifted in phonology only.

For the word pairs with true relations, the AFF ranged from 29.95 to 41.5. For the word pairs with false relations, the AFF ranged from 30.39 to 44.12. Word pairs with true relations came from the same word family and, thus, had the same AFF. In an attempt to equate the AFF of the items with true relations and the items with false relations (e.g., pearly-pea), false word pairs were selected only if the difference in average family frequency SFI between the paired words was less than four SFI. For example, the AFF for entanglement was calculated to be 34.25 and the AFF for angle, its falsely related item, was 35.25. Thus the difference in AFF was 1 SFI. An independent samples t-test revealed that there was no significant difference in the AFF for words with true relations \( (M = 35.84, SD = 3.36) \) and word pairs with false relations \( (M = 35.95, SD = 3.36; t(70) = .127, p = .84) \); see Table 2 for a list of target items according to relation type (i.e., true or false relation), shift type, and average family frequency SFI.

Directions and four examples were presented both verbally and in print. The participants responded by circling either ‘yes’ or ‘no.’ Items were scored as correct or incorrect. The items on this task measured relational morphological awareness.

**Derivational suffix task.** The derivational suffix task (DST) was based on tasks created by Carlisle (1988, 2000). Eleven of the thirty-six items were adapted from Mahony’s (1994) real word, multiple choice, sentence completion task. The remaining 25 items were created by the primary researcher. In this 36 item task, participants read a base word (e.g., act) and an incomplete sentence (e.g., The secret police arrested the ___ before he could give his speech.) and were asked to complete the sentence using a form of the word provided (see Appendix F). AFF ranged from 31.65 to 40.1 SFI. Base word frequency for the items ranged from 34.5 to 63.9 SFI; derived word frequency ranged from 22.1 to 53.6 SFI. The task included 12 two-shift items, 12 one-shift items, and 12 no-shift items.
Finally, every effort was made to include target items for a variety of grammatical categories. The two-shift items contained six nouns and six adjectives. The no-shift items contained three nouns, four verbs and five adjectives. The single-shift items contained four adjectives and eight nouns (see Table 3 for a list of target items, shift type, SFI for base word, SFI for derived word, SFI for AFF, and grammatical category). Directions and four examples were presented both verbally and in writing. Correct responses were correctly spelled words. The items on this task measured syntactic morphological awareness.

**Nonword sentence completion task.** The nonword sentence completion task (NWSC) was based on Mahony (1994); all items were taken from Mahony’s nonsense word task (see Appendix G). Participants read 27 incomplete written sentences (e.g., They presented the highly ____ evidence first). Participants chose the best option to complete the sentence from an array of four possible non-word choices that varied according to the suffix (e.g., credenthive, credenthification, credenthicism, credenthify). All non-words were composed of a nonsense root or base word combined with a real suffix. Nine of the targets were nonsense noun derivatives, nine were nonsense adjective derivatives, and nine were nonsense verb derivatives. Directions and one example were presented both verbally and in writing. Responses were scored as correct or incorrect. The items on this task measured syntactic morphological awareness.

**Sentence Comprehension.** The Test of Silent Reading Efficiency and Comprehension (TOSREC; Wagner, 2010) for college students served as a measure of sentence level reading comprehension. Participants read as many sentences as possible in a three-minute timed opportunity and indicated whether each sentence was logical by circling ‘yes’ or ‘no’ beside each sentence. Responses were scored as correct or incorrect in accordance with the administrative manual. Raw scores were calculated and used in the analyses. Pilot normative data for this test were obtained from a sample of 66 undergraduates at a southeastern university. Alternate form reliability was reported to be .79. Validity was measured by calculating the correlation between the TOSREC and the Woodcock Johnson Test of Reading Efficiency-Third Version and was reported to be .77.

**Word Reading.** Participants were tested individually and read aloud all 50 target words taken from the TWS-IV, Form A. Thus, participants read aloud the same 50 words that they spelled. Responses were recorded and scored as correct or incorrect. Responses were scored as incorrect if they varied from the pronunciation key contained in the TWS-IV administrative
manual or if participants did not attempt to read aloud the target items. Cronbach’s alpha coefficient was calculated and judged to be adequate at .71 (Nunnally, 1978).

**Reliability for Scoring**

Reliability for scoring across the six tasks was determined by interrater agreement. Results for 20% of the sample (43 participants) were rescored by a graduate student in the Department of Communication Science and Disorders who was trained in scoring procedures. Across the tasks, interrater agreement ranged from 99% to 99.99%.

**Statistical Analyses**

**Question 1: Factor structure of morphological awareness.** To answer the first research question, a CFA and an Exploratory Factor Analysis (EFA) were conducted. These analyses were conducted in Mplus version 6.0 (Muthen & Muthen, 2010) using a Weighted Least Squares Multivariate (WLSMV) estimator. The fit of the models was evaluated using the ratio between the chi-square statistic and its degrees of freedom (Carmines & McIver, 1981; Eisen, Wilcox, Leff, Schaefer, & Culhane, 1999), comparative fit index (CFI; Loehlin, 1998; McDonald & Marsh, 1990), and root mean square error of approximation (RMSEA; Steiger & Lind, 1980). The chi-square ratio was chosen rather than the chi-square value because the chi-square test is widely recognized to be sensitive to sample size (Joreskog, 1969); as the sample size increases, it becomes more difficult to retain the null hypothesis. A chi-square ratio of 2 or less represents acceptable fit, with smaller ratios representing a better fit of the data to the model (Carmines & McIver, 1981). CFI values closer to 1 indicate better fit, with values greater than .90 suggesting most reasonable fit (Bentler & Bonett, 1980). RMSEA values closer to 0 indicate better fit, with values less than .06 suggesting most reasonable fit (Hu & Bentler, 1999).

First, a CFA was conducted to test the fit of the hypothesized two-factor structure to the observed data. The two-factor model hypothesis was rejected based on poor model fit indices. Next, an EFA was conducted to discover the factor structure of the morphological awareness tasks. In addition to the model fit indices described above, factor loadings and individual item loadings were examined for the EFA.

**Question 2: Causal effects of morphological awareness on literacy abilities.** To answer the second research question, two phases of analyses were conducted. In the first phase, Item Response Theory (IRT) was used to modify and validate the morphological awareness measure and to ensure that the measure provided maximum information and discrimination using
a minimal number of items. Prior to conducting the IRT analyses, the assumptions underlying the use of IRT were examined.

There are two primary, underlying assumptions in IRT. They are 1) unidimensionality of the data (i.e., the items measure the intended dimension), and 2) local item independence (i.e., for a given ability level, responses to a set of items are statistically independent of each other) (Hattie, Krakowski, Rogers, & Swaminathan, 1996). Unidimensionality was established using EFA described above. Conceptually, local item independence is tied to unidimensionality. Both assumptions are considered to be met if, for a given level of ability, the average covariance over pairs of items on the measure is small in magnitude (i.e., essential unidimensionality; Petscher & Schatschneider, 2010; Stout, 1990). Average covariances over pairs of items were examined and were found to be small in magnitude. Thus, both assumptions underlying IRT were met.

Data were analyzed using the two-parameter logistic (2PL) model. The 2PL model measures the probability of providing a correct answer for an item, given an ability level, as a function of the difficulty level of the item and how well the item discriminates between different levels of the underlying trait. Difficulty parameters (i.e., b) and discrimination parameters (i.e., a) were the IRT measures used to assess item difficulty and item discriminatory ability. Item difficulty is the ability level at which the probability of providing a correct response is .50. Item difficulty parameters typically range from -3 (i.e., the easiest items) to 3 (i.e., the most difficult items), with a value of 0.0 being average (Petscher & Schatschneider, 2010). Item discrimination represents the ability of an item to discriminate between individuals on an ability continuum. Item discrimination parameters can range mathematically from infinity to infinity, but typically range from 0.0 to 2; lower values are indicative of a less discriminating item (Petscher & Schatschneider).

