MEASUREMENT OF MORPHOLOGICAL AWARENESS USE OF FOURTH AND FIFTH GRADE STUDENTS WITH READING DIFFICULTIES

By

Joanne Veatch Coggins

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Dissertation Committee:

Dr. Eric L. Oslund, Chair

Dr. Amy M. Elleman

Dr. Cyrille L. Magne

For my students, who inspired be to be more than I am, and who encouraged me to do more than I can. I want to give you wings.

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ABSTRACT

The reliability and validity of a Morphological Awareness (MA) battery and a researcher created Morphological Awareness Assessment Battery (MAAB) were evaluated to determine how each type contributed to passage reading comprehension among 56 fourth and fifth graders with reading difficulties. The MA battery is an assessment battery comprised of four widely used tasks of morphological awareness, and the Morphological Awareness Assessment Battery (MAAB) is a shorter version of the MA battery and contains five newly created items designed from each of the four tasks used in the MA battery. Morphological awareness is an important skill that is linked to other literacy skills. However, a technically adequate measure of morphological awareness is needed in order to measure the impact of morphological awareness on the literacy skills known to support reading comprehension, as well as, the direct impact of morphological awareness upon reading comprehension. Prior research provides evidence that poor readers may rely upon morphological awareness as a compensatory strategy (Elbro & Arnbak, 1996), and there is evidence that morphological awareness use may predict future late emerging poor comprehenders in elementary school (Tong et al., 2011). Development of an accurate measure of morphological awareness could prove to be a critically important tool for instructional decision making of later elementary students.

In the present study, regression analyses showed that the MA battery significantly predicted between 10% and 53% of the variation in passage reading comprehension, 11% of the variation in decoding, and 35% of the variation in passage reading fluency. These findings support prior research that morphological awareness is a more accurate predictor of passage reading comprehension than measures of decoding (Tong et al., 2011) and oral vocabulary (Nagy et al., 2003). Examination of the direct relationship between morphological awareness and reading comprehension, as well as, the indirect relationships between morphological awareness and other literacy measures and reading comprehension indicated that morphological awareness is a significant factor in reading comprehension. Development of the MA battery and the MAAB, as reliable and valid measures of morphological awareness, provided an incremental step in research of the use of morphological awareness by fourth and fifth grade students with reading difficulties.

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CHAPTER ONE

INTRODUCTION

Toward the end of second grade, typical readers begin to enter the third stage of reading development, in which careful decoding and effortful reading begin to change into fluent, prosodic reading (Chall, 1983). Initially, after carefully sounding out the same words several times, beginning readers start learning the words by sight (Ehri, 2000). As readers' word recognition increases, so does fluency, allowing them to more easily read (Ehri, 2000). Reading success encourages more reading, and increased reading volume feeds sight word vocabulary and fluency bidirectionally (Ehri, 2000).

Typically developing readers appear to become "unglued" from the initially slow and effortful phoneme by phoneme decoding process, and reading becomes faster (Chall, 1983; Ehri, 1998). The combined ability to read sight words and rapidly decode new words allows readers to develop word reading automaticity, freeing cognitive resources needed for comprehension (Kruk & Bergman, 2013; Perfetti, 2007). Usually this developmental process begins to occur during third grade, when typically developing readers switch from learning to read and begin reading to learn (Chall, 1983). From this point on young readers rapidly acquire the literacy skills that will allow them to explore and learn from text.

Still learning to read in the later elementary years, poor readers are unable to maintain the academic pace of peers with typically developing reading skills. Due to the multidirectional and mutually supportive processes of fluency, vocabulary, and reading comprehension, typically developing readers experience stronger growth in reading skills than do poor readers, who gain skills much more slowly (Stanovich, 1986). As a result, struggling readers suffer the *Matthew Effects*, as average readers' skills improve, and the gap expands between those with rich and those with poor reading skills (Stanovich, 1986). Even when students with severe reading deficits receive intensive remediation using explicit and systematic phonics, 25 percent of poor readers continue to exhibit limited growth in the word reading skills needed to achieve fluency (Torgesen et al., 2001).

During this transitional time, readers who fail to develop word reading automaticity do not develop the fluency needed to comprehend increasing text complexity (Perfetti, 1992; Rasinski, Reutzel, Chard & Linan-Thompson, 2011). Lack of word reading automaticity is a primary cause of reading disabilities (Roberts, Christo & Shefelbine, 2013). From fourth grade onward, text complexity continues to increase, and students are presented with a broader array of subject areas and literature types. By the fifth grade, many students who still struggle to read demonstrate significant word reading and comprehension deficits—characteristics of what have been referred to as garden variety poor readers (Gough & Tunmer, 1986; Stanovich, 1988).

Studies have shown that morphological awareness, above skills of phonological awareness, decoding, oral vocabulary, working memory, and intelligence, uniquely contributes to word reading and reading comprehension skills (Deacon & Kirby, 2004; Kirby et al., 2012; Tong et al., 2011). Because morphological awareness is an important process in reading multisyllable words (Kearns, 2015), phonetic reading skills alone are insufficient for beginning readers (Berninger, Abbott, Nagy & Carlisle, 2010). Morphological awareness may be used to determine the pronunciation or spelling of novel words, to provide syntactic information, and to give definitional access via the rich orthography and meaning inherent in English (Apel, Diehm, & Apel, 2013; Wolter & Dilworth, 2014).

In addition to contributing to reading fluency and spelling (Berninger et al., 2003; Wolter & Dilworth, 2014), in typically developing readers morphological awareness is a powerful generative process for building vocabulary (Carlisle & Stone, 2005; White, Power & White, 1989; Wysocki & Jenkins, 1987); and vocabulary knowledge is tied to reading comprehension (Pearson, Hiebert & Kamil, 2007). Students with very poor word reading skills may rely on morphological analysis in ways that typically developing readers do not (Casalis, Colé, & Sopo, 2004; Elbro & Arnbak, 1996). Many variables mediate the effect of phonetic reading skill on fluency processes (Torgesen, Wagner & Rashotte, 1997), including vocabulary size (Stanovich, 1986), reading volume, and amount of exposure to print (Stanovich, 1993), morphological awareness skills (Tong et al. 2011), and the reader's ability to use contextual clues (Tunmer & Chapman, 1995). This suggests that areas of strength among any of these factors, including morphological awareness, could be used to help compensate for weak phonetic reading skills (Torgeson et al., 1997).

Reading fluency is a critical component of reading because it is an indicator of word level automaticity necessary for reading comprehension (Indrisano & Chall, 1995).

Research conducted by Nunes, Bryant, and Barros (2012) found that the use of both graphophonic units (high frequency letter strings) and morphemes were strong predictors of reading comprehension, but use of morphemes was the stronger predictor. Morphological awareness has been shown to make independent contributions to both reading comprehension and fluency (Apel et al., 2013; Nunes et al., 2012). Readers who are able to parse morphologically complex words into component affix and base parts read more efficiently because the morphemes are either known or follow a familiar pattern (Kearns, 2015; Nunes et al., 2012; Venezky, 1979). Increased reading fluency may improve reading comprehension because the reader spends fewer cognitive resources on word reading and is better able to attend to text meaning (Kruck & Bergman, 2013; Pressley, 1998).

Measurement of morphological awareness is both necessary and problematic. It is critical to develop reliable and valid assessments of morphological awareness in order to measure the processes that occur during reading development and to inform instructional decision making. An assessment of morphological awareness needs to include a variety of tasks designed to reflect the many different reading processes that occur at the specific developmental stage of the student (Carlisle, 2010). Morphological awareness as a predictor of reading ability in primary, secondary, and post-secondary students has been measured using a variety of researcher developed tests.

There is, however, no general agreement of which task type best measures the singular contribution of morphological awareness to literacy development at specific developmental stages. Carlisle (2010) stated that the contributions made by morphological awareness to other areas of literacy are underspecified, and more research is needed to determine the full contribution morphological awareness makes toward reading. Researchers believe that morphological awareness impacts many other literacy skills, but determining the exact nature of those relationships remains problematic because of the variety of study designs and ways of measuring morphological awareness. Diversity of design and purpose among morphological awareness studies show that there are many aspects of morphological awareness, and that morphological awareness impacts various areas of literacy in different ways. However, morphological awareness research is still in its infancy, and does not yet have the depth of research that has revealed the role of phonological awareness in various literacy processes at different developmental stages (Carlisle, 2010). Research of the types of morphological awareness used by students at different developmental and grade levels is needed in order to determine their relative importance to reading development. Such rigorous research necessitates further development of morphological awareness measures.

Apel et al. (2013) argued that morphological awareness assessments generally fall into three major categories, tasks of judgment, analogy, or production, each with several variations. The four morphological awareness subscale tasks used in the present study are representative of the variety of researcher developed tasks that have been studied to date. The Apel et al. study included tasks of analogy, production, judgment, and affix identification. Researchers concluded that morphological awareness of typical readers contributed significantly to vocabulary knowledge, fluency, and reading comprehension differently at the developmental stages experienced in kindergarten through second grade. The Apel et al. study is one of the first to find that morphological awareness accounts for a significant and unique contribution to reading comprehension and vocabulary knowledge in early primary school students. Additionally, the researchers found differentiation among tasks of morphological awareness assessment at specific grade levels.

Though literacy research shows that students use morphological awareness in a variety of ways at different developmental stages (Goodwin & Ahn, 2010; Kruck & Bergman, 2013; Kuo & Anderson, 2006; Wysocki & Jenkins, 1987) there have been mixed findings surrounding morphological awareness use of elementary students. One main reason for these seemingly inconsistent results is that different types of tasks are being used to measure students in a wide range of ages (Apel et al., 2013). There are few studies of morphological awareness use of later elementary students with reading difficulties, and none of the studies have used the same the same tasks of morphological awareness as another study. Concentrated effort to unravel which measurement tasks are most applicable at various developmental stages is crucial in order to measure the necessity or efficacy of interventions that include instruction of morphological awareness skills. The design and analysis of morphological awareness tasks is an emerging area of interest in the field of reading research, as researchers work to determine the role it plays in reading comprehension.

Purpose of the Dissertation

The purpose of this dissertation research was to systematically evaluate four of the most common tasks used to measure morphological awareness of students in the later elementary grades, and to create a valid and reliable assessment of morphological awareness in order to explore the relationship between morphological awareness and reading comprehension of fourth and fifth grade garden variety poor readers. Knowledge of which tasks adequately measure developmentally appropriate types of morphological awareness is essential in order to create an accurate assessment of morphological awareness that informs instruction differentiated to the individual needs of the students. This research contributes to the development of a morphological awareness test capable of assessing reading comprehension using multiple measures of morphemic awareness that may prove critical for instructional planning of poor readers.

CHAPTER TWO

LITERATURE REVIEW

Morphological awareness is an important literacy process that contributes significantly to reading comprehension by supporting other literacy skills (Baumann et al., 2003; Berninger et al., 2010; Bowers & Kirby, 2010; Carlisle, 2003; Carlisle & Goodwin, 2013; Kearns, 2015). This literature review includes four sections: the first briefly explains morphological awareness, and the second discusses the theoretical underpinnings that support research into the relationship between elementary students' morphological awareness and other literacy skills. The third section provides a synthesis of research of the morphological awareness processes used by elementary students identified with a reading disability or as struggling readers. The last section provides information from specific studies regarding issues involved in the measurement of morphological awareness.

Morphological Awareness

Morphemes are the building blocks of language in which individual morphemes provide syntactic and semantic information encoded in words (Carlisle, 2000). A free morpheme, also known as a base-word or root word, can be used on its own (i.e., *run*). Bound morphemes are affixes that are added to a word to create other words. When the affix changes the tense or number of the base-word, it is considered an *inflectional* morpheme (i.e., *unlikely* or *runs*). When the affix changes the meaning and/or class of the word, it is considered a *derivational* morpheme (i.e., *fame* to *famous*). In addition to inflectional and derivational morphemic processes, compound words can be created by adding free morphemes (e.g., *dog + house = doghouse)* (Goodwin et al., 2011).

Word identification is influenced by many processes, but for the purposes of creating morphological awareness tasks there are three main considerations: base-word frequency (Nagy, Anderson, Schommer, Scott, & Stallman, 1989), transparency of morphemic structure (Goodwin et al., 2011), and developmental stage of the students assessed (Carlisle, 2000). Words that have highly productive bases are more likely to be recognized, because they occur much more frequently in print (Carlisle & Stone, 2005; Reichle & Perfetti, 2003). An example from Carlisle and Katz (2006) shows nine words that derive from *intense* (*intensive, intensely, intensity, intensify, intensified, intensifiers, intensifying, intensities*, and *intensively*) as opposed to *serene* which includes only *serenely* and *serenity* in its family. *Intense*, with its family members, is more productive and, therefore, more likely to be encountered in print by readers than *serene* and its members.

