Title

Unraveling the Contribution of Morphological Awareness to Reading: A Longitudinal Analysis of Word-Level Outcomes for Latent Profiles of Young Readers

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Unraveling the Contribution of Morphological Awareness to Reading: A Longitudinal Analysis of Word-Level Outcomes for Latent Profiles of Young Readers

By

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of the

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Professor Anne Cunningham, Co-Chair
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Abstract

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Theories of English literacy development assume that both phonological awareness and morphological awareness are metalinguistic skills involved in word identification. While there is robust empirical evidence supporting the key role of phonological awareness in reading, there is a smaller – though growing - body of empirical evidence suggesting morphological awareness makes a unique contribution to word identification. Much of the morphological awareness research has focused on its contribution to decoding in general; analysis of its specific role in the identification of different word types (i.e., morphologically complex words compared to non-morphologically complex words; real words compared to pseudowords) is inconsistent and limited. This study aims to fill this gap by examining Grade 2 students' accuracy reading a variety of word types, controlling for morphological awareness, phonological awareness, and verbal cognitive ability. Results suggest that morphological awareness contributes to the recognition of morphologically complex and non-morphologically complex real words, but not to pseudowords. Also crucial to the field of morphological awareness research is a more developed understanding of the reader. Latent profile analysis was used to empirically determine unique student profiles of phonological and morphological awareness ability. Reading outcomes (e.g., decoding accuracy and reading comprehension) were analyzed longitudinally for each profile, across Grades 2-4, a critical developmental period when learning to read. Students in the morphologically dominant group and the phonologically dominant group performed similarly across time on all outcome measures. Students with commensurate development of these skills outperformed the other two groups on all measures at all time points, suggesting both skills are needed for higher levels of reading achievement during elementary school grade levels. Because many students struggle learning to read, this finding is useful in identifying the different skill profiles that are more or less at-risk for future reading outcomes.

Keywords: morphological awareness, reading acquisition, metalinguistic awareness, early literacy

DEDICATION

I dedicate this to the students I have taught who both inspired this work and continue to motivate me to explore the role of morphology in reading. I am amazed and humbled by the creative ways students and the human brain learn to do this rather unnatural task.

I would also like to thank the people who have supported me along my academic path and helped me become the scholar I am today. My master's advisor, Yvonne Bui, who encouraged me to continue in academia and then came on as faculty during my doctorate tenure so I was lucky to again work with her. My advisor throughout my doctorate, Anne Cunningham, who modeled what it means to be a scholar and a mentor and who was a support both professionally and personally throughout this journey. I was also fortunate to have mentorship and support from a village of world-renowned scholars for whom I am grateful and attribute much of this work to their mentorship as well. To name a few, Sharon Inkelas, David Pearson, Hélène Deacon, Eric Claravall, Elfrieda Hiebert, and Mark Wilson. In addition to their support, I was also fortunate to overlap with incredibly supportive and intellectual peers who were both colleagues and friends. They motivated and encouraged me to question and explore my research interests and without whom I know I would not have completed this journey as grounded nor as sane. There were many people along the way but I want to give special thanks to Yi-Jui Iva Chen, Renee Starowicz, Alexander Blum, Dorcas Yap, and Alan Omand.

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A word of thanks does not do justice to the role you all played in this but I do sincerely thank you and am indebted to you for your role in this journey.

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INTRODUCTION

A reader's sensitivity to patterns in language is associated with reading acquisition (Gombert, 1992; Liberman, 1973; Liberman, Shankweiler, Fischer, & Carter, 1974; Mattingly, 1972, 1984). The awareness of these language patterns, termed metalinguistic awareness, as operationalized by Berninger, Abbott, Nagy, and Carlisle (2009) is "awareness and reflection about a spoken or written word and its parts or its relationship to other words" (p.142). Metalinguistic awareness is characterized by a combination of cognitive and language abilities and develops as a child ages (Carlisle, 2003). Theories of English literacy development hypothesize that both phonological awareness and morphological awareness are necessary metalinguistic skills involved in reading (Apel & Masterson, 2001; Ehri & McCormick, 1998; Frost, 2012; Seymour, 1997).

Phonological awareness, the ability to access and manipulate words at the sound level, dominated reading research once it was recognized that the ability to analyze the sounds of spoken words is an integral part of the word identification process (Bruce, 1964; Goswami & Bryant, 1990; Gough, 1996). Evidence for its foundational role in reading is plentiful (Adams, 1990; Liberman et al., 1974; National Reading Panel, 2000; Snow, Burns, & Griffin, 1998; Treiman, 1985; Wagner & Torgeson, 1987). Research demonstrates that phonological awareness plays a critical role in early English reading acquisition, explaining between 28 to 43% of the variance in word recognition (Apel, Wilson-Fowler, Brimo, & Perrin, 2012; Badian, 2001; Blachman, 2000; Kirby, Parrila, & Pfeiffer, 2003; Swanson, Trainin, Necoecha, & Hammill, 2003). Although phonology accounts for the largest (or most significant) part of the word recognition process, because English orthography is a morphophonemic system (Chomsky & Halle, 1968; Venezky, 1999), in which letters represent sounds in strings (e.g., words, morphemes) that link with meaning, morphology also plays a role (Venezky, 1999).