Model fit for each item was evaluated using the difficulty and discrimination measures, together with a review of the Item Characteristic Curve (ICC; i.e., a representation in graph form of the relation between ability and the probability of obtaining a correct response) for each item. Items with difficulty parameter estimates containing extremely negative and extremely positive values were removed. Items with either low discrimination parameter estimates or those with ICCs that were not S-shaped upon visual scan also were removed. Finally, a Test Information Function Curve (TIF; i.e., a representation in graph form of the amount of information that can
be obtained from the overall measure across the distribution of ability levels) was examined to determine how well the measure predicted across a range of proficiency (or ability) scores.

In the second phase of analyses, a path analysis was conducted using Mplus 6.0 (Muthen & Muthen, 2010) WLSMV to determine the direct and indirect causal relations between the latent, validated morphological awareness measure, spelling, word reading, and sentence comprehension. It was hypothesized that morphological awareness would predict spelling, word reading, and sentence comprehension. To evaluate the fit of the proposed causal model, chi-square, the CFI, and the RMSEA fit indices were examined. To determine whether individual paths were significant, the p value for each path was examined.
CHAPTER THREE

RESULTS

Two hundred and fourteen college students with no known language, hearing, vision or academic difficulties were administered six tasks to measure spelling, word reading, morphological awareness, and sentence comprehension abilities. Descriptive statistics for each of these measures are shown in Table 4.

Question 1: Factor Structure of Morphological Awareness Tasks

To test the hypothesis of a two-factor model for morphological awareness, a CFA was conducted. Model fit indices for the two-dimensional model yielded chi-square of 3941.321 ($df = 2701$, $p < .001$), chi-square ratio of 1.46, CFI of .74, and RMSEA of .024. Two of the three fit indices (i.e. RMSEA) suggested reasonable fit; the remaining index suggested that the two-factor model did not fit the data and that an alternative model would be more appropriate. Thus, we rejected the null hypothesis of a good fit for the two-factor model of morphological awareness. An EFA then was conducted to examine dimensionality of the three morphological awareness tasks.

Prior to running the EFA, the model was trimmed by removing items with 98% or greater accuracy, items with negative total correlations, and items with a standardized estimate of less than .2. The EFA extracted 68 Eigenvalues. Twenty-six of those Eigenvalues had a value greater than 1 (Kaiser method), thus statistically indicating 26 possible, meaningful, underlying factors (Brown, 2006; Hatcher, 1994). To further determine the appropriate number of factors to be extracted, the Eigenvalue scree plot was visually scanned and the ratios of dominance of the first Eigenvalue (14.73) to the second Eigenvalue (4.41), and of the second Eigenvalue to the third Eigenvalue (3.63), were calculated (Cattell, 1996; Petscher & Schatschneider, 2010). The ratios of dominance between the first and second Eigenvalues, and between the second and third Eigenvalues, were determined to be 3.34 and 1.22, respectively. Thus, the magnitude of change between the first and second Eigenvalues was 2.74 times greater than the magnitude of change between the second and third factors, providing a strong indication that the data fit a unidimensional model (Cattell).

To simplify and further clarify the factor structure, Geomin oblique rotations were conducted. Individual item loadings for one, two and three factor solutions were examined to
further evaluate whether the items best fit on one factor or multiple factors. Factor loadings indicated that many items fit on multiple possible factors in both multidimensional factor models, thus providing further evidence that different items may be measuring the same construct. The one factor solution was preferred because of the leveling off of Eigenvalues on the scree plot after one factor (Cattell, 1996) and the difficulty of theoretically interpreting factor loadings for the second and third factors.

The unidimensional model yielded a chi-square ratio of 1.11, a CFI of .80, and RMSEA of .02. The chi-square ratio of 1.11 (e.g., Eisen et al., 1999) and the RMSEA of .02 (Steiger & Lind, 1980) suggest reasonable fit, while the CFI value of .80 was lower than the accepted cut-off value of .90 (Bentler & Bonett, 1980; Hu & Bentler, 1995, 1999). Thus, two of the three fit indices suggested that the unidimensional model was a good fit.

**Question 2: Causal Effects of Morphological Awareness on Literacy Abilities**

**Phase 1: Validating morphological awareness measure.** Item Response Theory was used to obtain a reliable and valid morphological awareness measure. The initial 99 items were trimmed to 68 items in the factor analyses. The remaining 68 items ranged in difficulty from -27.938 to 50.580 and ranged in discrimination value from .036 to 1.555. Items were removed based on item difficulty and discrimination parameter estimates and upon a visual scan of each ICC. After item removal, the morphological awareness measure was reduced from 68 items to 24 items (see Appendix H). Difficulty and discrimination parameter estimates for the final 24 items are presented in Table 5. Additionally, a graphical depiction of the parameter estimates for the final 24 items (i.e., ICC) is contained in Figure 1. Difficulty estimates for the final 24 items ranged from -2.595 to 1.505, thus indicating that the measure included a range of items that were more and less difficult. Discrimination estimates ranged from .572 to 1.407, indicating that the measure contained items that discriminated among low and high performers.

The TIF Curve (i.e., the sum of the item information curves) was examined because it provided an overall visual depiction of the location along the ability continuum at which the morphological awareness measure was most precise (Reise & Waller, 2002). As seen in Figure 2, the peak of the TIF Curve occurs at 1 ½ standard deviations below the mean of the ability distribution; thus, the measure appears to be most accurate in estimating ability in the lower range and less accurate in the higher range of morphological awareness abilities.
Phase 2: Path analysis. To determine the direct and indirect effects of morphological awareness ability on spelling, word reading and sentence comprehension, a path analysis was conducted. The proposed model yielded a chi-square value of 358.08 ($df=323, p=.09$), CFI of .97, and RMSEA of .02; all three of the fit indices provided evidence of a good model fit. The resulting standardized path coefficients and standard errors are presented in Figure 3.

Direct effects. Morphological awareness significantly explained 59% of the variance in spelling ($B=.77, p<.001$), 38% of the variance in word reading ($B=.62, p<.001$), and 33% of the variance in sentence comprehension ($B=.58, p<.001$). After controlling for word reading, spelling predicted 25% of the variance in sentence comprehension ($B=.50, p<.001$). After controlling for spelling, word reading predicted 4.4% of the variance in sentence comprehension ($B=.21, p = .004$). Thus, morphological awareness ability had a direct and strong influence on the students’ spelling abilities, a direct and moderate effect on their word reading abilities, and a direct and moderate effect on their sentence comprehension abilities. Further, it was a stronger predictor of college students’ spelling abilities than of their word reading abilities.