Transparency of multimorphemic words also plays a significant role in word reading (Carlisle, 2000). A word is considered phonologically transparent if the pronunciation of the word is not significantly changed when additional morphemes are added. *Happy* is phonologically transparent in the word *happiness*. A word is said to be phonologically opaque when the pronunciation of the derived word differs significantly from the base, as in *heal* and *health* (Carlisle & Stone, 2005). Orthographically transparent words maintain spelling of the base within the derived word, as in *love* and *lovely*. By contrast, derived words are considered orthographically/morphologically opaque when the word does not retain most of the spelling of the base-word, as in the transition of *old* to *elder*. Orthographic transparency and morphologic transparency are different terms for the same concept, so a *morphologically opaque derivative* is a word that has undergone a significant spelling change during derivation. A word can be either phonologically or morphologically opaque or it can be both phonologically and morphologically opaque.

Morphological awareness of derived words appears to develop from third to fifth grade such that by fifth grade, students are much better at reading phonologically opaque words in text than they were as third graders (Carlisle, 2000). From a developmental perspective, younger students that are learning to read derived words are better able to read phonologically and morphologically transparent words, while older readers develop the necessary morphological awareness to read increasingly complex words that are phonologically and/or orthographically opaque (Carlisle & Stone, 2005). When creating a test of morphological awareness it is important to target the appropriate base-word frequency, phonological and/or morphological opacity, and developmental stage of the students to be tested.

Morphological Awareness and Literacy Skills of Elementary Students

English is a morphophonemic language, so readers must use both phonological and morphological skills in order to read text fluently and with good comprehension (Elbro & Arnbak, 1996; Goodwin et al, 2011). Consensus among reading researchers is that morphological awareness contributes significantly to many other literacy skills (Deacon & Kirby, 2004; Kruck & Bergman, 2013; Nagy, Berninger, & Abbott, 2006;

Pressley, 1998). The literacy skills most commonly associated with morphological awareness include word level reading skills (including decoding, word reading, and nonword reading), fluency (including rate, accuracy and prosody), spelling, vocabulary knowledge, and reading comprehension.

These literacy processes are integral to the reading process, and they support one another in ways still not fully understood, although many theories exist. The convergence of data shows that morphological awareness relates to word level reading skills across the elementary grades (Goodwin et al., 2011; Kirby et al., 2012; Kruck & Bergman, 2012). In fact, by the fifth grade, morphological awareness is a better predictor of word reading than phonemic awareness (Carlisle & Stone, 2005; Tong et al., 2011).

Morphological awareness has also been found to make unique contributions to reading comprehension and fluency. In a 2012 study by Nunes, Bryant, and Barros, participant data from the Avon Longitudinal Study of Parents and Children (ALSPAC) in western England were compared to the results of achievement tests of 7,354 children (2,080 children with a mean age of 12; 2 and 5,521 children with a mean age of 13; 10). Predictor variables included the WISC-III-UK-Verbal IQ, and word decoding, pseudoword decoding, and spelling subtests. Outcome variables included the TOWRE assessment and the Neal Analysis of Reading Ability—Second Revised British Edition (NARA-II), which measures fluency and reading comprehension. By means of multiple regression, Nunes, et al. determined that children's morphological awareness use and use of graphophonic units each make unique contributions to reading comprehension and reading fluency.

In order to form a complete picture of the global relationship of morphological awareness to other literacy skills, it is necessary first to consider their associations individually, beginning with word level reading skills. Accurate, fluent word reading requires integration of both phonological and morphological awareness processes in order to decode and recognize words (Ehri, 1998). Beginning readers learn to recognize the phoneme-grapheme relationship in order to sound out words (Ehri, 1998). Once sounded out, words can then be recognized from the reader's oral lexicon (Chall, 1983). Phonological decoding of words is a foundational skill that builds reading fluency from the bottom up (Cutting & Scarborough, 2006). It offers beginning readers the chance to practice reading, which leads to automaticity of word reading (Ehri, 2000). Words read automatically have been encoded as whole units in the lexicon (Chall, 1983; Ehri, 2000). These lexical units can be words, morphemes, and graphophonemes (Kearns, 2015). Morphological awareness is part of the foundational process of decoding and word recognition necessary for developing reading fluency and comprehension.

Morphological awareness is also part of the top down process by which word parts (i.e., graphophonemes and morphemes) are recognized in larger words and are retrieved from the lexicon (Kearns, 2015; Venezky, 1979; Verhoeven & Perfetti, 2003). Recognition of individual morphemes within a word offers a host of benefits to the reader, including pronunciation and information about word origin, spelling, meaning, and usage (Carlisle & Katz, 2006; Coltheart, Rastle, Perry, Langdon, Ziegler, 2001; Kearns, 2015). Morphological awareness provides semantic, syntactic, and definitional information used to read and understand words (Berninger et al., 2010; Bowers & Kirby, 2010). It can also used in higher order analysis of multisyllabic, multimorphemic words because multisyllabic words often contain multiple morphemes (Kearns, 2015; Nunes & Bryant, 2006). These analytical processes are implicit for the majority of readers (Carlisle & Fleming, 2003).

Phonological and morphological awareness both contribute to reading competence (Carlisle & Fleming, 2003; Kearns, 2015; Nunes et al., 2012). This becomes increasingly evident as word complexity increases, and young readers begin encountering multisyllabic, multimorphemic words. Dual-route theory suggests that readers access the mental lexicon using dual phonological/orthographic and morphological paths (Coltheart et al., 2001; Deutsch, Frost & Forster, 1998; Elbro & Arnbak, 1996). Integrated use of phonological/orthographic and morphological awareness skills increases reading comprehension and vocabulary acquisition by their bidirectional nature (Coltheart et al., 2001). Students use morphemic analysis to define unknown words in order to understand text; and they use reading comprehension to infer the meaning of new words. Through this process morphological awareness is able to strengthen both vocabulary knowledge and reading comprehension.

Using morphemic analysis, readers can parse multisyllabic, multimorphemic novel words into more recognizable morphemic constituents in order to pronounce, spell, and define them (Carlisle, 2000; Carlisle & Goodwin, 2013; Ehri, 2000; Gilbert, et al., 2013; Kearns, 2015). In general, multisyllabic word reading begins during the third grade when children may encounter between 4,000 and 10,000 new words each year, of which half are morphologically complex (Nagy & Anderson, 1984). From third to fifth grade students' awareness of morphologically derived words increases sharply (Anglin, 1993), as these young readers encounter three times more derived words than root words. Vocabulary growth between the second and fifth grades averages between 2.3 and 3.0 words per day. This rapid vocabulary growth has been attributed, at least in part, to morphological awareness (Ehri, 2000).

According to triple word form theory, phonological, orthographic, and morphological awareness are individual processes that co-develop in a reciprocal and mutually facilitative way (Berninger et al., 2010), and this growth is greatest during the elementary years (Berninger et al., 2010; Bahr, Silliman, Berninger & Dow, 2012). Young children quickly learn morphological word production roles and can be seen generating novel words by using affixes in creative ways (Ehri, 2000).

As morphological awareness grows, children learn to connect strings of phonemes (language sounds) to morphemes (letter combinations that have meaning; Ehri, 2000). For typical readers, repeated exposure through reading builds the lexical representations of words and morphemes that are necessary for rapid access during fluent reading. Children become aware of morphemes implicitly through exposures to print and through explicit instruction (Carlisle, 2000). Spelling and pronunciation are products of morphemic analysis, which is also used to gain meaning from words (Carlisle, 2000); and word comprehension is used to understand sentences (Carlisle, 2003; Tong, Deacon, Kirby, Cain & Parilla, 2011). In this manner, morphological awareness contributes to decoding, sight word reading, and reading comprehension beginning in early elementary years (Deacon & Kirby, 2004; Wolter, Wood & D’zatko, 2009).

According to Perfetti and Hart (2002), in order to have good reading comprehension one must have high lexical quality at the word reading level. Orthographic-phonological mapping must occur rapidly during reading, and retrieval of the word meaning from the lexicon must be swift. If the lexical quality of the retrieved word is good, it contains an amalgam of orthographic, semantic, and phonological information (Perfetti & Hart, 2002). Poor lexical quality results in partial word representation and can lead to a breakdown in comprehension at the word level.

Adding to Perfetti and Hart's lexical quality hypothesis (2002), Berninger et al. (2010) assert that phonological, morphological, and orthographic awareness are interrelated and requisite for normative reading comprehension. These linguistic functions are mutually supportive because English is a morphophonemic language. The English language has evolved to include many words that have been adopted from other languages, often retaining their unique morphological and phonological representations (Venezky, 1979). Morphemes convey information about word origin and meaning which the astute reader can use to pronounce, decode and define novel words (Roberts, Christo, & Shefelbine, 2013). It follows that morphological awareness is correlated with measures of decoding, fluency, spelling, vocabulary and reading comprehension (Nunes & Bryant, 2006; Nunes et al., 2012; Rasinski et al., 2011).

Nagy et al. (1989) found that morphologically related words, both inflectional and derivational, are more quickly recognized than words with overlapping letter strings (i.e., *fee*, *feet*, *feed*), supporting the hypothesis that morphologically related word families are organized together in the lexicon. This provides further support that the ability to recognize root words allows more efficient retrieval from the lexicon than phonetic reading alone (Nagy et al., 1989). Rapid and efficient word recognition separates good and poor readers (Nagy et al., 1989). Research indicates that morphological awareness contributes to reading comprehension directly (Apel et al., 2013; Nagy et al., 2006), and the interaction of word reading and morphological awareness together contributes to reading comprehension (Gilbert et al., 2013).

Morphological Awareness of Elementary Students with Reading Disabilities

An estimated 25 percent of students with reading disabilities do not show significant reading growth despite intensive phonics instruction (Torgesen et al., 2001). For those students, an additional route to reading must be devised. A study by Arnbak and Elbro (2000) found that “meaning-oriented decoding strategies” may offer help for the reading disabled by bridging bottom up word level decoding skills with top down fluency and comprehension through the use of morphemic analysis. Several factors explain why morphological awareness may offer particular advantage to the reading disabled. Average readers show developmental advancement of morphological processing, though their understanding of the process is implicit rather than explicit (Carlisle, 2000). Anglin defined reading development in terms of “increasing morphological complexity” (1993); while Abbot and Berninger (1999) advised that English is layered in morphemic patterns from Anglo-Saxon, Greek, Latin, and French.

As readers mature, they are exposed to and begin to access an increasingly sophisticated English vocabulary that has evolved from these languages. Morphemic awareness provides a wealth of syntactic, semantic, and orthographic knowledge for readers able to access it (Berninger et al., 2010). A recent study of late-emerging poor readers estimated that 52 percent had reading comprehension problems, 36 percent had word reading problems, and 12 percent had both comprehension and word reading problems (Catts, Compton, Tomblin & Bridges, 2012). For late-emerging poor readers, increased morphemic analysis ability may provide help with both word reading and comprehension (Gilbert et al., 2013; Torgesen et al., 1997). Measurement of morphological awareness might provide the opportunity to predict late-emerging poor readers for early intervention (Tong et al., 2011; Kirby et al., 2012), as research continues to unravel the relationship between morphological awareness and reading comprehension.

The interaction between morphological awareness and reading comprehension is not directly addressed by the lexical quality theory or the simple view of reading; however, by extension both theories encompass morphemic skills. In order for adequate lexical quality of words to develop, semantic, phonological, and orthographic components must be fully formed (Perfetti & Hart, 2002); and morphological awareness is an integral part of those components of reading (Carlisle, 2000). Morphological processing is a core component to developing high quality lexical word representations (Tong et al., 2011). Poor morphological awareness negatively impacts lexical quality, thereby inhibiting word reading accuracy. Inadequate morphological processing inhibits both the bottom-up decoding and top-down semantic and syntactic processing necessary for good reading comprehension (Carlisle, 2000; Carlisle & Stone, 2005; Kearns, 2015). These negative outcomes of poor morphological awareness help explain why some fifth grade students with average phonological decoding skills are late to emerge as poor comprehenders (Tong et al., 2011), and/or have difficulty reading multisyllabic, multimorphemic words (Kearns, 2015).