In a linguistic context, morphology is defined as the study of word structure and formation (Aronoff & Fudeman, 2011; Gonnerman, 2018). This definition can be derived from morphological analysis of the word itself—*morph-* means "shape or form" and *-ology* means "to study" so it refers to the study of the morphological form or structure of a given word. A morpheme is the smallest unit of meaning in a word. There are three types of morphologically complex word types in English: compound words (*bedroom*), inflected words (*cats*), and derived words (*unhappy, joyful*). A morpheme can be a single sound (typically represented by one letter), such as the *–s* plural marker in the word *cats,* or a string of sounds, as in the root word *cat* or the prefix *un-*. While inflectional affixes like plural *-s* preserve the essential meaning and part of speech of the word they combine with, derivational affixes changes meaning or grammatical class. For example, the suffix *-ful* in the word *joyful* changes the meaning of the word "joy" to "full of joy," which can then be changed from a noun to an adverb by adhering another suffix *–ly* and creating the legal word combination: *joyfully*.

It is necessary for students to be able to decode and derive the meaning of morphologically complex words, as words with meanings that are predictable from the meanings of their parts make up roughly 60% of the new words that students learn in academic settings (Nagy & Anderson, 1984). To illustrate, approximately 82% of the words contained in the most recent Academic Word List are of Greek or Latin origin (Coxhead, 2000). Words of these origins are characteristically comprised of identifiable roots combined with affixes, suggesting that studying the morphology of these words may assist in deriving multiple word meanings. Across the grade levels, content-area textbooks and English anthologies generally contain a large number of morphologically complex words that students must decipher quickly and automatically (Hiebert, Goodwin, & Cervetti, 2018). Essentially words must be “decoded” by matching the letters on a page to a meaningful word unit, which may be completed through automatic recognition of the entire word unit or through a process in which the word is broken down into recognizable chunks, be that at the letter, syllable, or morphemic level. Because these words can be chunked at the morphemic level (Dawson, Rastle, & Ricketts, 2018; Feldman & Milin, 2018; Leong, 1989; Longtin & Meunier, 2005; Rastle & Davis, 2008; Schreuder & Baayan, 1995), it logically follows that morphological awareness may contribute to decoding when words are accessed via morphological units, morphemes.

LITERATURE REVIEW

Morphological Awareness

Awareness of the morphology of language, i.e., morphological awareness, correlates with phonological awareness (Casalis, Cole, & Sopo, 2004; Mann, 2000) but there is empirical evidence that it constitutes a separate ability (Carlisle & Nomanbhoy, 1993; Singson, Mahony, & Mann, 2000). Notably, there is consistent evidence that the unique contribution of morphological awareness ranges from 4 to 5 percent of the variance in children's decoding ability in English even after accounting for the contribution of their intelligence, vocabulary knowledge, and phonological awareness, which increases across grade levels (Reed, 2008). In one study with upper elementary English-speaking students, the amount of variance explained was even higher; 10% of the variance in decoding was explained by morphological awareness (Wang, Cheng, & Chen, 2006).

Although there is strong empirical evidence that morphological awareness contributes significantly to word recognition, paradoxically, the field has not yet adopted a consistent definition of morphological awareness (Apel, 2014). There are some similarities across definitions and consensus that morphological awareness involves some level of conscious or explicit awareness of morphemes, but beyond that, many definitions are vague or fail to specify a comprehensive list of attributes (Apel, 2014; Berthiaume, Bourcier, & Diagle, 2018). See Table 1 for a sampling of definitions from the current literature, in chronological order.

As evidenced by the definitions listed, different characteristics of morphological awareness are highlighted or neglected within a given definition. For example, while seven of the definitions use the word "manipulate" to describe this ability, the definition proffered by Berninger, Abbott, Nagy, and Carlisle (2010) is the only one that specifically mentions semantics and judgement. Apel (2014) proffered a comprehensive definition and a call to researchers to adopt it.

> Morphological awareness includes: (a) awareness of spoken and written forms of morphemes; (b) the meaning of affixes and the alterations in meaning and grammatical class they bring to base words/roots (e.g., -ed causes a verb to refer to the past as in walked; -er can change a verb to a noun, as in teach to teacher); (c) the manner in which written affixes connect to base words/roots, including changes to those base words/roots (e.g., some suffixes require a consonant to be doubled or dropped when attached to a base word/root in written form, such as in hop to hopping and hope to hoped); and (d) the relation between base words/roots and their inflected or derived forms (e.g., knowing that a variety of words are related because they share the same base word/root, such as act, action, react, and activity). (p. 200)

This comprehensive definition allows researchers to define which aspect(s) of morphological awareness they aim to study, allowing for the selection of appropriately aligned measures, ensuring the inferences drawn are clear and substantiated.