Indirect effects. After controlling for word reading, the total indirect effect of morphological awareness on sentence comprehension through spelling was .38 ($p < .001$), thus explaining 14.4% of the variance in sentence comprehension. After controlling for spelling, the total indirect effect of morphological awareness on sentence comprehension through word reading was .13 ($p < .001$), explaining 1.7% of the variance in sentence comprehension. Thus, both spelling and word reading mediated the relations between morphological awareness and sentence comprehension. However, spelling was a stronger mediator of the relations between morphological awareness and sentence comprehension than word reading.
CHAPTER FOUR

DISCUSSION

In this investigation, we sought to determine (1) the underlying factor structure of morphological awareness tasks administered to college students with no known language, hearing, vision, or academic difficulties, and (2) to create a reliable and valid measure of morphological awareness for the purpose of determining its direct and indirect influence on spelling, word reading and sentence comprehension abilities in these college students. The factor structure of morphological awareness in college students had not been investigated previously. Knowledge of the factor structure is important for determining the most reliable and valid tasks and items to best assess morphological awareness. Additionally, most studies of the influence of morphological awareness on literacy skills have focused on children from kindergarten to high school; only two have examined these relations in college students. Measures of reliability and validity for the morphological awareness tasks were not reported in these two college studies; thus, it was not known whether similar findings would be obtained again.

We hypothesized that morphological awareness would be a multidimensional construct with one factor representing syntactic morphological awareness and a second factor representing meaning relations of morphological awareness. We further hypothesized that morphological awareness would influence spelling, word reading, and sentence comprehension. However, the relative strength and nature (i.e., direct or indirect) of the influence was not known. The results of this study contradicted the first hypothesis and confirmed the second hypothesis.

Question One: Factor Structure of Morphological Awareness

In response to the first research question, we found that morphological awareness, as measured via three tasks, was a unidimensional construct for college students with no known language, hearing, vision or academic difficulties. This finding adds new information to the knowledge base and extends dimensionality findings for morphological awareness to the college population. Only one previous study used SEM to investigate and report the nature of morphological awareness in children who were school-age (Muse, 2005). Our findings are consistent with this study that found morphological awareness to be unidimensional in fourth-grade children. However, Muse also reported that a two-factor model provided an equally good
fit to the data, and the single factor model was chosen due to its parsimony. Thus, morphological awareness may be a unitary construct across development. Another possibility, which is more consistent with Tyler and Nagy’s (1989) multidimensional theory, is that morphological awareness may be separable into different dimensions in young children, but the separate dimensions merge together and become less distinct as children progress through school. By the time students enter college, different aspects of morphological awareness may have bonded and morphological awareness represents a unitary construct.

**Question Two: Influence of Validated Morphological Awareness Measure on Literacy Abilities**

The purpose of the second research question was two-fold. First, we sought to create a reliable and valid morphological awareness measure for college students using IRT analysis. Second, we intended to determine whether this reliable and validated morphological awareness measure predicted spelling, word reading and sentence comprehension in these college students.

**The morphological awareness measure.** After conducting IRT on college students’ responses on three morphological awareness tasks, we created a reliable and validated morphological awareness task, thus adding a new measure to the literature base for use with the college population. The measure is unique in several respects. First, it is the only morphological awareness measure to be created using IRT analysis to select items. Most researchers have used Classical Test Theory to develop measures and to evaluate the difficulty of the items and the internal consistency of the measure (Petscher & Schatschneider, 2010). IRT offers a different approach to establishing the validity and reliability of measures. One advantage of IRT is that it allows for the creation of a more precise scale than Classical Test Theory (Petscher & Schatschneider). On our final, validated morphological awareness measure, twenty-four of ninety-nine original items were retained. These retained items provide good discrimination and difficulty estimates for the college student population, thereby addressing reliability and validity concerns related to the measurement of morphological awareness.

Second, the final, validated morphological awareness measure includes items taken from two different types of tasks, the DST and the NWSC. Sixteen of the original 36 target items from the DST were retained. This type of sentence cloze task has been used in a number of different investigations with elementary-age children (Apel & Thomas-Tate, 2009; Berko, 1958; Carlisle, 1988, 1995, 2000; McCutcheon et al., 2008) and adolescents (e.g., Nagy et al., 2006). The DST
had not been used previously with college students who were typically developing; this was the first investigation with college students to include a sentence cloze task that required production of the correct response rather than recognition from an array of choices. Further, it was the first to include items within a specified AFF range that systematically varied according to the type and number of shifts between base and derived word (i.e., two shifts, one shift, and no shift). The 16 DST items that were retained include a range of items from all three shift categories; five were two-shift items (e.g., muscle/musculature), four were no-shift items (e.g., odor/odorous), and seven were one-shift items (e.g., logic/logician).

Findings from previous research with younger students (Carlisle & Stone, 2005) suggest that there is a hierarchy of difficulty when reading multimorpheme words (i.e., no-shift items are easiest and two-shift items are the most difficult). However, the difficulty parameters of the DST items obtained through the IRT process indicated that there was a variety of shift types among the easiest and most difficult items. Thus, it may be that there are other explanations for the relative difficulty level of target items on the DST with an AFF of 30 to 40 SFI in this population. We did not control for the complexity of the sentence structure of the DST, yet it is known that the complexity of sentences influences comprehension (Kintsch & Rawson, 2007; Scott, 2009). It may be that there are aspects of the syntax of sentence prompts or other characteristics of the derived words (e.g., frequency of suffix, base word or derived word) that contribute to the difficulty level of the target items. These factors remain to be investigated.

The final morphological awareness measure also included eight of the original 27 items from the NWSC. The NWSC is a multiple choice, sentence completion task that uses real affixes combined with nonsense base and root words. This type of task also has been used in a number of investigations with elementary-age children (e.g., Singson, Mahony, & Mann, 2000) and high school and college students (Mahony, 1994). The retained items included a range of noun, verb, and adjective responses; two were nouns, two were verbs, and four were adjectives.

None of the original 36 target items from the third task, the Relatedness Task, were retained in the final morphological awareness measure. All of the items on this task displayed low discrimination parameters (i.e., discrimination estimates were less than .5) and/or low difficulty parameters (i.e., difficulty estimates were less than -3) and were removed in the process of IRT analysis. This indicates that the Relatedness Task is not a valid measure of morphological awareness, thus corroborating suggestions from other investigators that the
Relatedness Task is not a useful measure of this construct (Carlisle, 1995; Carlisle & Fleming, 2003; Katz, 2004; Mahony, 1994). This task was the only task that did not involve syntactic constraints; both the DST and the NWSC required sentence completion. Our findings suggest, then, that sentence level tasks best capture morphological awareness in college students.

Third, the 24 items on the final validated measure represented a range of difficulty levels (i.e., difficulty parameters range from -2.595 to 1.505) and discriminated among high and low performers (i.e., discrimination parameters range from .572 to 1.407). However, the measure best predicted morphological awareness abilities for college student who are 1 ½ standard deviations below the mean. The peak of the total Test Information Function occurs at 1 ½ standard deviations below the mean on the ability distribution and declines as the function moves away along the X axis (See Figure 2). Thus, it is most informative in the lower half of the ability distribution and less informative in the higher range of morphological awareness abilities.

Because our measure did not predict equally well across a range of ability scores, it may best be suited to separate those who perform at or above 1 ½ standard deviations below the mean (i.e., within typical limits) and those who fall below 1 1/2 standard deviations below the mean (i.e., below typical limits). The final validated measure may be a useful tool for clinical purposes. It is desirable to develop measures that capture students who are notably (i.e., less than 1.5 standard deviations) below the mean. The process of item and ability level analysis using IRT has provided a cutoff that may demarcate college students with adequate morphological awareness abilities from those with poor morphological awareness abilities; however, this also remains to be investigated.

Predicting literacy skills using morphological awareness. In response to the second phase of our research question, path analysis was conducted to determine the relative strength and direction of the validated morphological awareness measure on spelling, word reading and sentence comprehension. Both direct and indirect effects were examined.