Inclusion Criteria. While there are many studies exploring the relationship between morphological awareness and other literacy skills used by typical readers, the use of morphological awareness by elementary students with reading disabilities has been measured less frequently (Goodwin & Ahn, 2010; Reed, 2008 Torgesen et al., 2001; Torgesen, et al., 1997; Wolter & Dilworth, 2014). In order to identify relevant studies, a comprehensive search was conducted using the search engines ERIC, MEDLINE, Education Full Text, PsycInfo, Web of Science, ScienceDirect, MIT CogNet, and JSTOR. Only peer reviewed, quasi-experimental studies using quantitative data published between 1950 and 2015 were considered. Unpublished dissertations, case studies, book reviews, and studies including foreign language acquisition or including L2 students were rejected. Only studies including a measure of morphological analysis and another standardized assessment of literacy were included. A preliminary search of these databases using the Boolean phrase *morphological* OR *morphology* returned 21,328 entries. Narrowing the search to the terms *morpholog** AND *elementary* AND *literacy* yielded 72 entries, of which only 30 involved L1 students; and of those 30 articles, 15 were studies of students in grades one to six that were identified as having a reading disability or as struggling readers. Of the 15 studies measuring the morphological awareness of elementary struggling readers 13 were intervention studies and two were measurement-only studies. Despite the present study being a measurement study of struggling readers it was determined that eliminating the intervention studies would overly narrow the review of literature.

The 15 primary studies generally fell into overlapping categories relating morphological awareness to word level reading processes (decoding, pronunciation, fluency, spelling, word structure, word reading) or vocabulary processes (definitional access and word recognition) as literacy skills that support reading comprehension. No studies were found that only studied morphological awareness and reading comprehension. The variety of researcher-created measures of morphological awareness that were compared to an array of standardized literacy measures resulted in diverse findings. Study designs tended to be so different that direct comparison between studies was difficult; however, excluding any of these studies based on design would have narrowed significantly the field of research.

Morphological Awareness and Word Level Reading. Studies of morphological awareness use of elementary students with reading difficulties have shown that increasing morphological awareness provides a boost to a variety of literacy skills. Eight primary studies compared morphological awareness to phonological processes such as decoding, word pronunciation, and word recognition. Studies by Berninger et al. (2003), Henry (1989), Henry (2003), Leong (1989), Lovett and Steinbach (1997), Lovett et al. (2000), Nagy et al. (2003), and Nunes et al. (2006) were constructed on the premise that morphemes represent larger phonological units, therefore improvement in morphemic analysis should improve word reading. In a series of studies from 1988 to 1993, M. K. Henry researched third, fourth, and fifth grade student groups with reading disabilities and found that the groups who received morphophonemic instruction that included word origin lessons made more gains on reading measures than the phonics-only groups.

Studies by Lovett and Steinbach (1997) and Lovett et al. (2000) combined phonics training with morphemic analysis instruction (word identification) and compared it to phonics-only instruction. Instruction in morphemic analysis was limited to affix identification and word pronunciation. Students, in grades two through six, made equivalent gains across grade levels and among intervention types. However, phonics-only instruction produced gains in phonological processing, whereas the morphological-phonological intervention showed transfer to real words of transparent and opaque morphology. This series of reading studies headed by Lovett used multilinguistic interventions targeting second to fifth graders with severe reading disabilities and found that all grade levels responded to the interventions; and all groups made significant gains on the word attack and word identification subtests (Woodcock-Johnson Reading Mastery Test-Revised, 1987; Lovett & Steinbach, 1997; Lovett et al., 2000b).

Of the eight studies investigating the relationship between morphological and phonological awareness, two were measurement-only studies by Leong (1989) and Nagy, Berninger, Abbott, Vaughan, and Vermeulen (2003). In Leong's study, fourth, fifth and sixth grade good vs. poor readers were asked to read primed words of varying morphological complexity on a computer screen. Findings indicated that poor readers also have poor morphological awareness, as indicated by a significantly slower response time reading orally primed words. The tests of morphological awareness used by Nagy, et al. included tasks of derivational production, compound structure, and morphological relatives more commonly found as intervention measures of morphological awareness. In the study by Nagy et al. morphological awareness uniquely predicted reading contribution above measures of phonological awareness and oral vocabulary for second graders at risk of reading disabilities

Designed to test the dual-route theory, third and fourth graders in a study by Nunes et al. (2006) received either morphological awareness training, phonics with writing instruction. A control group received the school's standard phonics instruction. Both intervention types were split into subgroups that either did or did not include writing, and performance was compared to a control group . It was expected that students who received instruction in morphemic analysis would show greater increases in sight word reading, while students receiving instruction in phonetics would show greater increases in decoding. Both groups made greater gains in word reading than did the control group. Berninger, et al. (2003) found that training in morphemic analysis helped compensate for phonological processing deficits in dyslexic fourth to sixth grade students' word reading. As with the Nunes, et al. study, teaching students to use larger word chunks (morphemes) increased word reading fluency. This may be because good readers already have implicit understanding of morphological processes that struggling readers specifically lack (Berninger et al., 2010).

Five studies of the role of morphological awareness on word recognition, word reading, writing, and spelling were conducted by Abbott and Berninger (1999), Berninger et al. (2003), Berninger et al. (2013), Kirk and Gillon (2009), and Wolter and Dilworth (2014), and all studies showed morphological awareness was significantly correlated to word reading and word recognition. In astudy by Arnbak and Elbro (2000), dyslexic Danish students showed significant improvement in word level reading skills after morphemic instruction in affix meanings and determining root words because working with chunks of words instead of strings of letters reduced the load on verbal memory. As a result of this and prior studies, Arnbak and Elbro felt that students in their experimental group began to develop an "alternative encoding strategy based on morpheme units" which enabled increased word level reading skills (p. 248). Studies by Kirk and Gillon (2009) and Wolter and Dilworth (2014) focused on improving decoding by adding morphological awareness instruction to phonological-orthographic reading interventions for second through fifth grade students struggling readers. Students in both studies showed greater gains in reading comprehension than control groups with phonics instruction only.

Morphological Awareness and Word Meaning. Because morphemes are building blocks of language, they are used as a sophisticated decoding skill, as well as, tools to aid readers through syntactic contextual cues, pronunciation and word meaning (Carlisle, 2000). Readers may use these discrete bits of meaning when encountering unfamiliar words for vocabulary building, and vocabulary is very important for reading fluency and comprehension.

A study by Tong et al. (2011) that measured the derivational morphology, word reading, and passage comprehension of fifth graders and sorted them into groupings of poor, average, and good readers. Comparing archival data from the third grade, researchers examined reading assessment data of fifth grade poor comprehenders and grouped them into expected and unexpected poor comprehenders. Third graders who demonstrated inadequate decoding skills were expected to develop reading comprehension difficulties by fifth grade. However, unexpected poor comprehenders comprised a group that had good decoding skills in third grade, yet still developed poor reading comprehension. The researchers found that fifth grade unexpected poor comprehenders had poor analytic use of derivational morphology. In contrast, fifth grade unexpected good comprehenders tended to have poor decoding skills in third grade, but had average derivational morphological awareness. The researchers credited the relative strength or weakness in derivational morphology skills as a contributing factor in comprehension.

Despite widespread belief that explicit instruction in morphemic analysis is effective (Apel & Swank, 1999; Carlisle & Goodwin, 2013), research has shown mixed results (Reed, 2008). At present there is no general agreement about what specific type of morphemic instruction is most beneficial for older elementary students, though derivational morphology appears to play a significant role in reading during that developmental stage (Carlisle, 2000). Part of the problem of determining whether interventions which include direct instruction in morphemic analysis is that no valid and reliable assessment battery is generally recognized to adequately measure morphological awareness use of students in the later elementary grades. It is imperative to accurately measure morphological awareness use in order to determine whether direct instruction of morphemic analysis in reading interventions is a good use of instructional time.

Measuring Morphological Awareness

Determining the differences in skills use between typical and struggling readers is a primary step in knowing how best to remediate a reading difficulty. However, the scant research into multilinguistic interventions used to treat elementary students with reading disabilities generally does not measure growth of morphological awareness. In a review of interventions that incorporated morphological awareness instruction in grades K through 12, Carlisle (2010) found 16 intervention studies in six languages that administered both a measure of morphological awareness and a measure of another literacy skill such as word reading or comprehension. Since Carlisle's integrative review of morphological awareness interventions, one additional study has been published which fit these criteria (Wolter & Dilworth, 2014).

Collectively, these studies measure a range of literacy outcomes including spelling, word reading rate, word reading accuracy, fluency, and reading comprehension. While it is important to measure targeted reading goals such as word accuracy or fluency in order to determine the magnitude of effect a treatment has on the desired outcome, those measures may not reveal the full effects of the intervention (Carlisle, 2010). It is critical to measure directly the morphemic analysis skills taught during intervention in order to determine whether significant, positive progress in literacy skills has been achieved. Investigations into the efficacy of interventions that include instruction of morphological awareness should measure changes in the specific morphemic analysis skills being taught and at least one other literacy outcome (Carlisle, 2010) in order to determine whether morphological awareness is a causal contributor to other reading skills.

Morphological awareness has been researched using a variety of study designs and a variety of tasks created to assess morphological awareness. This body of research includes studies that measure different types of morphological awareness used by various student populations, from children as young as four (Tyler, Lewis, Haskill & Tolbert, 2002) through adulthood (Leiken & Hagit, 2006). The developmental stages of the types of morphological awareness used by typical readers have begun to take shape. Research into the kinds of morphological awareness used by students with an array of reading difficulties has been included in both measurement studies (Gilbert, et. al., 2013; Kearns, 2015; Leong, 1989) and intervention studies of multilinguistic instruction that include morphemic analysis (Arnbak & Elbro, 2000; Baumann et. al., 2002; Berninger et al., 2003).

Despite the diverse tasks of morphological measurement that have been used in a variety of studies of students in the later elementary grades, no morphological assessment battery has been devised to measure the morphological awareness that fourth and fifth graders with reading difficulties would be expected to use. Morphological awareness tasks must adequately measure both the processes used by readers and the increased awareness caused by explicit instruction in morphemic analysis in order to determine any causal effects of morphological awareness on other literacy skills. What reading research currently lacks are studies determining which types of assessment tasks are most relevant for fourth and fifth grade students. Development of this morphological assessment battery, refined from prior research studies of the use of morphological awareness by elementary students, contributes to that research effort.

Tasks of Morphological Awareness

Studies by Apel et al. (2013) and by Carlisle (2010) review the types and nature of morphological assessment tasks. Carlisle divides morphemic analysis interventions into those designed to improve phonological awareness, orthographic development, and word learning. To determine efficacy of an intervention, the particular morphemic analysis skill that has been taught must be adequately measured. Just as interventions blend many literacy skills into the language arts curriculum (Carlisle, 2010), assessment of these skills are often a mix of morphological awareness tasks (Apel et al., 2013). A judgment task, an identification task, an analogy task, and a production task were combined to create the morphological awareness (MA) battery used in the present study. The Morphological Awareness Assessment Battery (MAAB) is a shorter version of the MA battery that has five researcher created questions based on the design of each of the four tasks used in the MA battery..

Analogy Tasks. This task generally requires readers to complete an analogy using inflected and derivational forms. Items may vary in their morphological and/or phonological opacity depending on the degree of task difficulty required. Analogy tasks can be word tasks (e.g., mortal: mortality::mature: ____), as used in a 2012 study by Kirby, et al. They can also take the form of sentence tasks like the ones used in a 2004 study by Deacon and Kirby (e.g., Today I <u>play</u> at school. Yesterday I <u>played</u> at school. Today I <u>work</u> at home. Yesterday I ____ at home.) One of the most well-known analogy tasks is Berko's Wug test (e.g., "Here is a *Wug*. Now there are two ____."), which was designed to measure the knowledge and use of inflectional morphology by very young children (as cited in Goodwin et al., 2011). Sentence tasks measure inflectional morphology only; else they begin merging into becoming production tasks (Apel et al., 2013).

In a longitudinal study of typically developing readers from first to third grades, Kirby et al. (2012) found that the word analogy task uniquely predicted reading comprehension beyond word reading. The analogy task used in the present study is the same task used in the Kirby et al. study of reading development, which produced a split-half reliability of .80, .91, and .89 for first, second, and third grades respectively. The researchers first measured 103 children during the latter half of kindergarten using Raven's Colored Progressive Matrices (Raven) and the PPVT-III. During the first grade, students were administered the Word Blending and Elision subtests of the Comprehensive Test of Phonological Processing (CTOPP). In the fall of their first, second, and third grade years, students were assessed using the Word Analogy task by Kirby et al. The 20-item Word Analogy task was composed of 10 inflectional and 10 derivational items. During the fall of their third grade year, students were also administered the Woodcock Johnson, Third Edition (WJ-III) word attack, word identification, and passage comprehension subtests, and the word reading speed subtest of the Test of Word Reading Efficiency (TOWRE, 1999). Researchers used two passages from the GORT-IV to measure text reading speed.