Table 1

Definitions of Morphological Awareness by Year

Year	Researcher(s)	Definition
1995	Carlisle	"the conscious awareness of the morphemic structure of words and their ability to reflect on and manipulate that structure" (p. 194)
2000	Carlisle	"the ability to parse words and analyze constituent morphemes for the purpose of constructing meaning" (p. 170)
2006	Kuo and Anderson	"ability to reflect upon and manipulate morphemes and employ word formation rules in one's language" (p. 161)
2006	McBride-Chang, Cheung, Chow, Chow, and Choi	"the awareness of and conscious access to morphemes in words comprised of two or more morphemes" (p. 699)
2008	Jarmulowicz, Hay, Taran, and Ethington	"the explicit understanding of word structure" (p. 227)
2009	Deacon, Kirby, and Casselman-Bell	"the awareness of and ability to manipulate the minimal units of meaning" (p. 301)
2010	Berninger, Abbott, Nagy, and Carlisle	"judgments about semantic or semantic-syntactic relationships that depend upon the form of the word or its parts" (p. 142)
2011	Guo, Roehrig, and Williams	"explicit knowledge of the way in which words are built up by combining smaller meaningful units, such as prefixes, roots, and suffixes" (p. 160)
2011	Tong, Deacon, Kirby, Cain, and Parrila	"conscious awareness of the morphemic structure of words and (individuals') ability to reflect on and manipulate that structure" (p. 523)
2012	Kieffer and Lesaux	"the understanding of complex words as combinations of meaningful smaller units or morphemes (i.e., prefixes, suffixes, and roots) that contribute to the words' meanings and functions" (p. 520)
2012	Kirby, Deacon, Bowers, Izenberg, Wade-Woolley, and Parrila	"the conscious awareness of the morphemic structure of words and (their) ability to reflect on and manipulate that structure" (p. 389).
2013	Deacon, Benere, and Pasquarella	"the awareness of and the ability to manipulate morphemes in the oral language" (p. 1113)
2014	Nagy, Carlisle, Goodwin	"the ability to analyze words into smaller meaningful parts such as prefixes, roots, and suffixes" (p.4)
2014	Apel	See text below
2015	McCutchen and Stull	"the metalinguistic insight that words consist of meaningful roots an affixes (i.e., morphemes) that can be isolated and manipulated" (p.1)

Taking a different stance, Berthiaume, Bourcier, and Diagle (2018) claim that morphological awareness is actually a "generic designation" (p. 49) and propose an integrative model of morphological knowledge and processing that highlights the role of these different modalities within this construct (see Figure 1). They define morphological knowledge as a combination of specific morphological knowledge, knowledge of the rules and regularities, and morphological processing. They further break processing into the differing tasks required by oral and written processing of morphology while recognizing they may inform one another. This is in alignment with Apel's definition that clearly specifies awareness of both spoken and written morphemes, but an aspect that was unspecified in many previous definitions.

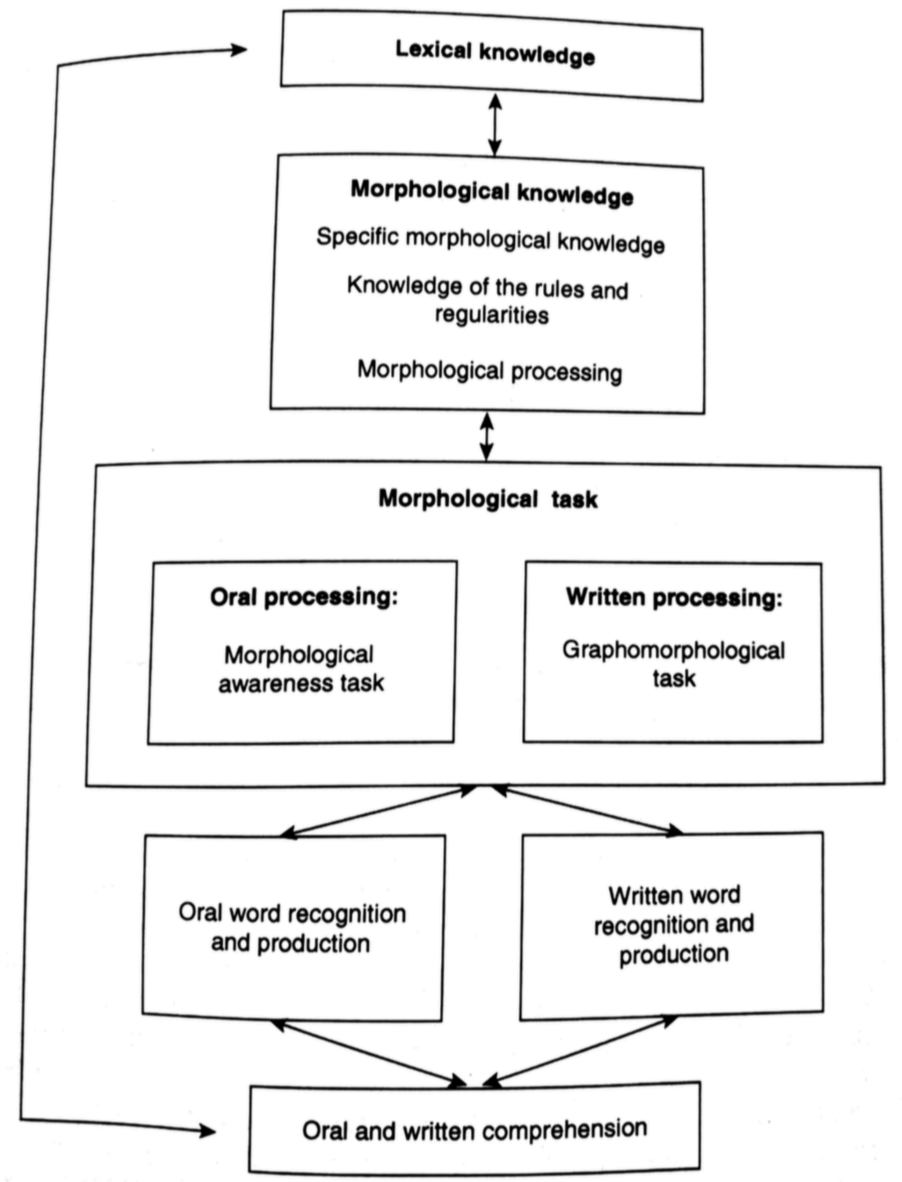

Figure 1. Model of morphological knowledge and processing (Berthaiaume, Bourcier, & Daigle, 2018).