Direct effects of morphological awareness on spelling and word reading abilities. The validated morphological awareness measure directly predicted 59% of participants’ performance on the spelling task and 38% of performance in word reading. To date, no investigations of college students have used a reliable and validated latent morphological awareness task to predict their literacy abilities. Additionally, none have conducted path analyses to determine the strength and direction of influence of morphological awareness on literacy abilities. Further, no
investigations of college students have examined the predictive ability of morphological awareness for spelling. Thus, our findings for spelling add new information to the literature base for college students. Our findings also extend the results from investigations with middle school and high school students (e.g., Nagy et al., 2006) to college students that morphological awareness is a strong predictor of spelling abilities.

Turning to the predictive ability of morphological awareness for word reading, our findings mirror and support the findings from Leikin and Hagit (2006) that morphological awareness is moderately predictive of word reading ability in college students. Leikin and Hagit found that morphological awareness significantly predicted 39% of Hebrew-speaking, college students’ word reading abilities using regression analyses. Our findings are almost identical despite differences in the morphological structure of Hebrew and English, the tasks used, and the type of statistical analysis conducted; thus, the consistency of findings across both studies provides a stronger basis of support and generalization for the utility of morphological awareness to predict word reading.

Morphological awareness may be predictive of spelling and word reading because, when spelling and reading morphologically-complex words, spellers and readers tap into their knowledge of morphemes. Consistent with Perfetti’s (2007) Lexical Quality Hypothesis, repeated encounters in print with morphemes in multimorpheme words likely reinforces the quality of the lexical representation for those morphemes. Because the same morphemes appear in different multimorpheme words (e.g., the morpheme ‘act’ may appear in the multimorpheme words active, actor, action and react), readers and spellers of these multimorpheme words may have multiple opportunities to bond the underlying phonological, orthographic and morphological properties into a high quality lexical representation. In turn, the higher quality of the lexical representation likely increases the accuracy and efficiency of access to those morphemes for spelling or reading multimorpheme words that contain those familiar morphemes.

The ability of college students to consciously think about and manipulate morphemes in words predicted larger variance in spelling abilities than word reading abilities. This is the first study of college students that has investigated the influence of morphological awareness on spelling and word reading abilities simultaneously. Our findings mirror those of Nagy and colleagues (2006) who found a similar difference in the predictive nature of morphological
awareness for spelling and word reading in younger students; sixth- and seventh-grade students’ morphological awareness abilities predicted a larger amount of variance on a spelling task than on a word reading task.

The differences in the ability of morphological awareness to predict spelling versus reading may be due, in part, to differences in the task demands involved with these two literacy tasks. The spelling task required participants to produce an accurate and complete representation of the words being spelled, including detailed information of the phonology, orthography and morphological structure. When spelling multimorpheme words, spelling rules often govern orthographic and phonological changes that must occur to the base morpheme when adding suffixes (Nagy et al., 2006). For example, when adding the suffix morpheme “ive” to a base morpheme that ends with a silent “e” (e.g., create), the rules of English orthography require that the silent “e” be omitted (e.g., creat ive). Repeated encounters of this spelling rule as it occurs in other multimorpheme words that follow the rule may then facilitate the depth of integration of the morphological, orthographic and phonological details necessary to produce accurate spellings of multimorpheme words.

Alternately, the word reading task required participants to match printed words to detailed lexical representations that they already had stored; matching a printed word to a stored lexical representation of a word that is only partially accurate may be sufficient for word reading (Ehri, 2005). For example, successful recognition of the stored lexical representation of the multimorpheme word “creative,” may not depend upon explicit awareness that the orthography of the base morpheme “create” has changed. Thus, the demands of producing the words in the spelling task may have tapped more into the need to consider the morphological characteristics of the words than was required by the reading task.

Effects of morphological awareness on sentence comprehension. Morphological awareness directly and moderately predicted 33.6% of the variance in sentence comprehension. Further, there was a significant and weak indirect effect of morphological awareness on sentence comprehension through spelling (i.e., 14.4%) and word reading (i.e., 1.7%). No other investigators have examined the direct influence of morphological awareness on sentence comprehension abilities or examined the mediating effects of word level literacy skills on the relations between morphological awareness and sentence comprehension in college students. Thus, this information contributes new knowledge to the research base.
Direct effects of morphological awareness on sentence comprehension. Morphological awareness was moderately and directly predictive of college students’ ability to understand written sentences. Mahony (1994) conducted the only investigation with college students of the relation between morphological awareness and an indirect measure of reading comprehension at the text level (i.e., SAT scores). Our finding for sentence comprehension is consistent with, and expands upon, Mahony’s finding of a moderate and positive correlation between morphological awareness and an indirect measure of text level comprehension, thus lending strength to previous findings.

There are two possible explanations for the direct influence of morphological awareness on sentence comprehension. First, it may be due to participants’ abilities to use their conscious awareness of morphemes in morphologically complex words to understand the meaning of these more complex words in sentences. An increased understanding of the meaning of complex words likely facilitates better understanding of the overall meaning of the sentence. Second, like the sentence comprehension measure, all of the items on the morphological awareness measure involved sentence level responses, thus drawing upon syntactic knowledge. Completion of both the morphological awareness task and the sentence comprehension task may have drawn similarly upon the syntactic cues provided by the sentence context, verbal reasoning, and the awareness of the grammatical meaning provided by the addition of affixes.

Indirect effects of morphological awareness on sentence comprehension. Both spelling and word reading mediated the relations between morphological awareness and sentence comprehension; thus, morphological awareness had a weak but significant, indirect effect on sentence comprehension, with spelling having a stronger effect on sentence comprehension than word reading. Results from this path analysis provide new insights into the links between morphological awareness and sentence comprehension of college students. Findings provide initial evidence for the mediating role of spelling and word reading between morphological awareness and the ability of college students to understand sentences.

Spelling ability was a stronger transmitter of the effect of morphological awareness on to sentence comprehension than word reading ability. This may be because the stringent requirements of spelling with morphemes contribute to higher quality lexical representations than the requirements of reading multimorpheme words. A successful speller of multimorpheme words may apply spelling rules when combining base words and affixes. According to Perfetti’s
Lexical Quality Hypothesis, each encounter with the same morpheme (either base morpheme or affix) provides an opportunity to integrate the underlying linguistic knowledge (i.e., phonological, orthographic, morphologic, and semantic) into a cohesive lexical representation. Because the same morphemes occur in many different words, spellers have multiple opportunities to apply certain spelling rules, which may consistently change the orthography and/or phonology of the multimorpheme word. In this way, the act of spelling with morphemes may contribute to the creation of higher quality lexical representations of morphemes in words. Higher quality lexical representations may, in turn, be more accurately and efficiently retrieved from the mental lexicon, thus freeing up cognitive resources to deal with other demands of text comprehension.

Limitations

Four limitations of this investigation must be addressed. The first limitation concerns both theory and methodology. The statistical path analysis that was conducted in the present study assumes a unidirectional model of influence, from morphological awareness to spelling and reading words to understanding sentences. However, it is likely that the relations between these variables are more reciprocal (e.g., morphological awareness may influence and/or be influenced by the ability to spell and read words; Kemp, 2006). Thus, the statistical analyses may not reflect the complexity of the relations among the variables. Future researchers could investigate the nature of the relations between morphological awareness and literacy abilities using more sophisticated statistical analyses that take into account nonlinear relations.

A second limitation also involves methodology. The morphological awareness measure was concurrently calibrated and validated in the same sample of 214 participants. Although there is no agreed upon sample size necessary to calibrate measures using IRT, more stable parameters might have been obtained using a slightly higher sample size (Petscher & Schatschneider, 2010). With a greater sample size, the morphological awareness measure could have been calibrated using one-half of the sample, and then validated using the remaining one-half of the sample.