In the study by Kirby et al. (2012) Raven and PPVT-III means indicated the kindergarten sample was slightly above norms for that age; however, WJ-III word attack, word identification, word reading speed, and passage comprehension subtest means were average for third grade. Researchers noted that the analogy test means increased during subsequent measurements across grade levels and that students found the task was increasingly easier. Correlation among all outcome variables and morphological awareness during third grade was significant ($p < .01$), and passage comprehension and the analogy test were moderately correlated at $r = .67$. Using hierarchical regression analysis, the researchers determined that morphological awareness was a unique predictor of reading comprehension beyond measures of phonological awareness and intelligence. At third grade, the effect size of morphological awareness on text reading speed and passage comprehension was comparable to phonological awareness.

Judgment Tasks. Judgment tasks typically require the student to decide whether two words are used correctly or whether they are semantically related. These may require yes/no responses, as in the case of "Does moth come from mother?" (Berninger et al., 2010; Ku & Anderson, 2003; Nagy et al., 2006). Other judgment tasks are multiple choice (e.g., *light, lighter, lightly, lit.* Will you turn on the ____?). These tasks can be presented as oral-only or oral and written tasks; and the target words may be inflectional and/or derivational, phonologically and/or morphologically opaque (Apel et al., 2013). Judgment tasks represent the greatest variety and number of morphological awareness measures.

The judgment task used in the present study comes from Goodwin, Gilbert, and Cho's Test of Knowledge of Derivational Relationships (2013). The Goodwin et al. measurement study used two tasks to test the morphological awareness of 221 seventh and eighth grade students. The first task, often called the "comes from" task, required readers to determine whether two words were morphologically related. The correlation between reading comprehension and the "Comes From" task was .57 in the Goodwin et al. study of middle school students.

Identification Tasks. The identification task came from a research study by Singson, Mahony, and Mann (2000). The identification task required students to select the pseudoword with the appropriate derivational suffix in order to complete a sentence. Students relied on their knowledge of derivational suffix usage in order to determine which pseudoword could be used to complete the sentence in a grammatically correct manner (e.g., I could feel the froodness). In the study by Singson et al., the identification task and word attack were moderately correlated ($r = .57$; $p < .001$); however, the identification task was not compared to a measure of reading comprehension.

Production Tasks. Production tasks often use a cloze procedure to assess whether a student can derive a word (e.g., *Sleep*. Yesterday I _____.) (Wolter et al., 2009; Casalis, Colé, & Sopo, 2004) or decompose a multimorphemic word (e.g., *Teacher*. Ms. Smith likes to ____; Berninger et al., 2010). Researchers have also studied various productive responses to multimorphemic words. Wolter et al. (2009) asked students to spell words to determine their ability to spell suffixes; and Kirk and Gillon (2009) used prompted spelling to get students to spell morphologically complex words like *mopping* and monomorphemic words such as *trick*. Researchers have required students to read words aloud (Carlisle, 2000; Jeon, 2011), and others have asked students to define multimorphemic real and nonsense words (Tsesmeli & Seymour, 2006). Goodwin et al. (2011) presented their Extract the Base test orally and visually to L1 and L2 learners, requiring students to decompose multimorphemic words of varying morphological and phonological opacity (e.g., *height*. That box is too ___). Extract the Base was developed from Carlisle's (1988) Base Forms Test. In this manner researchers insure continuity of assessment by using and refining tasks from prior research.

The production task used in the current research study comes from Carlisle's 2000 study of the morphological awareness use typical of elementary school readers. In her study, 34 third graders and 26 fifth graders who scored above the 30th percentile on the school's Comprehensive Testing Program (CTP) vocabulary and reading comprehension subtests were assessed on researcher-designed measures of word reading, a test of morphological structure (TMS), and the Test of Absolute Vocabulary Knowledge designed by Anglin (1993).

Carlisle's TMS is a two part production task of 28 items each. One half of the assessment requires the participant to decompose derived words in order to finish the sentence (e.g., driver. Children are too young to ____.); while the other half of the assessment requires students to derive words from base forms (e.g., farm. My uncle is a ____.). While the TMS was found to be highly correlated with fifth grade reading comprehension ($r = .69$; $p < .0001$), Carlisle reported that the decomposition half of the assessment was a less effective measure due to possible ceiling effects. Therefore, only the 28-item derivation task was used in the current MA battery.

Research Questions

This research focuses on the measurement of morphological awareness and its prediction of reading comprehension by fourth and fifth graders with reading disabilities. Reading comprehension is a complex process involving many literacy skills, including morphological awareness. Therefore, it is also valuable to measure the ability of morphological awareness to predict word reading, receptive vocabulary, reading rate, accuracy, and fluency—factors known to influence reading comprehension.

In order to adequately measure morphological awareness, it is imperative to use multiple measures of morphemic analysis skills. Multiple measures help mitigate item imperfections, as well as provide a wide-array of information about skills of morphological awareness. Morphological awareness is developmental, and research data show which tasks typical fourth and fifth graders can be expected to perform (Gilbert et al., 2013; Goodwin et al., 2011). However, students in the later elementary grades who have reading difficulties may experience developmental delays in some literacy skills (Lovett & Steinbach, 1997; Stanovich, 1993), while relying on other reading skills as coping mechanisms that same-aged typical readers do not need or use (Elbro & Arnbak, 1996; Leiken & Hagit, 2006; Pressley, 1998). This research study combines four tasks used in prior research in order to create a morphological awareness (MA) battery and a much shorter test called the Morphological Awareness Assessment Battery (MAAB) that was created using the design of the MA battery tasks. The purpose of this research study was to create an assessment battery sensitive and comprehensive enough to measure the complex relationship between the morphological awareness and reading comprehension of fourth and fifth grade students with reading difficulties. No other research study has used a battery of morphological awareness tasks to predict the reading comprehension of later elementary students with reading difficulties.

This research study answers these questions:

1. What are the reliability estimates of the MA battery and the MAAB?
2. What is the ability of the MA battery and/or the MAAB, both as the composite score and individual components, to predict reading comprehension?
3. What is the ability of the MA battery to predict word attack decoding, oral, receptive vocabulary and/or reading fluency?

CHAPTER THREE

METHOD

This study investigated four tasks designed to measure the morphological awareness abilities of 56 fourth and fifth grade L1 students identified as having specific learning disabilities in reading or as being struggling readers in RTI tier three intervention. Four tasks of morphological awareness borrowed from prior research studies were combined to create the MA battery. The four tasks of morphological awareness used to assess students' metalinguistic skills were the MA battery identification, analogy, judgment, and production subscales. The researcher compared the MA battery with established assessments of fluency, decoding, oral vocabulary knowledge, and passage reading comprehension. It was hypothesized that the MA battery would predict reading comprehension, fluency, decoding, and vocabulary. In order to investigate the independent ability of each MA battery subscale to predict reading comprehension for these students, additional analyses were performed on the MA battery subscales individually.

To each of the MA battery subscale tasks, five additional researcher-designed items were added to create the MAAB. The 20 items of the MAAB were also compared to established measures of fluency, decoding, oral vocabulary knowledge, and passage reading comprehension. The researcher hypothesized that a similar, shortened version of the MA battery would be able to predict the same literacy measures as the MA battery, while decreasing assessment time. Finally, stepwise regression analyses were conducted to explore the practical implications of refining the MA battery.

Participants

Participants were 22 fourth and 34 fifth graders in a rural school district in the Southeastern United States who were in tier three RTI or who were receiving special education services for a reading disability. Students scored below the 25th percentile on the Tennessee Comprehensive Assessment Program or on STAR Reading diagnostic benchmarks. Ethnicity of the sample included 43 Caucasian students (76%), seven African-American (13%), and six Hispanic (11%) students. Mean student age was 10 years, 7 months; and all students were native speakers of English. Twenty-six participants were female and 30 were male. Individual socioeconomic status of participants was unreported; however, all participating elementary school students received federally funded free breakfast and lunch.

Students in this study were assessed for placement in 13 small, ability-grouped intervention settings as part of the normal course of instruction. All participants received 60-minute Seeing Stars™ reading interventions four times a week during the entire 2015-2016 school year; and all passed screenings for hearing and vision deficits that could negatively impact academic performance. Each participant received intervention placement testing at the beginning of the school year, returned signed parental consent forms approved by the MTSU institutional review board, and provided personal assent to participate.

Measures

Students at the district's four elementary schools were administered a battery of assessments from mid-August to mid-September 2015. Students were ability-grouped for reading intervention using the following placement tests: the Reading Fluency and Passage Comprehension subtests of the Gray Oral Reading Tests, Fourth Edition (GORT-IV), the word attack subtest of the WRMT-III, and the Peabody Picture Vocabulary Test, Fourth Edition test of oral, receptive vocabulary (PPVT-IV).

Ability grouping using these tests is considered to be part of the regular course of instructional activities for these low-achieving students who have reading difficulties. Three district lead reading instructors received eight hours of training, were required to achieve 100% scoring and accuracy, and demonstrated 100% delivery accuracy of all placement assessments, including the GORT-IV, PPVT-IV, and WRMT-III. The two assessment trainers randomly observed one-third of all assessments as they were given in order to assure delivery accuracy. All measures were double-scored by the test administrator and an assessment administration trainer to ensure accuracy.

Because literacy skills are interrelated and vary depending on the reading task, multiple reading comprehension measures were used. The three reading comprehension assessments differ in instrument administration and measurement focus. Two tests assess students in an untimed one-on-one setting, while one test is group administered and timed. Two of the tests require multiple choice responses, while one requires the student to supply their own oral answer. All tests are norm-referenced and the assessment developers provide reliability and validity information.

Measures of Passage Reading Comprehension and Fluency. *Gray Oral Reading Tests, Fourth Edition*, Passage Comprehension (GORT-IV-PC) and reading fluency subtests are standardized, norm-referenced assessments for students aged six years to 18 years 11 months, in which students read passages aloud before answering multiple choice comprehension questions about the passage (Bryant & Wiederholt, 2001). The test administrator scores passage reading for rate, accuracy and overall reading fluency. Alternate form reliability for fluency is .94 and .95 for comprehension. The GORT-IV administration manual reports that concurrent validity was evaluated using teacher ratings of student ability, and comparisons to the GORT-III, the Iowa Tests of Educational Development (ITED), and the Diagnostic Achievement Battery, Second Edition (DAB-II; Bryant & Wiederholt, 2001).

Gates-MacGinitie Reading Tests, Fourth Edition, Passage Comprehension (GMRT-IV PC). The passage comprehension subtest of the GMRT-IV PC is a 35-minute, timed subtest in which students read passages and answer multiple choice questions about the text. It has been standardized and norm-referenced for individuals pre-kindergarten to adult. Concurrent validity when compared to the GMRT-III is .92. Reliability for the level four form is .96.

Woodcock Reading Mastery Tests, Third Edition, Passage Comprehension (WRMT-III PC). This reading comprehension assessment is individually administered to students, requiring them to answer orally to complete a passage they read aloud. It has been standardized and norm-referenced for individuals aged four years, six months to 79 years, 11 months. The WRMT-III PC has been compared to the Woodcock Reading Mastery Tests, Revised/Normative Update (WRMT-R/NU), the Kaufman Test of Educational Achievement, Second Edition (KTEA-II), and the Wechsler Individual

Achievement Test, Third Edition (WIAT-III) in order to ascertain concurrent validity. Median split-half reliability is .97.

Measure of Vocabulary. *The Peabody Picture Vocabulary Test, Fourth Edition* (PPVT-IV) is a standardized measure of receptive vocabulary in which students are asked to choose which of four pictures best represents the orally presented word (Dunn & Dunn, 2007). The test has been norm-referenced on participants from the age of two years, six months to 90 years. The PPVT-IV has an internal reliability of .90 to .96 for the age range 9 to 11 years. The test administration manual states that the PPVT-IV has been validated against other known vocabulary measures, including the PPVT-III.

Measure of Decoding Ability. The *Woodcock Reading Mastery Test, Third Edition,* (WRMT-III) word attack subtest includes pseudoword decoding of increasing difficulty; and it has been standardized and norm-referenced for individuals age ranged four years, six months to 79 years, 11 months. The WRMT-III word attack has been compared to the Woodcock Reading Mastery Tests, Revised/Normative Update (WRMT-R/NU) and the Wechsler Individual Achievement Test, Third Edition (WIAT-III) word attack subtests in order to ascertain concurrent validity. Median split-half reliability is .97.

Measure Development

The subscale measures in this study have been refined during previous studies by researchers and are representative of four different tasks of morphological awareness skills. Each of the subscale tasks of identification, analogy, judgment, and production that comprise the MAAB were used with permission. In addition to the original task items, the researcher created five additional items to each subscale task. These 20 new items were used in a parallel instrument, the MAAB, to determine whether a shortened version of the MA battery could similarly predict reading comprehension.