As illustrated above, this sampling of the literature demonstrates the inconsistencies in the operationalization of the metalinguistic skill of morphological awareness as well as just how difficult it is to specify this skill. Once theory and empirical evidence converge a clear definition will emerge.

Multidimensionality of Morphological Awareness

The model proposed by Berthaiaume, Bourcier, and Daigle (2018) theorizes that morphological awareness is multidimensional, composed of morphological knowledge and both oral and written processing. Yet empirical evidence has led to disagreement about whether morphological awareness is unidimensional (see Muse, 2005; Nagy, Berninger, Abbot, Vaughan, & Vermeulen, 2006) or better modeled as a multidimensional construct (see Berninger, Abbott, Nagy, & Carlisle, 2010; Goodwin, Petscher, Carlisle, & Mitchell, 2015). Muse (2005) was one of the first to explicitly explore the issue of dimensionality of morphological awareness with Grade 4 participants. She examined modality (oral versus written presentation), multiple-choice versus production response format, and tasks that required morphological use (implicit) and conscious awareness of morphemes (explicit), and found that morphological awareness was best modeled by a single latent trait, suggesting this is a unidimensional construct. However, with a sample of adolescents, Goodwin, Petscher, Carlisle, and Mitchell (2015) used confirmatory factor analyses and structural equation modeling and found that a bifactor model with a general factor for morphological knowledge and seven specific factors representing various aspects of morphological knowledge (e.g., suffix choice, word reading, reading comprehension, and spelling, etc.), fit the data best. Although they had originally hypothesized that these factors would represent two dimensions of morphological knowledge: tacit processing and strategic analysis, the data did not support this, suggesting there are multiple dimensions of morphological knowledge. Differing results of dimensionality may be due to the factors included or the assessment format of those factors; therefore, it is important to consider which aspects of morphological awareness may represent different dimensions and how they can be best measured. Two aspects are reviewed: one that is theoretically supported (e.g., modality) and one that is empirically supported (e.g., word type).

Modality of representation. Oral and written morphological awareness may represent different dimensions of this knowledge. However, morphological awareness has primarily and perhaps unintentionally been assessed in the oral realm. Carlisle was one of the first to offer a definition (see Carlisle, 1995 in Table 1) of morphological awareness, one that is frequently referenced by morphology researchers, she did not specify the modality of morphological awareness in this definition. However, this seminal definition is often interpreted as relating to oral ability. Berthaiaume and colleagues (2018) suggest that this may be because of the assumption that this definition is related to general linguistic awareness, akin to phonological awareness which is measured orally. Yet this assumption may be due at least in part, to the fact that Carlisle's (2000) measure of morphological awareness is an oral task. Additionally, the first widespread measure of morphological productivity, what has become known as the "Wug Test" (Berko, 1959), assesses oral morphological knowledge, which may also contribute to the field's focus on the oral realm.

Assessing the construct of morphological awareness orally allows for the isolation of the task from reading ability which many researchers sought to achieve as they employed this measure, thinking it provided a purer assessment of this skill. However, this neglects to address the idea that there is potentially a textual, or graphomorphological, aspect of this skill (see Figure

1). Although the dimension of modality has strong theoretical support (Berthaiaume, Bourcier, & Daigle, 2018), empirical support for this dimension is lacking. It has been argued that this is largely due to the fact that there is only one pure measure of graphomorphological awareness in the literature (Apel, 2013). Some researchers have used a written and oral presentation of their assessment as a way to combat this issue (Nagy et al., 2006; Singson, Mahony, & Mann, 2000), but while this introduces a textual representation and accounts potential reading ability issues, it does not illuminate whether there is a specific graphomorphological feature because the oral presentation confounds it. Until there is conclusive evidence that modality does or does not represent a separate dimension. it is important to specify the modality used to measure the construct and limit inferences to that modality. Therefore, within the context of the current study, morphological awareness is specifically referred to as oral morphological awareness as an acknowledgement that the measure used was administered orally.

Word type. Another aspect that may represent a multidimensional component of morphological awareness is the role it plays in the recognition of different word types. One example of this is real words vs pseudowords. Some researchers opt to use a pseudoword measure to index morphological awareness because it does not have the confound of word knowledge. However, I hypothesize that morphological awareness, because it is linked to meaning, will predict accurate real word reading recognition more than it will predict pseudoword reading ability. So, it is important to consider if distinction between these word types is warranted.

There is mixed evidence for the role morphological awareness plays when reading pseudowords and real words (Apel, Diehm, & Apel, 2013; Deacon & Kirby, 2004). Some researchers have found empirical evidence that these word types represent different dimensions of morphological awareness. For example, Tighe and Schatschneider (2015) looked at dimensionality of several aspects of morphological awareness (e.g., inflectional versus derivational morphology, real words versus pseudowords, and contextual cues versus no contextual cues). The only distinction they found was for real words versus pseudowords, which yielded a marginally nonsignificant chi-square difference. This evidence that real words and pseudowords represent different dimensions suggests that assessments that only include stimuli with one word type may not comprehensively assess this construct.

Morphological awareness may also differentially contribute to recognition for morphologically complex words as compared to non-morphologically complex words. While it may be obvious that morphological awareness contributes to the recognition of morphologically complex words, the role (if any) it plays in the recognition of non-morphologically complex words is less clear. Perhaps a letter sequence that sometimes represents a morpheme is used to recognize a word in which it is not acting as a morpheme (e.g., the *-er* in after or the *un-* in under). Although the literature regarding the role it plays in the recognition of these specific word types is scarce, evidence for the role of morphology in the recognition and storage of morphologically complex word is more plentiful (Beauvillain, 1994; Caramazza, Laudana, & Romani, 1988; Taft & Forster, 1976; Longtin & Meunier, 2005; Marslen-Wilson, Tyler, Waksler, & Older, 1994; Sandra, 1994). That said, the specifics of how and when morphology of a word is accessed remains a topic of continuing debate. Clearly, there is need for additional empirical evidence of the role of morphological awareness at the word level.