Third, three types of morphological awareness tasks were administered in this investigation. Other types of tasks that have been administered with younger students were not included in the current study. It may be that the tasks used in the present study were not tasks that captured potential, different underlying dimensions of the construct. Future studies could investigate the underlying nature of morphological awareness with different tasks.
Finally, it must be noted that participants spelled and read the same set of 50 words taken from the TWS-4. The testing order was set such that participants spelled the words at the beginning of the testing session and read the words 80 minutes later at the end of the testing session; multiple tasks were administered in the interim. However, it is possible that participants’ performance on the word reading task was facilitated by the spelling task; the process of spelling may have contributed to the development of a stronger lexical representation of the word which, then, may have increased recognition of the word during the word reading task. Thus, our findings may reflect a weaker effect of morphological awareness on word reading due to decreased variance on the word reading task.

**Conclusions and Future Research Directions**

This investigation has fulfilled several purposes. First, we examined the underlying nature of morphological awareness in college students. Second, we created a validated and reliable measure for morphological awareness for use with college students. Finally, our findings yielded new information about the influence of morphological awareness on college students’ literacy abilities. One potential clinical application of the findings is instructional in nature. The validated morphological awareness measure may be used to determine whether college students have morphological awareness abilities that fall within or outside of typical expectations; performance on this measure might be useful in guiding intervention decisions for college students who struggle with reading and writing. The findings also suggest that efforts to increase college students’ morphological awareness abilities likely are necessary for increasing the ability to spell words, read words, and understand sentences, and that spelling is a stronger mediator of the relations between morphological awareness and sentence comprehension than word reading, given the current tasks.

Literacy measures were limited to word level spelling and reading abilities and sentence comprehension. It may be that relations between morphological awareness and literacy abilities differ when measuring reading comprehension or spelling in discourse level text. Future studies could investigate the relation between morphological awareness and these other types of literacy tasks.

Further research is needed to understand the more detailed nature of the relations among morphological awareness, spelling, word reading and sentence comprehension abilities. The current study investigated morphological awareness using items within a limited AFF range (i.e.,
from 30 SFI to 40 SFI). Future research also could address whether literacy abilities are more heavily influenced by other ranges of AFF and/or different measures of frequency, such as base word frequency or affix frequency. More specific information about the factors that influence the relations between morphological awareness and literacy may facilitate refined measures of morphological awareness and provide more direction for efficacy studies of clinical assessment and intervention protocols. Finally, we created the first reliable and valid measure of morphological awareness for use with college students. Future research should determine the usefulness of this measure for assessment or intervention with college students who are struggling with reading and writing.
# TABLE 1

**Summary of Departments and Courses Contacted for Recruitment and Number of Student Participants**

<table>
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<th>Department</th>
<th>Course</th>
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<th>#students interested</th>
<th>#students participated</th>
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<td>3</td>
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<td>GEO 2200</td>
<td>18</td>
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<td>2</td>
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<tr>
<td></td>
<td>GEA 1000</td>
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<td>17</td>
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<td>2</td>
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<td>2</td>
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<td>ADV 3008 Principles of Advertising</td>
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<td>23</td>
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TABLE 2

*Relatedness Task Target Items’ Relation Type, Shift Type, Word Frequency, AFF, & Family Size.*

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<th>FF</th>
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*Note.* Word Freq = frequency of appearance of word; AFF = average family frequency; Fam Size = family size; missing variables in AFF and Fam Size columns indicate that word pairs have true relations and data can be found in far right AFF and Fam Size columns.
TABLE 3

Derivational Suffix Task Target Items’ Base and Derived Word, Shift Type, SFI of Base and Derived Word, AFF, and Part of Speech.

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<th>Derived Word</th>
<th>Part of Speech</th>
<th>Derived Word SFI</th>
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<tr>
<td>43.2</td>
<td>one-shift</td>
<td>43.2</td>
<td>instruct</td>
<td>adjective</td>
<td>47.1</td>
<td>38.82</td>
<td>15</td>
</tr>
</tbody>
</table>

Note. SFI = standard frequency index; AFF = average family frequency.
## TABLE 4

*Means, Standard Deviations (SD) and Range of Morphological Awareness Tasks, Spelling, Word Reading, and Sentence Comprehension Measures*

<table>
<thead>
<tr>
<th>Task</th>
<th>Range</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relatedness Task (maximum = 36)</td>
<td>26-36</td>
<td>32.60</td>
<td>2.10</td>
</tr>
<tr>
<td>Derivational Suffix Task (maximum = 36)</td>
<td>4-34</td>
<td>24.21</td>
<td>5.20</td>
</tr>
<tr>
<td>Nonword Sentence Completion Task (maximum = 27)</td>
<td>16-27</td>
<td>25.51</td>
<td>2.20</td>
</tr>
<tr>
<td>Test of Written Spelling-4 (maximum = 50)</td>
<td>22-50</td>
<td>44.45</td>
<td>4.45</td>
</tr>
<tr>
<td>Word Reading Task (maximum = 50)</td>
<td>36-50</td>
<td>47.61</td>
<td>2.14</td>
</tr>
<tr>
<td>TOSREC (maximum = 80)*</td>
<td>21-78</td>
<td>47.80</td>
<td>11.18</td>
</tr>
</tbody>
</table>

*Note.* Mean raw scores are reported for all measures.
*TOSREC = Test of Silent Reading Efficiency and Comprehension.*
### TABLE 5

*Difficulty and Discrimination Parameters of Final Validated Morphological Awareness Target Items*

<table>
<thead>
<tr>
<th>Item</th>
<th>Discrimination</th>
<th>SE</th>
<th>Difficulty</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>D3</td>
<td>.599</td>
<td>.156</td>
<td>-2.022</td>
<td>.450</td>
</tr>
<tr>
<td>D4</td>
<td>.783</td>
<td>.157</td>
<td>-1.387</td>
<td>.242</td>
</tr>
<tr>
<td>D5</td>
<td>.776</td>
<td>.157</td>
<td>-1.262</td>
<td>.228</td>
</tr>
<tr>
<td>D11</td>
<td>.679</td>
<td>.171</td>
<td>-2.120</td>
<td>.435</td>
</tr>
<tr>
<td>D13</td>
<td>.775</td>
<td>.110</td>
<td>1.019</td>
<td>.199</td>
</tr>
<tr>
<td>D14</td>
<td>.811</td>
<td>.135</td>
<td>-0.711</td>
<td>.157</td>
</tr>
<tr>
<td>D18</td>
<td>1.407</td>
<td>.305</td>
<td>-1.350</td>
<td>.183</td>
</tr>
<tr>
<td>D20</td>
<td>.585</td>
<td>.134</td>
<td>-1.470</td>
<td>.320</td>
</tr>
<tr>
<td>D23</td>
<td>.572</td>
<td>.162</td>
<td>-2.306</td>
<td>.551</td>
</tr>
<tr>
<td>D25</td>
<td>.835</td>
<td>.167</td>
<td>-0.719</td>
<td>.167</td>
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<tr>
<td>D27</td>
<td>.690</td>
<td>.126</td>
<td>-0.374</td>
<td>.159</td>
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<tr>
<td>D30</td>
<td>1.157</td>
<td>.169</td>
<td>.592</td>
<td>.133</td>
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<td>D31</td>
<td>.625</td>
<td>.190</td>
<td>-2.490</td>
<td>.605</td>
</tr>
<tr>
<td>D33</td>
<td>.653</td>
<td>.113</td>
<td>-0.389</td>
<td>.164</td>
</tr>
<tr>
<td>D34</td>
<td>.943</td>
<td>.200</td>
<td>-2.202</td>
<td>.396</td>
</tr>
<tr>
<td>D36</td>
<td>.583</td>
<td>.107</td>
<td>1.505</td>
<td>.311</td>
</tr>
<tr>
<td>N4</td>
<td>1.399</td>
<td>.468</td>
<td>-2.348</td>
<td>.452</td>
</tr>
<tr>
<td>N11</td>
<td>.766</td>
<td>.232</td>
<td>-2.840</td>
<td>.665</td>
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<tr>
<td>N18</td>
<td>1.390</td>
<td>.296</td>
<td>-1.697</td>
<td>.228</td>
</tr>
<tr>
<td>N20</td>
<td>.703</td>
<td>.186</td>
<td>-2.114</td>
<td>.437</td>
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<tr>
<td>N21</td>
<td>.821</td>
<td>.241</td>
<td>-2.234</td>
<td>.477</td>
</tr>
<tr>
<td>N22</td>
<td>.847</td>
<td>.193</td>
<td>-2.595</td>
<td>.508</td>
</tr>
<tr>
<td>N24</td>
<td>.703</td>
<td>.203</td>
<td>-2.451</td>
<td>.544</td>
</tr>
<tr>
<td>N26</td>
<td>.845</td>
<td>.181</td>
<td>-1.773</td>
<td>.291</td>
</tr>
</tbody>
</table>