The target words in the newly created task items were evaluated using *The Educator's Word Frequency Guide* by Zeno, Ivens, Millard, and Duvvuri (1995). The U-value is word frequency per million words weighted by the dispersion (word family size). The standard frequency index (SFI) is a logarithmic transformation of the U-value across the corpus. The mean SFI and fourth and fifth grade level U-values (averaged) were identified for each task's target words in order to mitigate floor and ceiling effects. Words chosen for the new item were one- or two- syllable words from moderately to highly productive word families. The 20 newly created task items followed the design of the individual subscales of the MA battery.

Identification. The identification task required students to recognize real affixes attached to nonsense words in order to determine which word could correctly complete the given sentence. This measure assessed student knowledge of the rules of suffix usage, and came from a 2000 study by Mahony, Singson, and Mann. Because the target words were all nonsense words, the prior vocabulary knowledge of the participants was mitigated. Students were given sentences to complete with one of four multiple choice nonsense words (e.g., I could feel the ____. froodly, froodful, frooden, froodness). The MA battery identification subscale included 20 items and the MAAB identification subscale was composed of an additional five researcher created items. The target words were all pseudowords; therefore, there is no mean SFI or U-value to report.

Analogy. The analogy subscale used in the present study comes from a 2012 study by Kirby et al. that asked students to compare word pairs to complete a task of analogy. Productive tasks of analogy require completion of word sets such as: *pretty—prettier:: strong—*________, and are administered orally to students. Participants provided written responses to phonologically and morphologically derived words. The MA battery analogy subscale included six analogy practice sets before the 20 test items. The MAAB analogy subscale was composed of five additional newly created analogy task items.

Judgment. The judgment subscale in the current study was originally used by Goodwin, et al. (2013), who called it the "comes from" task. Students were exposed to pairs of words that appeared to be morphologically related and asked whether one word *comes from* another word. Examples included related word pairs such as *weigh--weight* and unrelated word pairs like *sold—soldier*. This task was read aloud by the test administrator and required a yes/no response. The judgment subscale of the MA battery comprised two practice items and 15 assessment items. An additional five new items composed the MAAB judgment subscale.

Production. The production task used in the current study came from a 2000 study by Carlisle, and it tested students' ability to derive a word from a morphologically related word in order to complete a sentence. This measure contained two practice items and 33 sentences that were completed by deriving a morphological relative from a priming root word (e.g., *Expand. The company planned an* ___________.). Students were assessed individually by the researcher or graduate student trained for this task. The task administrator read the priming word aloud twice before reading the sentence up to a maximum of two times. Students responded orally to the prompt and the researcher recorded the morphologically related word in the blank. The five test items that comprised the MAAB production subscale matched the larger set of 28 MA battery production subscale items. The MAAB was composed of 20 total items, five of each of the four different subscale tasks.

Procedure

Students were group assessed in a 50-minute session and individually assessed in 20 to 25 minute test sessions. The GMRT-IV PC and the identification, analogy, and judgment subscales of the MA battery were group administered by the researcher. The WRMT-III PC and the production subscale of the MAAB were individually administered by the researcher or a graduate research assistant. By completing the MA battery students have necessarily completed the MAAB. Each test session lasted 75 minutes. The assessment battery was delivered using scripted test directions.

Training time for the MAAB production subscale took approximately 15 minutes. Graduate research assistants were required to achieve 100% scoring accuracy and to demonstrate 100% delivery accuracy of the 28 item MA battery and 5 item MAAB production subscales. The WRMT-III PC and word attack and the GORT-IV PC and reading fluency subtests were administered by the researcher. The researcher was trained by Lindamood-Bell Learning Systems and was required to achieve 100% scoring accuracy and to demonstrate 100% delivery accuracy. One graduate researcher received WRMT-III test administration training through the Dyslexia Center in Murfreesboro, Tennessee where she was required to demonstrate 100% scoring and delivery accuracy. Only the researcher and the trained graduate researcher administered the WRMT-III PC. The MA battery and MAAB were double-scored to ensure scoring reliability.

Data Analysis

Analyses were conducted using SPSS 22. Internal reliability of the MA battery and the MAAB was evaluated using Cronbach's alpha, and item-test correlations were conducted to examine the relationship of subscale items to their subscales. Regression analyses were performed to examine the variance explained by the MA battery and the MAAB of each of the GMRT-IV, WRMT-III, GORT-IV passage comprehension (PC) tests, as well as the GORT-IV reading fluency test, the PPVT-IV test of receptive vocabulary, and the WRMT-III word attack test of decoding ability. Stepwise regression analyses were conducted on all subtests of the MA battery in order to probe the individual contributions to reading comprehension made by the subtests to their respective assessment batteries.

CHAPTER FOUR

RESULTS

Scoring Reliability

A rating rubric was created prior to test administration. After test administration, the researcher and a second rater examined MA battery analogy and production subscales to determine possible correct answers. The identification subscale was multiple-choice and the judgment subscale was yes/no response, so there was no need to make a qualitative determination of correct responses. However, the analogy and production subscales each had two items where alternate answers were considered. Minor adjustments were made to the scoring rubric and two raters scored all MA battery and MAAB responses. In instances where raters were in disagreement a third rater made the final judgment. Overall scoring reliability was 99.7% (5751 agreed items/ 5768 total).

Descriptive Statistics

Students in the sample were selected because they have reading difficulties. Mean scores for the GMRT-IV PC, the GORT-IV PC, the WRMT-III PC, GORT-IV reading fluency, PPVT-IV, and WRMT-III word attack confirmed that the reading skills of these students were significantly below average. Standard scores for the GORT-IV PC, the WRMT-III PC, the WRMT-III word attack, the PPVT-IV vocabulary, and the GORT-IV Fluency tests were used for analyses. Standard scores for the GRMT-IV PC were unavailable, so raw scores of this assessment were used in all analyses. Skewness and kurtosis values of all measures were analyzed and found to be within appropriate parameters. Descriptive statistics are reported in Table 1.

Table 1

Descriptive Statistics of Scores for Literacy Measures and MA Battery Outcomes (*N* = 56)

	M	*SD*	Range
WRMT-III Word Attack [a]	86.0	12.0	66-119
GORT-IV Fluency [a]	5.1	3.3	1-11
PPVT-IV Vocabulary [a]	89.4	11.5	67-114
GORT-IV PC [a]	6.5	3.1	2-13
WRMT-III PC [a]	83.1	10.0	57-101
GMRT-IV PC [b]	16.9	8.2	6 - 42
MA Battery [b]	36.3	10.5	16 - 65
Identification*	7.7	3.2	2 - 19
Analogy*	9.5	3.4	2 - 18
Judgment*	8.3	2.7	3 - 13
Production*	10.2	5.1	0 - 21
MAAB [b]	9.9	3.1	6 - 17
Identification**	1.8	1.2	0 - 5
Analogy**	2.6	1.6	0 - 5
Judgment**	3.5	1.2	1 - 5
Production**	2.1	1.2	0 - 5

Note. [a]Standard scores. [b]Raw scores. *MA battery Subscale. ** MAAB Subscale.

Reliability of the MA Battery and the MAAB

The MA battery, composed of four subscales totaling 83 items, produced Cronbach's alpha of .86, indicating the assessment battery had strong internal reliability. Cronbach's alpha for the MA battery subscales showed that the analogy ($\alpha = .71$) and production ($\alpha = .87$) subscales had acceptable internal reliability, whereas the identification ($\alpha = .61$) and judgment ($\alpha = .58$) subscales showed weak internal reliability. Item-test correlations for MA battery identification, analogy, and production subscales all produced moderate correlations (lower $r > .4$), however the judgment subscale produced $r = .25$ indicating only a small correlation with the MA battery. Classical Test Theory (CTT) item analysis of the relationship of each subscale item to the MA battery test yielded mixed findings. The MA battery identification and judgment subscales had 10 and 11 items respectively with $r < 2.0$, indicating these items had minimal to no correlation with the MA battery. The analogy and production subscales each had five items with $r < 2.0$. The moderate and strong correlations between the analogy and production subscale items and the MA battery indicated that these two subscales were likely to be the strongest predictors among the four subscales. Percentage correct, reliability, and CTT item-test correlations are reported in Table 2.

Table 2

Reliability and Item-Test Correlations for the MA Battery

	p	*SD*	*r*		*p*	*SD*	*r*
Identification	.38	.17	.46	Analogy	.47	.17	.49
Item 1	.45	.50	.21	Item 1	.39	.49	.00
Item 2	.23	.43	.36	Item 2	.82	.39	-.10
Item 3	.34	.50	.18	Item 3	.50	.51	-.06
Item 4	.34	.48	.27	Item 4	.16	.37	.37
Item 5	.43	.49	.22	Item 5	.13	.33	.28
Item 6	.38	.49	.14	Item 6	.34	.48	.30
Item 7	.20	.40	.08	Item 7	.70	.46	.22
Item 8	.25	.44	.14	Item 8	.39	.49	.37
Item 9	.36	.48	.17	Item 9	.46	.50	.25
Item 10	.32	.47	.31	Item 10	.59	.50	.32
Item 11	.46	.50	-.06	Item 11	.79	.41	.35
Item 12	.48	.50	.16	Item 12	.77	.43	.15
Item 13	.36	.48	.32	Item 13	.80	.40	.22
Item 14	.29	.46	.23	Item 14	.66	.48	.00
Item 15	.25	.44	.34	Item 15	.14	.35	.30
Item 16	.46	.50	.01	Item 16	.14	.35	.48
Item 17	.59	.50	.02	Item 17	.80	.40	.35
Item 18	.52	.50	.18	Item 18	.18	.39	.46
Item 19	.46	.50	.23	Item 19	.36	.48	.48
Item 20	.45	.50	.40	Item 20	.36	.48	.33

Table 2 (cont.).

	p	*SD*	*r*		*p*	*SD*	*r*
Judgment	.56	.18	.25	Production	.36	.18	.54
Item 1	.50	.51	-.18	Item 1	.25	.44	.46
Item 2	.93	.26	.12	Item 2	.95	.23	.45
Item 3	.38	.49	.30	Item 3	.34	.48	.25
Item 4	.79	.41	.04	Item 4	.02	.13	.10
Item 5	.52	.50	.10	Item 5	.55	.50	.51
Item 6	.63	.49	.12	Item 6	.61	.49	.39
Item 7	.77	.43	.19	Item 7	.30	.46	.38
Item 8	.45	.50	-.01	Item 8	.46	.50	.57
Item 9	.52	.50	.46	Item 9	.68	.47	.50
Item 10	.41	.50	-.15	Item 10	.64	.48	.55
Item 11	.75	.44	.32	Item 11	.29	.46	.50
Item 12	.46	.50	.18	Item 12	.14	.35	.56
Item 13	.61	.49	.17	Item 13	.70	.46	.50
Item 14	.27	.45	-.21	Item 14	.04	.19	.40
Item 15	.38	.49	.61	Item 15	.02	.13	.10
				Item 16	.00	.00	.00
				Item 17	.27	.45	.23
				Item 18	.50	.51	.32
				Item 19	.16	.37	.20
				Item 20	.18	.39	-.03
				Item 21	.89	.31	.52
				Item 22	.04	.19	.40
				Item 23	.84	.37	.48
				Item 24	.48	.50	.40
				Item 25	.38	.49	.21
				Item 26	.46	.50	.38
				Item 27	.13	.33	.54
				Item 28	.52	.50	.35

Note. *p* = percent answered correctly; *SD* = standard deviation; *r* = correlation coefficient

The MAAB totaling 20 items produced Cronbach's alpha of .53, indicating that this assessment battery had weak internal reliability. Item-total correlations for the individual MAAB subscales revealed that the analogy, judgment and production subscales produced $r > .4$, with only the identification subscale producing a weak correlation with the MAAB ($r = .24$). This was not surprising given that all five items of the MAAB identification subscale showed minimal correlation with the MAAB ($r < 2.1$). All five items of the MAAB analogy subscale were moderately correlated with the MAAB, but the MAAB judgment and production subscales each had two of five items that either minimally correlated or which showed no correlation with the MAAB. Reliability statistics for the MAAB are reported in Table 3.