Assessment of Morphological Awareness

Relative to other areas of literacy, there are few morphological awareness assessment tools (Apel, Diehm, & Apel, 2013) and no one measure has been used consistently across studies, further contributing to the variable findings regarding its exact role in word recognition. One can easily see why, because of its relation to other linguistic attributes (e.g., it links to orthographic units, semantic units, and phonological units), it is difficult to assess morphological awareness, which has further contributed to the difficulty in adopting a clear definition (Goodwin, 2010).

The existing tools used to assess morphological awareness can be grouped according to task requirements. There are analogy tasks that consist of either words or sentences typically presented orally (e.g., anger: angry:: strength: _______) (Berko, 1958; Bryant, Nunes & Bindman, 1997; Deacon & Kirby, 2004; Kirby, Deacon, Bowers, Izenberg, Wade-Woolley, & Parrila, 2012). Judgment tasks, for which students determine if there is a semantic relationship between two provided words (e.g., "Does moth come from mother?) (Berninger, et al., 2010; Kuo & Anderson, 2003; Mahony, Singson, & Mann 2000; Nagy, et al., 2006), are a commonly employed task. Production tasks, which seek to measure morphological awareness via a cloze procedure (e.g., "Farm. My uncle is a ______") (Casalis & Cole, 2009; McCutchen, Green, & Abbott, 2008; Tong, Deacon, Kirby, Cain, & Parilla, 2011; Wolter, Wood, & D'zatko, 2009), represent another category. Some production tasks require a definition (Jeon, 2011; Tsesmeli & Seymour, 2006), or ask students to spell multi-morphemic words (Apel, et al., 2012; Kirk & Gillon, 2007). Thus, many different tasks have been employed to measure morphological awareness; however, oral measures dominate the field. There is only one published textual measure of morphological awareness (Apel, 2014). The first, and as of yet, only tool developed to specifically measure the construct of textual morphological awareness or graphomorphological processing was created by Apel, Diehm, and Apel (2013). In this study the researcher-created assessment was administered to both first (n = 44) and second grade students (n = 54). Students were presented with four practice items followed by a list of 51 pseudowords with real affixes and asked to circle all the affixes within a time limit of three minutes.

In sum, the difficulty of isolating morphological awareness for assessment purposes and the many varied tasks that have been used to assess it have contributed to the differing findings for dimensionality, in addition to the historic difficulty adopting a comprehensive definition. The current study seeks to address this problem by defining the modality used to assess morphological awareness in a longitudinal reading study and confining the discussion of results to that modality, a practice that should be adopted by the field. Additionally, the role of morphological awareness in word recognition of different word types is analyzed across grade levels to contribute to our understanding of how this skill may differentially impact recognition of real words and pseudowords and morphologically complex and non-morphologically complex words. This will, in turn, inform researchers about appropriate stimuli selection for assessment which will provide the needed evidence to adopt a consistent definition. As part of this development, a firm understanding of the role morphology plays in the reading process is necessary.

Role of Morphology in the Reading Process

The reading process can be conceptualized via Perfetti's (2010) "Golden Triangle of Reading Skill: The DVC Triangle" (see Figure 2). The *C* in the triangle is the ultimate goal of reading, comprehension (i.e., understanding what is read). Understanding can only occur once words are accurately recognized or decoded (*D*) and if personal knowledge of the word's meaning (i.e., vocabulary knowledge [*V*]) can be accessed. Morphological awareness contributes to this process; Carlisle (2004) stated that, "readers who are unaware of morphological components of written words are at a particular disadvantage in decoding, vocabulary, and reading comprehension" (p. 329). The specific way it impacts all three of these aspects is explored below.

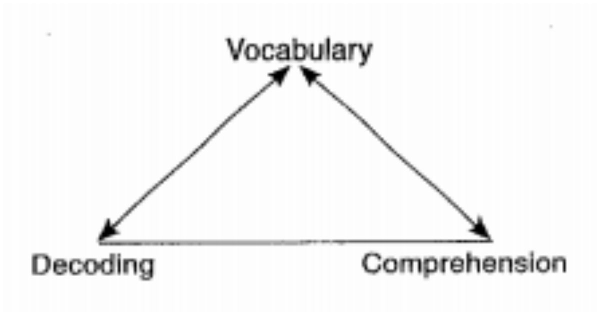

Figure 2. The DVC reading skill triangle (Perfetti, 2010).