*Note.* D = Item from Derivational Suffix Task; N = Item from Nonword Sentence Completion Task; Numerals indicate item number on original task.
Figure 1. Item characteristic curves for final twenty-four items on validated morphological awareness measure. X axis depicts the range of item difficulty and student ability with a mean of 0 and a standard deviation of 1. Y axis depicts probability of correct response. D items originated from Derivational Suffix Task. N items originated from Nonword Sentence Completion Task.
Figure 2. Test Information Function Curve for final morphological awareness measure. X axis depicts student ability level with a mean of 0 and a standard deviation of 1. Y axis depicts amount of information provided by sum of item information functions of final 24 validated items.
Figure 3. Standardized path coefficients for path analysis model. MA = latent, validated morphological awareness measure; TWS = Test of Written Spelling-Fourth Edition (Larson, Hammill, & Moats, 1999); WR = word reading; TOSREC = Test of Silent Reading Efficiency and Comprehension (Wagner, 2010); solid line (——) = direct effect; broken line (---) = indirect effect.
APPENDIX A

SCREENING SCRIPT

1. Are you a current undergraduate student?   Yes _____  No ______  Academic Level ________

2. Are you currently or have you ever received accommodations through the Office of Student Disabilities in college?    Yes _____  No _____

3. Are you currently or have you ever received help for speech, language, reading or writing?  Yes_________________  No__________________

4. Do you have any uncorrected hearing or vision problems?  
   Yes_________________  No__________________

5. If Yes to question 2, 3, or 4 above: Thank you for your interest in this study.  We are seeking students who are not currently receiving or who have not received accommodations through the Office of Student Disabilities, who are not currently and have not received speech, language or learning services, and who have no uncorrected concerns with hearing or vision.

6. If No to questions 2, 3 and 4 above: Please give me your name and contact information. Please tell me/send me the days and times that you would be available to participate in the study.
   Name__________________________________________
   Email__________________________________________
   Phone__________________________________________
   
   Best Days/Times for Study Participation
   ____________________________________________________________________________
   ____________________________________________________________________________

7. You will receive a $25 gift card for your participation in this study. Would you prefer to receive a gift card to Moe’s Restaurant or to Starbucks?
   Gift Card_________________________________________

   I will be back in touch with you as soon as possible to offer you some convenient options for participating in the study. Please contact me at either [redacted] if you have any questions or concerns. Thank you so much for your interest!
# APPENDIX B

## DISTRIBUTION OF MAJORS

<table>
<thead>
<tr>
<th>Major</th>
<th>Number of Participants</th>
</tr>
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<tbody>
<tr>
<td>Not specified or not declared</td>
<td>32</td>
</tr>
<tr>
<td>Criminology</td>
<td>26</td>
</tr>
<tr>
<td>Sociology</td>
<td>12</td>
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<tr>
<td>Exercise Science</td>
<td>11</td>
</tr>
<tr>
<td>Environmental Science</td>
<td>9</td>
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<tr>
<td>Biology</td>
<td>9</td>
</tr>
<tr>
<td>International Affairs</td>
<td>8</td>
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<tr>
<td>Marketing</td>
<td>8</td>
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<td>Political Science</td>
<td>8</td>
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<tr>
<td>Communications</td>
<td>7</td>
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<tr>
<td>Finance</td>
<td>7</td>
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<td>Economics</td>
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<td>Psychology</td>
<td>5</td>
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<td>Dietetics</td>
<td>5</td>
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<tr>
<td>Creative Writing</td>
<td>4</td>
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<td>Engineering</td>
<td>4</td>
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<td>Nursing</td>
<td>4</td>
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<td>Education</td>
<td>4</td>
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<td>Music</td>
<td>3</td>
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<td>Communication Disorders</td>
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<td>African American Studies</td>
<td>1</td>
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<td>Recreation and Leisure</td>
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<tr>
<td>Journalism</td>
<td>1</td>
</tr>
<tr>
<td>Anthropology</td>
<td>1</td>
</tr>
</tbody>
</table>
APPENDIX C

CONSENT FORM

AGREEMENT TO PARTICIPATE IN COLLEGE STUDENTS' LANGUAGE AND LITERACY RESEARCH PROJECT

Dear Participant,

I am a doctoral candidate in the School of Communication Science and Disorders at Florida State University. Under the direction of Dr. Kenn Apel, I am studying the underlying factors that affect college students' reading and spelling skills. Specifically, I am looking at how language and literacy factors most strongly influence typically-developing college students' word reading, sentence and passage comprehension and spelling abilities. You will be asked to play with sounds in words, spell words, read words and non-words, solve non-verbal problems, choose words and nonwords that best fit blanks in sentences and that are most similar to other words, read sentences and passages and answer multiple choice questions, and complete a short questionnaire about your age, gender, ethnicity, and grade point average. The different tasks will be given in two sessions: one group session lasting no longer than 75 minutes and one individual session lasting no longer than 15 minutes. The sessions will be scheduled at your convenience and held at Florida State University in the Regional Rehabilitation Center or in another university classroom.

You have been invited to participate because you are a college undergraduate with no history of receiving accommodations from university Student Disability Resource Center. All procedures are using are tasks, or adaptations of tasks that have been used previously with college students. Therefore, they do not involve activities that could cause discomfort to you or put you at risk in any way. However, if you should become upset for any reason, you can stop at any time without penalty or risk.

To maintain confidentiality of your records, I will assign an experimental code to your response forms. The results of this research study may be published but your name or identity will not be revealed. Only group findings will be reported. Confidentiality will be maintained to the extent allowed by law.

You will not directly benefit from involvement in this project. However, the results of this study will provide valuable information to researchers and educators that will lead to a better understanding of the nature of underlying language and literacy skills in college students which, one day, may lead to new teaching strategies.