Table 3

Reliability and Item-Test Correlations for the MAAB

	p	*SD*	*r*		*p*	*SD*	*r*
Identification	1.41	1.12	.46	Analogy	2.55	1.60	.49
Item 1	.21	.41	.21	Item 1	.57	.50	.53
Item 2	.34	.48	.10	Item 2	.52	.50	.51
Item 3	.30	.46	.05	Item 3	.63	.49	.50
Item 4	.30	.46	.01	Item 4	.63	.49	.34
Item 5	.25	.44	.21	Item 5	.21	.41	.31
Judgment	3.45	1.25	.25	Production	2.07	1.22	.54
Item 1	.55	.50	.18	Item 1	.23	.43	.21
Item 2	.80	.40	.39	Item 2	.23	.43	.12
Item 3	.59	.50	.24	Item 3	.73	.45	.28
Item 4	.75	.44	.40	Item 4	.45	.50	.23
Item 5	.75	.44	-.04	Item 5	.43	.50	.05

Regression Analyses of the MA Battery and MAAB

Regression analyses were conducted to determine if the MA battery or the MAAB significantly predicted reading comprehension. Three measures of passage reading comprehension were assessed using the GORT-IV PC, the WRMT-III PC, and the GMRT-IV PC. The MA battery explained 10% of the amount of the variance in reading comprehension as measured by the GORT-IV PC ($F(1,54) = 5.67$, $p < .05$, $R^2 = .10$, adjusted $R^2 = .08$), but the MAAB, although approaching statistical significance, was not a significant predictor of GORT-IV PC ($F(1,54) = 3.40$, $p = .07$, $R^2 = .06$, Adjusted $R^2 = .04$). Reading comprehension measured by the WRMT-III PC was predicted by both the MA battery ($F(1,54) = 51.19$, $p < .001$, $R^2 = .49$, adjusted $R^2 = .48$) and the MAAB ($F(1,54) = 25.30$, $p < .001$, $R^2 = .32$, adjusted $R^2 = .31$). The MA battery ($F(1,54) = 60.86$, $p < .001$, $R^2 = .53$, adjusted $R^2 = .52$) and the MAAB ($F(1,54) = 32.41$, $p < .001$, $R^2 = .38$, adjusted $R^2 = .36$) were statistically significant and explained 53% and 38% respectively of the variation in reading comprehension measured by the GMRT-IV PC. Table 4 includes regression coefficients for the MA battery and the MAAB.

Table 4

Regression Coefficients for the MA Battery, the MAAB, and Measures of Passage Reading Comprehension (n = 56)

Measure of Passage Reading Comprehension	Measure of Morphological Awareness	*F(1,54)*	R^2	Adjusted R^2	*P*
GORT-IV	MA Battery	5.67	.10*	.08*	.021
	MAAB	3.40	.06	.04	.07
WRMT-III	MA Battery	51.19	.49***	.48***	.000
	MAAB	25.30	.32***	.31***	.000
GMRT-IV	MA Battery	60.86	.53***	.52***	.000
	MAAB	32.41	.38***	.36***	.000

Regression analyses were performed to determine whether the MA battery or MAAB was able to predict a significant amount of the variation of WRMT-III word attack decoding, PPVT-IV oral vocabulary, and GORT-IV reading fluency—literacy skills known to support reading comprehension. Both the MA battery ($F(1,54) = 28.41$, $p < .001$, $R^2 = .35$, adjusted $R^2 = .33$) and the MAAB ($F(1,54) = 15.15$, $p < .001$, $R^2 = .22$, adjusted $R^2 = .21$) significantly predicted GORT-IV reading fluency. WRMT-III word attack was significantly predicted by the MA battery ($F(1,54) = 6.76$, $p < .05$, $R^2 = .11$, adjusted $R^2 = .10$), but the MAAB was not a significant predictor ($F(1,54) = 2.38$, $p = .13$, $R^2 = .04$, adjusted $R^2 = .03$) of word attack. Neither the MA battery ($F(1,54) = 1.38$,

p = .25, R^2 = .03, adjusted R^2 = .01) nor the MAAB (F(1,54) = 3.19, p = .08, R^2 = .06, adjusted R^2 = .04) were significant predictors of PPVT-IV oral, receptive vocabulary.

Additional investigation was conducted to explore the relationship between vocabulary and decoding. Comparison of person-level data of PPVT-IV and WRMT-III word attack standard scores showed that 24 of 56 students had a 15 point or more difference between vocabulary and decoding standard scores; and 15 of those 24 students had significantly higher vocabulary than decoding scores. Visual comparison of box plots, scatter plots, and histograms of the PPVT-IV (M = 89.4, SD = 11.5) and the WRMT-III word attack decoding (M = 86.0, SD = 12.0) showed that, despite having similar means and standard deviations, the PPVT-IV and word attack standard scores were distributed somewhat differently. Word attack scores were spread out, with less clustering of scores around the mean compared to vocabulary scores. The scatter plots demonstrated visually range of WRMT-III word attack scores (range = 66-119, SD = 12.0) compared to the slightly smaller range of PPVT-IV vocabulary scores (range = 67-114, SD = 11.5).

Further regression analyses were performed in an effort to evaluate the predictive ability of the individual subscales of the MA battery. The MA battery subscales were entered stepwise by order of magnitude of the correlation coefficients to each reading comprehension test. Stepwise analysis of the MA battery subscales included only the analogy subscale in the predictive model for the GORT-IV PC, while it failed to include the production, identification, and judgment subscales. The only subscale included in the model, the analogy subscale significantly predicted 25% of the variation in GORT-IV PC

($F(1, 54) = 18.07$, $p < .001$, $R^2 = .25$, adjusted $R^2 = .24$). Stepwise regression analysis included the analogy and production subscales in the model that significantly predicted WRMT-III PC ($F(1, 54) = 33.44$, $p < .001$, $R^2 = .56$, adjusted $R^2 = .54$), but failed to include the identification and judgment subscales Production, analogy, and judgment subscales, in order, were included in the stepwise regression model that significantly predicted the GMRT-IV PC ($F(1, 54) = 21.74$, $p < .001$, $R^2 = .56$, adjusted $R^2 = .53$).

CHAPTER FIVE

DISCUSSION

Reading development is characterized by exposure to increasingly complex layers of morphological complexity across subsequent grade levels (Anglin, 1993). Morphological awareness contributes to reading comprehension by supporting other literacy skills (Kearns 2015), and it has been found to contribute to reading comprehension directly (Nunes et al., 2012). Evidence from studies by Casalis et al. (2004) and Elbro and Arnbak (1996) suggest that struggling readers may rely on morphological awareness skills in ways that typically developing readers do not. Development of reliable and valid assessments of morphological awareness is critical in order to measure the processes that occur during reading development and to inform instructional decision making. However, measurement of morphological awareness is as problematic as it is necessary. There is, as yet, no general agreement among reading researchers of what morphological awareness tasks are developmentally appropriate for elementary students in fourth and fifth grades. Until researchers can adequately measure morphological awareness, its relative contributions to literacy will remain underspecified (Carlisle, 2010). As an area of reading research, morphological awareness measurement is still in its infancy (Carlisle, 2010).

The present study is built on research of the measurement of morphological awareness use of young students, and produced many results similar to findings from prior research studies. The measures used in this study came from studies by Carlisle (2000), Kirby et al. (2012), Singson et al. (2000), and Goodwin et al. (2013) and were representative of four of the most common tasks used to measure morphological awareness of elementary students. Findings from these foundational studies, all of which except the study by Kirby et al. specifically excluded students with reading difficulties, were similar to results in the current study in notable ways. In these four studies, students in kindergarten through eighth grade used morphological awareness to support word level reading skills and reading comprehension. The similarity between studies when data were compared is a strong indicator that the MA battery, especially the combination of the analogy, judgment, and production subscales, is a valid measure of morphological awareness for fourth and fifth grade students with reading disabilities.

The primary purpose of this research study was to evaluate the ability of a morphological awareness assessment battery including a variety of morphological awareness tasks to accurately predict reading comprehension of fourth and fifth graders with reading difficulties. To address the purpose of this study, the following research questions were asked:

1. What are the reliability estimates of the MA battery and MAAB?
2. What is the ability of the MA battery and/or the MAAB, both as the composite score and individual components, to predict reading comprehension?
3. What is the ability of the MA battery and/or the MAAB to predict word attack decoding, oral, receptive vocabulary, and/or reading fluency?

Summary of Study Findings

Reliability of the MA Battery and the MAAB. Cronbach's alpha produced by the MA battery indicated it had adequate internal reliability; however, the low Cronbach's alpha produced by the MAAB indicated that it had weak internal reliability. The low internal reliability may be the resultant combination of the MAAB having too few items, as well as, inadequacy of the five items of the identification subscale to measure the morphological awareness of these low-achieving students. Of the four MA battery subscales the identification, judgment, and analogy subscales had lower internal reliability than did the production subscale probably because those individual subscales included fewer items.

Ability of the MA Battery or the MAAB to Predict Reading Comprehension. Exploration of the psychometric properties of the MA battery and MAAB showed that both assessment batteries significantly and positively predicted multiple measures of reading comprehension. The three measures of reading comprehension used as dependent variables included the GORT-IV PC, the WRMT-III PC, and the GMRT-IV PC. Predictive validity was good for the MA battery, as it significantly and positively predicted all three measures of passage reading comprehension, reading fluency, and word attack decoding. The MAAB demonstrated less predictive validity than the MA battery, as it predicted less of the variation of reading comprehension measured by the WRMT-III PC and by the GMRT-IV PC, and it was unable to significantly predict the GORT-IV PC.

Ability of the Individual MA Battery Subscales to Predict Reading Comprehension. Stepwise regression analyses were performed to examine the predictive utility of the individual subscales of the MA battery. Stepwise analysis included the MA battery analogy subscale as the only significant predictor of the GORT-IV PC, and failed to include the production, judgment, and identification subscales. Similarly, stepwise analysis showed that the analogy and production subscales of the MA battery were significant predictors of WRMT-III PC, but did not include the identification and judgment subscales in the model. Finally, stepwise analysis included the analogy, production, and judgment subscales of the MA battery in the predictive model for the GMRT-IV PC, but failed to include the MA battery identification subscale.

Stepwise analysis failed to include the MA battery identification subscale in all three regression models used to predict passage reading comprehension. Ultimately, the analogy subscale, followed by the production subscale, and then the judgment subscale were included in the regression models used to predict passage reading comprehension. This indicates that the identification subscale was not a good assessment for this sample. It may be that using pseudowords combined with real affixes in the identification task is too challenging for fourth and fifth grade poor readers.

Ability of the MA Battery or the MAAB to Predict Decoding, Vocabulary, and/or Reading Fluency. This study also investigated the ability of the MA battery or the MAAB to predict three of the literacy skills known to support reading comprehension: fluency, decoding, and oral, receptive vocabulary. A series of regression analyses were performed using first the MA battery and then the MAAB as independent variables against dependent variables of GORT-IV reading fluency, WRMT-III word attack decoding, and PPVT-IV oral, receptive vocabulary. Regression analyses showed that the MA battery and the MAAB significantly and positively predicted reading fluency.

The MA battery predicted WRMT-III word attack decoding, however the MAAB did not. Additionally, in the present study, neither the MA battery nor the MAAB was a significant predictor of PPVT-IV vocabulary. The failure of the MAAB to predict decoding is not surprising given the weak internal reliability of the assessment. However, findings that the MA battery and the MAAB did not significantly predict vocabulary, and that vocabulary did not predict reading comprehension, initially were surprising, and warranted further internal examination, as well as examination in the context of other studies of morphological awareness and of struggling readers analysis of test scores indicated that students in the present study varied widely in the relative strengths and deficits of their decoding and oral vocabulary. Almost half of the sample had relatively unmatched decoding and vocabulary skills despite the similar mean standard scores for the sample group, so while one student had a higher vocabulary score and a lower word attack score, another student balanced the group by having a lower vocabulary score and a higher word attack score. Findings from the Tong et al. (2011) study showed that from third to fifth grade the association between vocabulary and word attack decreases. In the present study, the combination of the variation among participant vocabulary scores and the age of the students may explain why oral vocabulary was not significantly correlated to word attack.

Weak association between vocabulary and word attack does not explain why vocabulary did not predict passage reading comprehension; and results from the current study contradicted findings from studies of typically developing elementary readers (Carlisle, 2000; Singson et al., 2000). Findings from the present study should be evaluated in the context of other studies of morphological awareness use of elementary students, especially students with reading difficulties. The lack of relationship between measures of oral vocabulary and reading fluency, as well as between oral vocabulary and decoding in the present study is in line with research studies of elementary struggling readers (Nagy et al., 2003; Tong et al., 2011).

One concern with the findings of the present study was the failure of oral vocabulary to predict passage reading comprehension. The meta-analysis of the effects of vocabulary instruction of passage reading comprehension by Elleman et al. (2009) advocates vocabulary instruction for students with reading comprehension difficulties. Vocabulary benefits the reader because one must understand the words one is reading in order to comprehend the text. However, other literacy skills impact the relationship between vocabulary knowledge and reading comprehension. Deficits in word level reading skills can overtax short term memory to the detriment of comprehension. Students with adequate reading fluency and average vocabulary can still have trouble making inferences and fail to comprehend what they read.