Decoding

Reading comprehension, the goal of the reading act, requires first and foremost that a reader recognize the words on the page. Perfetti (2010) explained that decoding, as it is conceptualized within this model, encompasses both the broad concept of word identification as well as the more specific grapheme to phoneme match that occurs during reading. Regardless of the task used to measure morphological awareness, it has been found to significantly correlate with word recognition (Fowler & Liberman, 1995). Using an orally presented real word analogy measure Kirby, Deacon, Bowers, Izenberg, Wade-Woolley, & Parrilla (2012) found that morphological awareness significantly predicted both real word reading and pseudoword reading accuracy after controlling for phonological awareness for first through third grade students. As a complement to this study with regards to grade level, Singson, Mahony, and Mann (2000) analyzed the impact of knowledge of derivational suffixes specifically on decoding ability for third through sixth grade students. They found evidence that morphological awareness, measured by a derivational suffix test including real and pseudowords presented orally and in written form, not only made an independent contribution to decoding but also increased across grade levels. The results were mixed with a study of older students. Nagy, Berninger, and Abbott (2006) found that morphological awareness made a significant unique contribution to decoding rate for Grade 8 and 9 students but only contributed on some measures for Grade 4 and 5 students. They used two measures of morphological awareness: a suffix choice task (Nagy et al., 2003) and a morphological relatedness test (Nagy et al., 2003). Both were presented visually and auditorily. Although the degree to which morphological awareness contributes to decoding may vary by grade level, evidence supports the assertion that it does have an independent role in decoding.

Vocabulary

Words must be linked to meaning to facilitate comprehension (Hiebert, Goodwin, & Cervetti, 2017; Ricketts, Nation, & Bishop, 2007), a process that is informed by a reader's vocabulary knowledge, as represented in Figure 2. *Decoding* does not have an arrow directly connecting it with *comprehension*; rather, there is an arrow from *decoding* to *vocabulary* and from *vocabulary* to *comprehension*.

There is strong empirical evidence that morphological awareness is correlated with children's vocabulary knowledge (Ku & Anderson, 2003; McBride-Chang, Wagner, Muse, Chow, & Shu, 2005; McCutchen & Logan, 2011; Ramirez, Walton, & Roberts, 2014). Because morphemes represent meaningful units of a word and the oral vocabularies of children learning to read contain many morphologically complex words, it is not surprising that morphological awareness has been linked to vocabulary. As Nagy and Scott (2000) point out for English language learners, "It is hard to overstate the importance of morphology in vocabulary growth" (p. 275). Some researchers have suggested that these two concepts are in fact representative of the same construct (Kieffer & Lesaux, 2012). However, it has also been shown that morphological awareness and vocabulary knowledge are separate yet correlated constructs (Carlisle & Goodwin, 2014; Tighe & Schatschneider, 2015), potentially best characterized as a reciprocal relationship (Ramirez et al., 2014). It is also important to note that the relationship between vocabulary and morphological awareness appears to maintain over time. Nagy, Berninger, and Abbott (2006) examined the role of morphology to literacy outcomes with three different groups of students across the upper elementary (Grades 4/5) and middle school (Grades 6/7 and Grades 8/9 graders) grade levels. They found that morphological awareness made a unique contribution to reading vocabulary for each group, after the variance due to phonological working memory and decoding were partialled out.

Reading Comprehension

Once word recognition has occurred and the words on the page have been linked with vocabulary knowledge, comprehension of the text can occur (Perfetti, 2010). Accurate word recognition that has mapped on to vocabulary knowledge does not ensure comprehension, but in the absence of this, accurate comprehension cannot occur (Nation & Coady, 1988). In Figure 2 there is a bidirectional arrow between comprehension and vocabulary because of the interactive nature of these two processes. Vocabulary knowledge influences comprehension, comprehension in turn informs vocabulary, the more word meanings one is familiar with the more accurate comprehension becomes, and as more is read and understood, the larger one's vocabulary knowledge base becomes (Perfetti, 2010).

Research findings regarding the specific contribution of morphological awareness to reading comprehension are mixed. While there is evidence that morphological awareness plays a role in reading comprehension (Carlisle & Fleming, 2003; Deacon, Tong, & Francis, 2017; Kirby, et al., 2011; Tong, Deacon, & Kirby, 2011; Wolter & Pike, 2015), the question remains whether this is via a direct and/or an indirect path of influence. Some studies have found that the relationship between morphological awareness and reading comprehension is only indirect, via other related skills such as word identification and vocabulary. Jarmulowicz, Hay, Taran, and Ethington (2008) explored a developmental model of reading in which they proposed a sequence which begins with receptive language, followed by phonological awareness, morphological awareness, morphophonological accuracy, decoding, and concludes with reading comprehension. The results of their study with Grade 3 students indicated that morphological awareness, measured via an orally presented morphological analysis assessment, was only indirectly linked to reading comprehension outcomes via decoding through morphophonological accuracy. Similarly, Deacon, Kieffer, Laroche (2014) found evidence that morphological awareness, measured with an orally presented analogy task, indirectly influenced reading comprehension through decoding skills, but they also found that it directly influenced it through the language system. In contrast, Kirby and colleagues (2012) found that morphological awareness significantly predicted reading comprehension after controlling for verbal and nonverbal ability and phonological awareness for students in Grades 1-3. With an older sample of students in Grades 4-9, Nagy and colleagues (2006) found that morphological awareness significantly contributed to reading comprehension when controlling for vocabulary knowledge. Thus, there is converging evidence that morphological awareness is involved in some capacity in comprehension of text but its specific role is yet to be established.

To review, empirical evidence supports the hypothesis that morphological awareness plays a role in the reading process. In regards to how to incorporate morphology into instructional protocols, the potential instructional contributions of morphology are just beginning to be fully explored. There is strong evidence that developing morphological awareness is effective in improving word recognition, vocabulary knowledge, and to some degree reading comprehension (Carlisle, 2000; Hiebert & Bravo, 2010; Kuo & Anderson, 2006). Because decoding is the entry point for reading, and as such, is a crucial skill for becoming a reader, it is worth delving further into understanding the role of morphological awareness in word recognition. Thus, in the next section, I will discuss the units of lexical access employed by English readers.