Participation in this study is voluntary. If you choose to participate in and complete the tasks required in this study, I will provide a $25 gift card at the end of both testing sessions. If you choose not to participate or choose to withdraw from the study at any time prior to its completion, you will not receive the $25 payment in the form of a gift card. You will receive the gift card payment only if you complete the testing. If you have any questions concerning this research study, before or after your consent, please contact either Dr. Kenn Apel at 850-645-6566 or me at . If you feel you have been placed at risk, you can contact the Chair of the Human Subjects Committee, Institutional Review Board, through the Vice President for the Office of Research at (850) 644-6633.

Sincerely,

Elizabeth B. Wilson-Fowler, M.A., CCC-SLP

Project Title: Language and Literacy Abilities of College Students
Principal Investigator: Elizabeth B. Wilson-Fowler, M.A., CCC-SLP

I, , certify that I am at least 18 years old and I give my consent for my participation in the above study. I understand that all paper sheets containing my responses will be kept by Elizabeth B. Wilson-Fowler in a secure cabinet in a locked research laboratory with restricted access. I understand that only Elizabeth and any graduate students trained for this project will have access to these responses and that they will be destroyed by June 30, 2017. I understand that I may withdraw my consent and discontinue my participation at any time without penalty or loss of benefits to which I may otherwise be entitled. However, I understand that I will not receive payment if I withdraw my participation prior to completion of all tasks. In signing this consent form, I am not waiving any legal claims, rights or remedies.

Participant's Printed Name: ________________________________
Participant's Signature: __________________ (Date) __________________

APPENDIX D

IRB APPROVAL LETTER

Page 1 of 1

Subject: Use of Human Subjects in Research - Approval Memorandum

From: Human Subjects <humansubjects@magnet.fsu.edu>

Date: Friday, April 23, 2010 7:01 am

To: ebw07c@fsu.edu

Cc: kenn.apel@coli.fsu.edu

Office of the Vice President For Research
Human Subjects Committee
Tallahassee, Florida 32306-2742
(850) 644-8673 · FAX (850) 644-4392

APPROVAL MEMORANDUM (for change in research protocol)

Date: 4/20/2010

To: Elizabeth Wilson-Fowler

Address: [Redacted]

Dept.: COMMUNICATION DISORDERS

From: Thomas L. Jacobson, Chair

Re: Use of Human Subjects in Research (Approval for Change in Protocol)

Project entitled: Linguistic and Metalinguistic Influences on College Students' Literacy Skills

The form that you submitted to this office in regard to the requested change/amendment to your research protocol for the above-referenced project has been reviewed and approved.

Please be reminded that if the project has not been completed by 2/8/2011, you must request renewed approval for continuation of the project.

By copy of this memorandum, the chairman of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Human Research Protection. The Assurance Number is IRB00000446.

Cc: Kenn Apel, Advisor
HSC No. 2010.4431

http://webrmail2.fsu.edu/print.html

2/17/2011
APPENDIX E

PARTICIPANT INTAKE FORM

Code #:___________________________________________

Date:___________________________________________

Birthdate:_________________________________________

Freshman_____ Sophomore_____ Junior_____ Senior_____  

Ethnicity: Caucasian_____ African American____ Spanish American_____ Asian_____ Mixed_____ Other_____  

Gender: Female______ Male______  

Cumulative Grade Point Average:____________________________

How did you hear about this study?

Summer course?_________ If so, which course?____________________________

Posted flyer?__________

Other?_________________
## APPENDIX F

### RELATEDNESS TASK

Determine whether the second word comes from the first word

*Example: metric-meter*  

<table>
<thead>
<tr>
<th>Example</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>limber---limb</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>acknowledge---know</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>baggage---bag</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>coronation---crown</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>caustic---cost</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>allowance---allow</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>precious---price</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>numbers---numb</td>
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<td>NO</td>
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<td>infidelity---fad</td>
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<td>infinitesimal---infant</td>
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<td>NO</td>
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<td>personal---person</td>
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<td>pachyderm---pack</td>
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<td>NO</td>
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<tr>
<td>pearl---pea</td>
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<td>famish---fame</td>
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<td>NO</td>
</tr>
<tr>
<td>spatial---space</td>
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<tr>
<td>facsimile---fact</td>
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<td>lobotomy---lab</td>
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<td>month---moon</td>
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<tr>
<td>medieval---evil</td>
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<td>NO</td>
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<td>knapsack---nap</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>president---preside</td>
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<td>NO</td>
</tr>
<tr>
<td>syntax---sin</td>
<td>YES</td>
<td>NO</td>
</tr>
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<td>tailor---tail</td>
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</tr>
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<td>disease---ease</td>
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<td>NO</td>
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<td>furlough---furl</td>
<td>YES</td>
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</tr>
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<td>tournament---turn</td>
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<td>bully---bull</td>
<td>YES</td>
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</tr>
<tr>
<td>hardy---hard</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>procedure---proceed</td>
<td>YES</td>
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<tr>
<td>messenger---message</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>creature---create</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
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<td>NO</td>
</tr>
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<td>NO</td>
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<td>abstinence---abstain</td>
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<td>laboratory---labor</td>
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<tr>
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<td>NO</td>
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<tr>
<td>lingerie---long</td>
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</tr>
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</tbody>
</table>
APPENDIX G

DERIVATIONAL SUFFIX TASK

For each item, you will see a word and a sentence with a blank. Please change the word that is given to fill in the blank in the sentence. Please use only one word for each blank (no phrases). You must change the word that is given.

Examples:
impress: John wanted to make a good ____________________________ on his first date.
pretty: Despite her outward ____________________________, the young woman lacked confidence.
fertile: The farmer was concerned about the ____________________________ of the fields prior to planting.
fear: The opposing football team put up a ____________________________ fight.

1. indulge: The ____________________________ mother bought her daughter an expensive pair of jeans.
2. ideal: Some people ____________________________ famous movie actors and actresses.
3. muscle: The disease resulted in slower ____________________________ contractions.
4. correct: The judge explained the need to take ____________________________ action.
5. produce: The new owners turned the failing business into a highly ____________________________ operation.
6. mercy: The ____________________________ ruler freed his captives.
7. precise: The x-ray results located the tumor with ____________________________.
8. equal: The employer thought it was necessary to ____________________________ the responsibilities of all staff members.
9. general: It is sometimes difficult to ____________________________ information from one or two facts.
10. mature: Some people believe that the human process of ____________________________ is slow and steady.
11. demonstrate: She wished her fiancé were more ____________________________.
12. industry: Only the most ____________________________ farmers showed any profit that year.
13. logic: It is possible to pursue a career as a ____________________________.
14. odor: The neighbors were upset by the ____________________________ garbage can down the street.
15. drama: As she retold her argument with her mother, Jeanie ____________________________ the event.
16. console: The money was no ____________________________ after the tornado destroyed his home.
17. operate: Read through your textbook and underline the ____________________________ words.
18. weary: The doctor asked the patient to rate his ____________________________ on a scale from one to five.
19. defy: The police officer documented the suspect’s ____________________________.
Appendix G -- continued

20. intense: Frank broke down under the highly ____________________________ questioning.

21. suit: Those are not ____________________________ shoes for walking in the mud.

22. reduce: The committee was not persuaded by the arguments of the ____________________________.

23. electric: The family needed to call an _____________________________.


25. odd: It is an ____________________________ that some cats have six toes.

26. harp: The ____________________________ performed with emotion.

27. observe: His emotions were ____________________________ only to those who knew him.

28. algebra: Cory has difficulty following ____________________________ formulas.

29. sense: The judge did not believe that the musical ____________________________ would win the contest.

30. gene: The boy’s family consulted with a _____________________________.

31. tense: The ____________________________ between the two countries was growing every day.

32. act: The secret police arrested the ____________________________ before he could give his speech.