Given the extremely low reading fluency of the students in the present study, for these students it may be that vocabulary did not have the opportunity to play a significant role in reading comprehension. If a student cannot decode well enough to recognize the word, oral vocabulary knowledge might not have the opportunity to benefit reading comprehension (Cutting & Scarborough, 2006). Students may simply have been struggling to decode at the word level such that over-tasked working memory prevented vocabulary knowledge from playing a meaningful role in reading comprehension.

Tong et al. theorized that, because morphological awareness plays a significant role in listening comprehension, it may bridge the domains of decoding and listening comprehension. Poor comprehenders are also poor at inferring meanings of words used in context (Tong et al., 2011), and the ability to make inferences may make a contribution to reading comprehension beyond foundational literacy skills such as vocabulary and grammar (Silva & Cain, 2014). For these reasons it is not surprising that vocabulary did not predict reading comprehension for the poor readers in the present study.

Comparisons Between the Present Study and Primary Studies That Generated the MA Battery Subscales. Data from the current study shared many similarities with findings from the studies from which the MA battery subscales originated. The analogy subscale was borrowed from the 2012 study by Kirby et al., and both studies found that the analogy subscale significantly predicted passage reading comprehension. In the present study, stepwise regression failed to include every subscale *except* the analogy subscale in the model of the prediction of GORT-IV PC; and, alone, the analogy subscale explained 25% of the variation in reading comprehension.

Examination of the demographics of the Kirby et al. study and the current study may explain some of the similarity between study findings. No students in the Kirby et al. study were excluded on the basis of academic achievement, and the comparison results were from third graders. It may be that the younger age of the participants in the Kirby et al. study developmentally matched the fourth and fifth grade struggling readers in the present study.

The many remarkable similarities between the present study and the study by Kirby et al. create a sharp contrast between the seemingly contradictory findings of the relationship between vocabulary knowledge and reading comprehension, but make sense within the context of the developmental nature of both reading comprehension and morphological awareness. The current study supports findings from an earlier longitudinal study by Tong et al. (2011) that discovered that a measure of morphological awareness skills outperformed measures of decoding and oral vocabulary in the prediction of passage reading comprehension. In the study by Tong et al., researchers used tasks of morphological awareness, including the analogy task used by Kirby et al. used in the present research, to measure third graders' literacy skills in order to predict their reading comprehension as fifth graders. Based on scores of these literacy tests, third graders were sorted into groups of good, average, and poor comprehenders. In fifth grade these same students were reassessed and regrouped. The fifth grade "unexpected poor comprehenders" had average decoding skills and vocabulary knowledge, but poor morphological awareness skills in third grade. By contrast, the fifth grade "unexpected good comprehenders" demonstrated poor decoding skills in third grade, but average or better morphological awareness skills. The researchers also found that oral vocabulary knowledge did not significantly predict reading comprehension in the group of "unexpected poor comprehenders." These findings suggest that for struggling readers in fourth and fifth grade morphological awareness is a better predictor of reading comprehension than oral vocabulary or decoding.

Comparisons between findings of the present study and the studies by Tong et al. (2011), and Kirby et al. (2012) provide insight into the measurement ability of the MA battery. First, the MA battery analogy subscale significantly outperformed the MA battery identification, judgment, and production subscales in its ability to predict passage reading comprehension. The analogy subscale had proven to be a valid and reliable assessment of morphological awareness abilities for elementary students across grade levels both with and without reading difficulties in the Tong et al. and Kirby et al. studies. A significant factor in the success of the analogy task was that it measured both inflectional and derivational morphological awareness; and inflectional morphological awareness develops well ahead of awareness and use of derivational morphology (Apel et al., 2013; Goodwin et al., 2011). The analogy task was evenly split between inflectional and derivational morphological awareness test items, enabling measurement of a wide range of developmental skills. Some of the items of inflectional morphology were simple enough that all students should be able to answer correctly (ie.; *doll*: *dolls*:: *sneaker*: ____); and some of the items of derivational morphology were difficult enough to challenge more advanced elementary students (i.e., *see*: *sight*:: *flew*: ____). Another unique aspect of the analogy subscale was that it included six practice items prior to the scored task items. Test administration of the analogy task might have significantly benefited students by providing them sufficient opportunity to practice the task such that students performed well because they felt confident they could do well.

The production, identification, and judgment tasks were used in prior research studies to assess typical readers who did not have the literacy deficits of the students in the present study. While being valid and reliable measures for typical readers, those three tasks might be too developmentally advanced for the struggling readers in the present study. Derivational morphological awareness is a skill that develops much later than inflectional morphological awareness. The MA battery was composed primarily of task items of derivational morphology that may be appropriate for typical fourth and fifth grade readers, but may have been too challenging struggling readers in fourth and fifth grade. It is also possible that the MA battery production, identification, and judgment subscales might have performed better had they included six practice items each, as the analogy subscale did.

Concern about the validity of the MA battery arose during stepwise analysis of the MA battery subscales when predicting passage reading comprehension. The identification task was not included in any of the three models that predicted reading comprehension. The judgment task was included in only one of three, and the production task was included in only two, stepwise regression model of reading comprehension. All three of these tasks of morphological awareness differ, and their performances varied widely for several reasons.

The identification subscale came from a 2000 study by Singson et al., but it did not perform as well as was expected in this study. In the present study, stepwise regression analysis failed to include the identification subscale in all three models used to predict passage reading comprehension. These data raised concern that the identification subscale might not be good predictor of reading comprehension for this group. There are, however, several significant differences between the present study and the study by Singson et al. Demographic differences between the Singson study and the present study also may account for the performance discrepancy between the studies. Students with reading disabilities were excluded from the Singson et al. study, and reading achievement for all groups was at or above grade level according to the WRMT-III word attack, while students with reading difficulties were the focus of the current measurement study. Perhaps the identification task measures a more developmentally advanced type of morphological awareness skill that fourth and fifth grade students with reading difficulties are as yet unable to perform. The pseudoword format of the task was likely too linguistically challenging for the struggling readers in the present study. The identification task was the only MA battery subscale that did not have practice items to acquaint participants with the task, and this could have had a negative impact on student response. Ultimately, because the identification subscale did not significantly predict reading comprehension in the current study, in future studies the identification task should be eliminated from the MA battery or revised to include practice items.

The judgment subscale of the MA battery came from a 2013 study by Goodwin. Like the identification subscale, the judgment subscale did not perform well in the present study, and was eliminated through stepwise regression analysis in two of three models of the MA battery used to predict reading comprehension. However, the study by Goodwin et al. had a sample of seventh and eighth graders all of whom performed at or above the 70^{th} percentile. Additionally, the Goodwin et al. study only included results of an assessment battery composed of three related tasks, of which the exact judgment task used in the present study was only one of the tasks used and study tasks were not analyzed individually. Though data analyses between studies differed, both studies used the GMRT-IV PC as a measure of reading comprehension.

The production subscale used in the present study came from the 2000 study by Carlisle, and the findings between these two studies were similar. In the present study, the production subscale was included in two of three stepwise models used to predict reading comprehension. The Carlisle study found that the morphological assessment battery, which included the production subscale used in the present study, significantly and positively predicted the Comprehensive Testing Program, 3rd Edition passage comprehension (CTP-III PC) for the fifth grade group. The similarities between findings for the Carlisle study and the present study are remarkable given the demographic differences between the sample groups in the studies. The fifth grade sample in the Carlisle study excluded students who scored *below* the 30th percentile in reading comprehension measured by the CTP-III PC and the students in the present study included both fourth and fifth grade students and excluded students *above* the 25th percentile measured by the WRMT-III word attack, GORT-IV fluency, and the GORT-IV PC. That the regression coefficients produced in the Carlisle study were similar to those produced in the current study was surprising given these demographic differences. It is possible that the results are similar between the two studies because, as suggested by Nunes et al. (2006), students with reading difficulties are more reliant on morphological awareness skills relative to reading comprehension than are their normative peers. Regardless, the production subscale is a valuable and proven addition to the MA battery. Future versions of this MA battery subscale task, if used to measure the morphological awareness of struggling readers in fourth and fifth grade, may benefit by the addition of items of inflectional morphology in place of some of the more difficult items of derivational morphology currently included in the task.

Limitations and Future Research

Findings from this research should be viewed with several limitations in mind. The small sample size of this study may preclude it from being generalized to include *all* L-1 fourth and fifth grade students with reading difficulties. The design of this study also precluded detailed item analysis. With a larger sample, Item Response Theory analysis would make it possible to determine whether removal of misfitting items would improve the psychometric performance of the MA battery. It would also provide insight into which types of items fourth and fifth grade struggling readers are unable to answer consistently. Removing misfitting items could potentially shorten the MA battery, possibly decreasing the contribution of error due to test fatigue. Additional information about the relative contributions of various types of morphological awareness skills to reading comprehension would also inform decisions regarding the number and weighting of subscale items to use in a refined MA battery.

The task items of the MAAB were answered at the end of each task of the MA battery, so test fatigue could have played a role in its ability to predict reading comprehension. Administering the MAAB during a different test session might improve the performance of the assessment. Adding task items to the MAAB might improve both its reliability and prediction of reading comprehension.

For fourth and fifth grade students with reading difficulties there is a significant association between the morphological awareness tasks of word analogy and deriving morphologically related words, reading comprehension, and additional literacy skills. The analogy, judgment, and production tasks of morphological awareness significantly predicted passage reading comprehension, fluency, and decoding. These findings suggest that refining the MAAB in future research studies would be a worthwhile endeavor, and is the logical next step in the progression of morphological awareness research. The Future research that includes a larger sample of fourth and fifth grade students both with and without reading difficulties might better describe the developmental nature of morphological awareness and the tasks that best measure it.

Implications

The ability of the MA battery to predict passage reading comprehension, decoding, and fluency indicate that revising the MA battery might greatly enhance its ability to predict reading comprehension of struggling readers. An MA battery capable of predicting students at risk of becoming late emerging poor comprehenders could substantially improve instructional decision making for these students. Additionally, morphological awareness might be an especially beneficial literacy skill for fourth and fifth graders with reading difficulties. If elementary students who have reading difficulties are using morphological awareness implicitly in order to derive comprehension from text, then explicit instruction in morphological analysis might help improve their reading comprehension.

Conclusion

In this study, examination of the direct relationship between morphological awareness and reading comprehension, as well as the indirect relationships between morphological awareness and other literacy measures showed that morphological awareness appears to be a significant factor in reading comprehension. The combined tasks of analogy, production, and judgment used in the MA battery appear to offer the best prediction of passage reading comprehension for struggling readers in fourth and fifth grades. Construction of a reliable and valid measure of morphological awareness is an essential step toward future studies examining whether a causal relationship between morphological awareness and other literacy skills truly exists, and whether measuring morphological awareness could predict late-emerging poor comprehenders.

The current study provides further insight into which tasks of morphological awareness measures best measure passage reading comprehension of fourth and fifth grade students with reading difficulties. Prior studies (Abbot & Berninger, 1999; Kirk & Gillon, 2009; Wolter & Dilworth, 2014) provide evidence that direct instruction of morphological analysis skills may be particularly beneficial for fourth and fifth grade students. Future studies using more accurate measurement of morphological awareness, such as that provided by the MA battery or the MAAB, may offer further insight into the types of tasks of morphological awareness that are related to reading comprehension. The present study is an incremental step toward development of a morphological awareness assessment battery that captures the array of literacy skills used by students in the later elementary grades.

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APPENDICES

APPENDIX A

MORPHOLOGICAL AWARENESS ASSESSMENT

Identification Task

Derivational Suffix Test Oral + Written Form, Nonsense Word Version (Singson, Mahony & Mann, 2000) Items 1-20 used with permission of authors. Items 21-25 are researcher created.

Administrator directions

(Make sure each student has a pencil and cannot look on another student's paper before continuing.) **Read aloud**: "In this task the four answer choices are not real words. They are nonsense words. Nevertheless, one of these nonsense words makes a good sentence. The other three do not. Listen while I read each sentence. Then you decide which word is the best one to fill in the blank. Circle the letter of your answer. Listen carefully as I read each sentence. I may repeat a task item once if you raise your hand."