Models of Word Recognition

Researchers in different disciplines attempt to understand word recognition through their own lens, using varied methodologies. For example, researchers in the cognitive neuropsychology realm seek to explain skilled word recognition via computational models, which are designed to test theories of cognition by predicting and lexical access. Developmental psychologists construct theories of reading acquisition across time. In a complementary yet distinct field, linguistic scholars seek to explain the recognition processes through an analysis of the structure of language. A consideration of these various perspectives together may lead to a more holistic understanding of the process of reading and potentially a reinterpretation of the role of morphology in visual word recognition.

Dual Route Theory

Various architectures with differing underlying assumptions have been proposed to explain word recognition. A dual route theory of word recognition (Coltheart, 2005; Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001) represents two potential access routes, a lexical and a nonlexical route. The lexical route, as it suggests, represents direct access via the entire word in the mental lexicon, while the nonlexical route applies segmentation rules to access the word. This segmentation route represents decomposition of various unit types including both phonemes and morphemes. It is hypothesized that each route is occurring in parallel and a race model is used to explain which route "wins" (Caramazza, Laudanna, & Romani, 1988; Schreuder & Baayen, 1995).

A connectionist model in contrast, is a learning model, which seeks to explain visual word recognition via connections representing neural networks (Plaut, McClelland, Seidenberg, & Patterson, 1996; Seidenberg & McClelland, 1989). While symbolic models are based on fully pre-determined theories, connectionist models do not make any prior assumptions and instead learn from stimulus input. The connectionist model suggests the existence of a "learning device" that has the capability to determine the phonological, orthographic, and semantic similarities across words (Invernizzi, 2011). They are often represented by a graphic in the shape of a triangle, with phonological, orthographic, and semantic properties represented at the vertices. Multiple neural interactions connect each vertex, representing the learning of the model.

A theoretical application of aspects of these models that recognizes the contribution of both phonology and morphology is Verhoeven and Perfetti's (2011) model detailing the identification of complex orthographic word forms (Figure 3). This model allows for morphological decomposition, grapheme-phoneme connections, and full listing. The novel idea presented in this model is that morphological decomposition can occur early in the word identification process. This decomposition can either occur directly from the word form or indirectly from the orthography of the word. This model is similar to dual route models but with the added feature of interactive connections between the levels, which could represent the learning of the connectionist models.

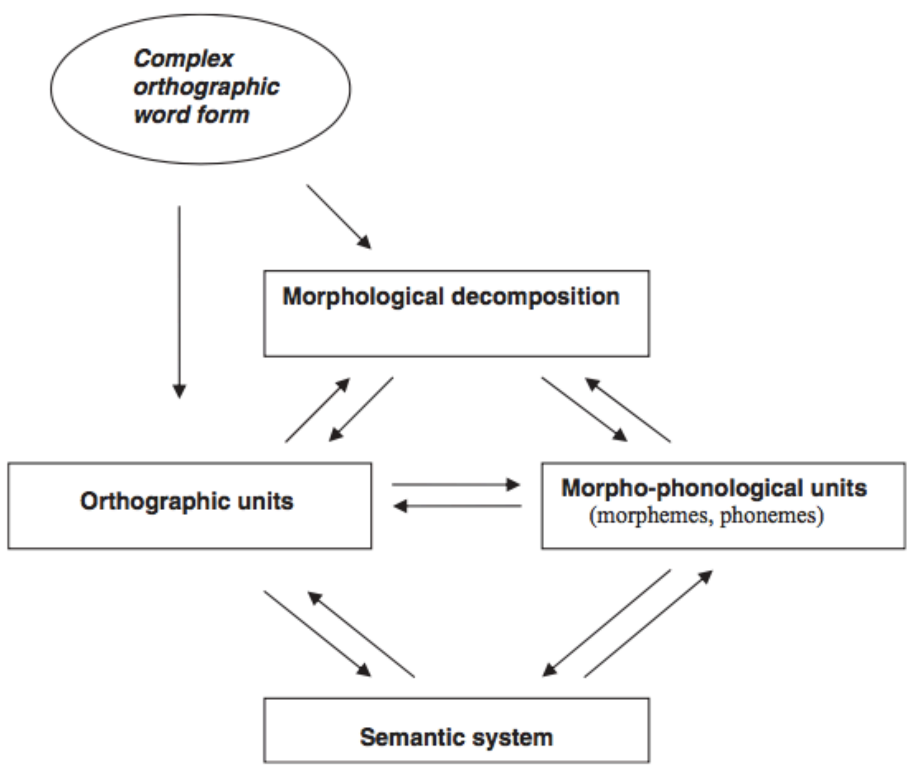

Figure 3. The role of morphology in the identification of complex orthographic word forms (Verhoeven & Perfetti, 2011).

Developmental Perspective

Dual route models have focused on modeling a single state, skilled reading, and have not yet been used to predict change over time. Thus, they aid our understanding of the processes involved in skilled reading, but have less relevance for understanding how skilled reading is learned and the role different linguistic factors may play in lexical access across development. Developmental theorists answer this call by considering the stages or phases at which development occurs, each of which is characterized by certain incremental milestones generally representing skills at the pre-reading, early reading, decoding, and fluent reading levels. The role of morphology in spelling was considered by early theorists (Chomsky, 1970; Seymour 1997) who recognized the contribution of both phonology and morphology to orthographic development, but its role in reading was not explored until decades later (Carlisle, 2010).