33. critic: John didn’t anticipate the harshly ____________________________ response to his work.

34. diverse: It is important to maintain natural ____________________________ in our forests and parks.

35. instruct: The ____________________________ quality of the course was superb.

36. migrate: The geese follow the same ____________________________ path every year.
APPENDIX H

NONWORD SENTENCE COMPLETION TASK

Instructions: Read the sentence and circle the nonsense word that best fits the sentence.

*Example:* Despite her knowledge, the _______ was unable to respond to the question.

*floxatize, floxatism, floxatist, floxatation*

1. They ______ the data in the back office.
   - curfamic, curfamation, curfamate, curfamity

2. All those models are strictly ______ and outdated, as well.
   - ambilemptify, ambilemptivist, ambilemptity, ambilemptive

3. In spite of his _______, he did an outstanding job.
   - disribize, disribation, disribational, disribify

4. Desert animals are not normally ______.
   - commalianization, commalious, commalianism, commalianize

5. He is so ______ that he offends almost everyone.
   - dictopithify, dictopithial, dictopithification, dictopithity

6. You can’t even begin to ______ without modern equipment.
   - equamanize, equamanizable, equamanity, equamanive

7. They presented the highly _____ evidence first.
   - credenthive, credenthification, credenthicism, credentify

8. They hope to ______ the two sides together.
   - uniromosity, uniromify, uniromous, uniromative

9. He wants to ______ while he still can.
   - fidamoration, fidamorian, fidamorational, fidamorate

10. Please try to be as totally ______ as possible.
    - progenalism, progenalize, progenious, progenify

11. Please _____ these forms as soon as possible.
    - scribsumptist, scribsumptious, scribsumptian, scribsumptize
Appendix H – Continued

12. The story of the _____ was repeated every year.
   vergalize, vergalicious, vergalify, vergalist

13. The most _____ samples were discarded.
   birendal, birendment, birendalize, birendify

14. If we can just overcome its inherent ______, we should complete the project on schedule.
   antiflidify, antiflidian, antiflidacious, antiflidicity

15. Dr. Jones, a well known ________, is speaking tonight.
   circumtarious, circumtarist, circumtarify, circumtarize

16. We should _____ that money by the end of the year.
   relaptification, relaptian, relaptify, relaptable

17. His ______ is greatly admired.
   superfilize, superfilive, superfilial, superfilation

18. The meeting was highly ______ and invigorating.
   loquarify, loquarial, loquarization, loquarialism

19. Too much ______ is bad for the economy.
   malburnity, malburnify, malburnicious, malburnable

20. Their progress was stopped by an unexpected ______.
   postramify, postramic, postramity, postramicize

21. Their approach to the problem is deceptively ______.
   torbatify, torbative, torbativize, torbature

22. The breeders ______ their stock every four generations.
   genilify, genility, genilification, geniliar

23. She met her first ______ when she moved to Florida State University.
   benedumptist, benedumptify, benedumptize, benedumptuous

24. Everyone resented the obvious ______ on the manager’s part.
   spectitious, spectitionalize, spectition, spectitive
Appendix H – Continued

25. You must _______ them quickly or you’ll ruin the colors.
   premanicism, premanicize, premanicity, premanic

26. All the suspiciously _______ specimens are kept in a separate tank.
   tribacize, tribacion, tribacism, tribacious

27. The new equipment will _______ everything automatically.
   transurbate, transurbativity, transurbatist transurbative
APPENDIX I

FINAL VALIDATED MORPHOLOGICAL AWARENESS MEASURE

Part 1

Instructions: Read the sentence and circle the nonsense word that best fits the sentence.

Example: Despite her knowledge, the ________ was unable to respond to the question.

floxatize, floxatism, floxatist, floxatation

1. Desert animals are not normally ________. (N4)
   commalianization, commalous, commalianism, commalianize

2. Please _____ these forms as soon as possible. (N11)
   scribsumptist, scribsumptious, scribsumptian, scribsumptize

3. The meeting was highly ________ and invigorating. (N18)
   loquarify, loquarial, loquarialize, loquarialism

4. Their progress was stopped by an unexpected ________. (N20)
   postramify, postramic, postramity, postramicize

5. Their approach to the problem is deceptively ________. (N21)
   torbatify, torbative, torbativize, torbature

6. The breeders ______ their stock every four generations. (N22)
   genilify, genility, genilification, geniliar

7. Everyone resented the obvious ______ on the manager’s part. (N24)
   spectitious, spectitionalize, spectition, spectitive

8. All the suspiciously ________ specimens are kept in a separate tank. (N26)
   tribacize, tribacion, tribacism, tribacious
Appendix I – Continued

Part 2
Instructions: For each item, you will see a word and a sentence with a blank. Please change the word that is given to fill in the blank in the sentence. Please use only one word for each blank (no phrases). You must change the word that is given.

Examples:

a) impress:  John wanted to make a good ___________________________ on his first date.  

b) pretty: Despite her outward ____________________________, the young woman lacked confidence.

c) fertile: The farmer was concerned about the __________________________ of the fields prior to planting.

d) fear: The opposing football team put up a ___________________________ fight.

1. muscle:  The disease resulted in slower ___________________________ contractions.  

2. correct: The judge explained the need to take ___________________________ action.

3. produce: The new owners turned the failing business into a highly ___________________________ operation.

4. demonstrate: She wished her fiancé were more ___________________________.

5. logic: It is possible to pursue a career as a ___________________________.

6. odor: The neighbors were upset by the ___________________________ garbage can down the street.

7. weary: The doctor asked the patient to rate his ___________________________ on a scale from one to five.

8. intense: Frank broke down under the highly ___________________________ questioning.

9. electric: The family needed to call an ___________________________.

10. odd: It is an ___________________________ that some cats have six toes.

11. observe: His emotions were ___________________________ only to those who knew him.

12. gene: The boy's family consulted with a ___________________________.

13. tense: The ___________________________ between the two countries was growing every day.

14. critic: John didn’t anticipate the harshly ___________________________ response to his work.

15. diverse: It is important to maintain natural ___________________________ in our forests and parks.
16. migrate: The geese follow the same ___________________________ path every year.

(D36)

Note. N refers to items from Nonword Sentence Completion Task; D refers to items from Derivational Suffix Task; numerals refer to original item number on each task (i.e., D33 refers to item number 33 of original Derivational Suffix Task).
APPENDIX J

FINAL MORPHOLOGICAL AWARENESS MEASURE

ANSWER KEY

Part 1
1. commalious
2. scribsumptize
3. loquarial
4. postramity
5. torbative
6. genilify
7. spectition
8. tribacious

Part 2
1. muscular
2. corrective
3. productive
4. demonstrative
5. logician
6. odorous
7. weariness
8. intensive or intensified
9. electrician
10. oddity
11. observable
12. geneticist or genealogist
13. tension
14. critical
15. diversity or diversification
16. migratory or migrational
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BIOGRAPHICAL SKETCH

Elizabeth Wilson-Fowler is employed as Assistant Professor in the Department of Communication Disorders at Eastern Washington University. Prior to her doctoral studies at Florida State University, she worked as a speech-language pathologist in private practice and in the public schools in Anacortes, Washington. Ms. Wilson-Fowler received her M.A. in Communication Disorders in 1999 from Western Washington University. She received her B.A. in Spanish from The University of Virginia in 1980.

Ms. Wilson-Fowler’s specialty area is school-age language and literacy. Her research involves investigation of the language and literacy abilities of middle school, high school and college students. Her current responsibilities include teaching graduate and undergraduate students and supervising graduate student clinicians in clinic and research.