1. I could feel the ____________.
A. froodly B. froodful C. frooden D. froodness

2. What a completely _____________ idea.
A. tribacious B. tribicism C. tribacize D. tribation

3. I admire her _______________.
A. sufilive B. sufilify C. sufilation D. sufilize

4. Where do they ___________ the money?
A. curfamic B. curfamity C. curfamate D. curfamation

5. Please _____________.
A. scriptial B. scriptize C. scriptist D. scriptious

6. The meeting was very ________________.
A. lorialize B. lorial C. lorialism D. lorify

7. I just heard a _____________ story.
A. dantment B. dantive C. danticism D. dantify

8. Dr. Smith is a famous _____________.
A. cicarist B. cicarize C. cicarify D. cicarial

9. Can you _______ both sides?
A. romify B. romity C. romious D. romative

10. He has too much _______________.

A. brinable B. brinicity C. brinify D. brinicious

11. Everyone resents Laura's ___________.

A. spectitious B. spectition C. specitionalize D. spectitive

12. Have you ever met a ________________?

A. bantize B. bantious C. bantify D. bantist

13. You must ____________ it on both sides.

A. ponic B. ponicize C. ponicity D. ponicism

14. Please be as __________ as possible.

A. fenious B. fenalize C. fenament D. fenify

15. The old model is too _________.

A. lempment B. lemptivity C. lemptify D. lemptive

16. They were stopped by the _________.

A. tramicize B. tramify C. tramic D. tramity

17. She wants to ______________.

A. morious B. moration C. morate D. morational

18. He wasn't bothered by the _____________.

A. drighten B. drightness C. drightly D. drightsome

19. That car is too ____________.

A. rendalize B. rendify C. rendment D. rendal

20. He needs to ________ his paycheck.

A. laptable B. laptification C. laptify D. laptian

21. Her crimes were ___________.

A. spoltious B. spoltation C. spoltify D. spoltize

22. Those vegetables were picked by the ____________.

A. gerdment B. gerdive C. gerdious D. gerdist

23. His horse was quite ____________.

A. pluffation B. plufficize C. pluffate D. pluffsome

24. I would like to _____________ today.

A. vitate B. vitible C. vitious D. vitence

25. To be fair you should always ________________ your door locks.
A. snartive B. snartify C. snartitious D. snartable

Word Analogy Task

Kirby, Deacon, Bowers, Izenberg, Wade-Woolley, & Parrila (2012)

Items 1-20 used with permission of authors. Items 21-25 researcher created.

Administrator directions

Read aloud: "I am going to ask you to figure out some missing words. If I say *push* and then I say *pushed*; then I say *jump*, so then I should say…?" If the child does not respond with *jumped*, say: "*push* and *pushed* are alike. *Jump* and *jumped* are alike the same way. Let's try some more!" (Continue with each item using the same language, but interjecting the new words.)

Practice Items

a. push: pushed:: jump: ___________________________________

b. walker: walk:: teacher: _________________________________

c. bird: birds:: goose: ____________________________________

d. sleep: sleepy:: cloud: __________________________________

e. bounce: bounced: skip: _________________________________

f. beauty: beautiful: fun: __________________________________

1 run: ran:: walk: ______________________________________

2 doll: dolls:: sneaker: __________________________________

3 good: better:: low: _____________________________________

4 jumped: jump:: stood: __________________________________

5 push: pushed:: lose: ___________________________________

6 help: helped:: say: _____________________________________

7 mouse: mice:: child: ______________________________

8 heard: hear:: kept: ______________________________

9 longer: long:: taller: ______________________________

10 dog: dogs:: person: ______________________________

11 mess: messy:: fun: ______________________________

12 paint: painter:: bake: ______________________________

13 anger: angry:: sun: ______________________________

14 teach: teacher:: work: ______________________________

15 high: height:: deep: ______________________________

16 decision: decide:: action: ______________________________

17 science: scientist: art: ______________________________

18 long: length:: wide: ______________________________

19 warmth: warm:: strength: ______________________________

20 magic: magician:: music: ______________________________

21 fix: fixture:: mix: ______________________________

22 know: knew:: throw: ______________________________

23 person: personal:: season: ______________________________

24 north: northern:: south: ______________________________

25 see: sight:: flew: ______________________________

Judgment Task

Test of Knowledge of Derivational Relationships

Goodwin, Gilbert & Cho (2013). Items 1-20 used with permission of authors. Items 21-25 researcher created.

Administrator directions

Read aloud: "Read each set of words silently. If you think the second word comes from the first word or if you think that both words come from the same root, circle YES. If not, circle NO. There are two examples that we are going to work together. Practice A: Weigh—Weight. Does weigh come from weight? Choose your answer. (pause) Weight comes from weigh because they share the same root. If you weigh something you are trying to find its weight. Practice B: Sold—Soldier. Does sold come from soldier? Choose your answer. (pause) Sold does not come from soldier because they do not share a root. You may begin this task now."

Practice A: Weigh—Weight ("Does weigh come from weight?") YES / NO

Practice B: Sold—Soldier ("Does sold come from soldier?") YES / NO

1. abolish—abolition YES / NO
2. magic—magician YES / NO
3. know—acknowledge YES / NO
4. alto—altogether YES / NO
5. tail—retail YES / NO
6. pity—pitiful YES / NO
7. fry—Friday YES / NO
8. malice—malicious YES / NO
9. let—letter YES / NO
10. angel—angelic YES / NO
11. tile—reptile YES / NO
12. comb—combination YES / NO
13. bad—badminton YES / NO
14. solid—solidify YES / NO
15. numb—number YES / NO
16. Define—Definition YES / NO

17. High—Height YES / NO

18. How—Howl YES / NO

19. Nose—Nostril YES / NO

20. Light—Lightening YES / NO

Production Task

Test of Morphological Structure: Derivation

Carlisle (2000). Used with permission of author.

Administrator directions.

Read aloud: "In this task I will read a word to you that is related to the word you will need to complete the sentence. All you have to do is tell me the word you think best completes the sentence and I will write it down for you. Let's practice! "*Farm. My uncle is a ________."* (Pause and gesture for a response. If the student gives a correct response nod and proceed to the second practice item. If the student gives an incorrect response say "Listen while I try this one and see if it makes sense to you. *Farm. My uncle is a farmer*. Let's try another one. *Help. My sister is always* ______. If an incorrect response is given say "Listen while I try this one and see it makes sense to you. *Help. My sister is always helpful*." Then say "Thank you for helping me with this. I appreciate your hard work! Help me complete the rest of these sentences just like you did the ones we just practiced."

This task is administered individually right after you give the WRMT-III. Let the student follow along with a copy while you write their oral responses on their MAAB.

Practice Items

a	farm	My uncle is a ________________________.
b	help	My sister is always ________________________.
1	warm	He chose the jacket for its ________________________.
2	teach	He is a very good ________________________.
3	permit	Father refused to give ___________________________.
4	profit	Selling lemonade in summer is ________________________.
5	appear	He cared about his _________________________________.

6	express	'OK' is a common ______________________.
7	four	The cyclist came in _________________________.
8	remark	The speed of the car was ____________________________.
9	protect	She wore glasses for _____________________________.
10	perform	Tonight is the last _______________________________.
11	expand	The company planned an ________________________.
12	revise	This paper is his second ________________________.
13	reason	Her argument was quite _______________________.
14	major	He won the vote by a _____________________________.
15	deep	The lake was well known for its ___________________.
16	equal	Boys and girls are treated with _______________________.
17	long	They measured the ladder's _______________________.
18	adventure	The trip sounded __________________________.
19	absorb	She chose the sponge for its _________________________.
20	active	He tired after so much _______________________.
21	swim	She was a strong __________________________.
22	human	The kind man was known for his ________________________.
23	wash	Put the laundry in the ________________________.
24	humor	The story was quite ____________________________.
25	assist	The teacher will give you _______________________.
26	mystery	The dark glasses made the man look ____________________.
27	produce	The play was a grand __________________________.

28	glory	The view from the hill was ___________________________.
29	absent	Because she talks a lot her __________________ from class was noticeable.
30	heal	I get my flu shot to try and stay ___________________.
31	fame	The rock star was ___________________________.
32	shade	When you stand in the sun you cast a ____________ on the ground.
33	three	Beth was proud to have placed ______________ in the race.

MAAB Scoring Rubric

Identification Task—Correct answers are 1 point each.

1. D
2. A
3. C
4. C
5. B
6. B
7. B
8. A
9. A
10. B
11. B
12. D
13. B
14. A
15. D
16. C
17. C
18. B
19. D
20. C
21. A
22. D
23. D
24. A
25. B

Word Analogy Task—Correct answers are 1 point each.

Practice Items

a. jumped
b. teach
c. geese
d. cloudy
e. skipped
f. funny

1. Walked
2. Sneakers
3. Lower

4. Stand
5. Lost
6. Said (count as correct: "sed")
7. Children
8. Keep (count as correct: "keap" or "kep")
9. Tall
10. People (count as correct: "peepl" or "pepl")
11. Funny (count as correct: "funy")
12. Baker
13. Sunny (count as correct: "suny")
14. Worker
15. Depth (count as correct: "deepth")
16. Act
17. Artist (count as correct: "artest)
18. Width (count as correct: "wideth")
19. Strong
20. Musician (count as correct: "musisian" or "muzisian" or "musishan" or "muzishan")
21. Mixture
22. Threw (count as correct: "thru" or "throo")
23. Seasonal (count as correct: "seasonul")
24. Southern (count as correct: "suthern")
25. Flight (count as correct: "flite")

Production Task –Correct answers are 1 point each. The test administrator will write down students' oral responses. Administrator spelling errors do not count as wrong answers.

Practice Items

- **a.** Farmer
- **b.** Helpful

1. Warmth
2. Teacher
3. Permission
4. Profitable
5. Appearance
6. Expression
7. Fourth

8. Remarkable
9. Protection
10. Performance
11. Expansion
12. Revision
13. Reasonable
14. Majority
15. Depth
16. Equality
17. Length
18. Adventurous
19. Absorption / Absorbance
20. Activity
21. Swimmer
22. Humanity
23. Washer
24. Humorous
25. Assistance
26. Mysterious
27. Production
28. Glorious
29. Absence
30. Healthy
31. Famous
32. Shadow
33. Third

Judgment Task—Correct items are 1 point each.

Practice Items

- **a.** Yes
- **b.** No

1. Yes
2. Yes
3. Yes
4. No
5. No
6. Yes
7. No

8. Yes
9. No
10. Yes
11. No
12. No
13. No
14. Yes
15. No
16. Yes
17. Yes
18. No
19. Yes
20. Yes

APPENDIX B

INSTITUTIONAL REVIEW BOARD APPROVAL NOTICE

IRB
INSTITUTIONAL REVIEW BOARD
Office of Research Compliance,
010A Sam Ingram Building,
2269 Middle Tennessee Blvd
Murfreesboro, TN 37129

MIDDLE TENNESSEE STATE UNIVERSITY

IRBN001 - EXPEDITED PROTOCOL APPROVAL NOTICE

Friday, February 12, 2016

Investigator(s): Joanne V. Coggins (PI) and Eric Oslund (FA)
Investigator(s') Email(s): jvc2j@mtmail.mtsu.edu; eric.oslund@mtsu.edu
Department: College of Education (Literacy Studies)

Study Title: ***Measurement of morphological awareness of fourth and fifth grade students with reading difficulties***
Protocol ID: **16-2137**

Dear Investigator(s),

The above identified research proposal has been reviewed by the MTSU Institutional Review Board (IRB) through the **EXPEDITED** mechanism under 45 CFR 46.110 and 21 CFR 56.110 within the category *(7) Research on individual or group characteristics or behavior* A summary of the IRB action and other particulars in regard to this protocol application is tabulated as shown below:

IRB Action	APPROVED for one year from the date this notification
Date of expiration	2/12/2017
Participant Size	60 (SIXTY) minors
Exceptions	**NONE**
Restrictions	**The proposed research is confined to the following Tullahoma City Schools: Jack T. Farrar Elementary, East Lincoln Elementary, Robert E. Lee Elementary and Bel-Aire Elementary**
Comments	**NONE**

This protocol can be continued for up to THREE years (**2/12/2019**) by obtaining a continuation approval prior to **2/12/2017**. Failure in obtaining an approval for continuation will automatically result in cancellation of this protocol. Moreover, the completion of this study MUST be notified to the Office of Compliance in order to close-out the protocol.

The investigator(s) indicated in this notification should read and abide by all of the post-approval conditions imposed with this approval. Refer to the post-approval guidelines posted in the MTSU IRB's website. Any unanticipated harms to participants or adverse events must be reported to the Office of Compliance at (615) 494-8918 within 48 hours of the incident. Amendments to this protocol must be approved by the IRB. Inclusion of new researchers must also be approved by the Office of Compliance before they begin to work on the project.

IRBN001 Version 1.2 Revision Date 05.11.2015

All of the research-related records, which include signed consent forms, investigator information and other documents related to the study, must be retained by the PI or the faculty advisor (if the PI is a student) at the sacure location mentioned in the protocol application. The data storage must be maintained for at least three (3) years after study completion. Subsequently, the researcher may destroy the data in a manner that maintains confidentiality and anonymity. IRB reserves the right to modify, change or cancel the terms of this letter without prior notice. Be advised that IRB also reserves the right to inspect or audit your records if needed.

Sincerely,

Institutional Review Board
Middle Tennessee State University

Quick Links:

Click here for a detailed list of the post-approval responsibilities.
More information on expedited procedures can be found here.