In 1990, Adams was one of the first to consider the relationship between morphology and reading. She suggested a model in which early stages of literacy development involve children's learning how sound and meaning map onto the written representations of words—emphasizing the collective contributions of the phonological processor, orthographic processor, and meaning processor. However, she suggested that morphological awareness instruction be taught in older grade levels when students' knowledge of words was more established. Adams thus postulated that morphology is developed after a student has mastered basic reading proficiency and once they frequently encounter morphologically complex words in their reading material (Adams, 1990).

While there have been several developmental theories posited over the years, perhaps none have been more widely accepted than Ehri's phase model (2005). Ehri's model spans from a pre-alphabetic phase, to partial alphabetic, followed by full alphabetic, culminating with the consolidated alphabetic/automaticity phase. She did not specifically explore reading development with regard to multimorphemic words, but she did theorize that the final stage, characterized by word recognition beyond a 1:1 grapheme-phoneme relationship, features word recognition via larger units including rimes, syllables, and morphemes.

Using verbal morphology as evidence of children's capabilities, Carlisle (2003) sought to reverse the opinion that morphological awareness should not be taught simultaneously with phonological awareness in early schooling (Adams, 1990; Ehri, 1992). She disagreed with the widely accepted but, in her opinion, mistaken view that derivations are too difficult for younger children and are not academically relevant until middle school, citing evidence of preschool children demonstrating morphological awareness by recognizing stems and modifying them in speech as appropriate (e.g. open, opening, opened, unopened). Since children show awareness of this concept as young as preschool, it seems appropriate to begin morphological awareness instruction at a younger age to help facilitate reading morphologically complex words later in schooling.

Psycholinguistic Grain Theory

In contrast to the computational models of skilled reading and developmental theories of reading development, psycholinguistic grain size theory is a model that focuses instead on the processing required by differing orthographies for reading accuracy and the development of that processing bias (see Figure 4; Ziegler & Goswami, 2005). Psycholinguistic grain size theory assumes lexical organization is impacted by an individual's development and varies across orthographies due to their consistency or lack thereof. It postulates that development does not cease and it predicts that readers exposed to inconsistent orthographies (i.e., English) will develop different lexical unit representations than readers who are exposed to consistent orthographies (i.e., German). English readers, due to the inconsistency of the letter sound relationship--exhibited especially by vowels-- must continually change the grain level at which they access text. This ability to switch grain size to accurately decode a word leads to flexible recoding strategies for English readers. While this theory neglects the specific role of morphemes as a unit of access, because language is organized at the morphemic level as well as the phonological level, the consideration of the morpheme as an additional potential grain size unit seems like a natural extension of this theory and may further illuminate reading behavior differences across orthographies (Kearns, 2015).

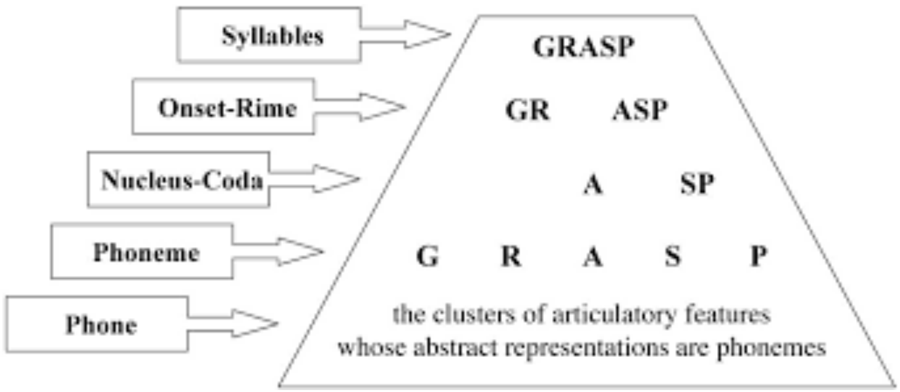

Figure 4. Psycholinguistic grain sizes (Ziegler & Goswami, 2005).

Taken together, computational models and both developmental and linguistic theories, suggest morphology may be involved in word recognition. Evidence from computational models suggest words may be decomposed based on morphology during the initial recognition stage. Developmentally, awareness of the morphology of words is hypothesized to increase over time as a person becomes a proficient reader. Linguistic theory suggests there may be different grain sizes readers attend to and that thus facilitate word identification; morphemes may constitute a grain size. When trying to dissect the role of morphological awareness in the reading process it is helpful and necessary to consider the evidence and theories proffered by varied fields regarding the potential role of morphology in word recognition.

The Learner

Understanding the process of word recognition is important, but it is just as important to understand the person engaged in the process, the learner. As the RAND reading group (Snow, 2002) suggests, the reader is an integral and equal part of the process of reading and therefore must be considered. For the purposes of this study, morphological awareness skill for emerging readers and varied-ability readers was analyzed.

Emerging Readers

A positive causal link exists between oral language and reading skills at all levels of a child’s development of reading (Whitehurst & Lonigan, 2002). Therefore, verbal morphological awareness may represent an aptitude and readiness to apply this understanding to text (Carlisle, 2000). There is evidence that pre-school aged children demonstrate oral morphological understanding (Berko, 1959; Clark, 1982), suggesting that instruction in the application of morphological awareness to word recognition may be appropriate for students in lower elementary grade levels.

Indeed, a growing body of evidence from intervention studies suggest that younger students may be developmentally ready for and benefit from early morphological awareness instruction (Apel, et al., 2013; Beyersman, Castles, & Coltheart, 2012). Although the majority of studies exploring morphological awareness have focused on upper elementary and middle school-aged students (Abbot & Berninger, 1999; Baumann, Edwards, Baland, Olejnik, & Kame-enui, 2003; Bowers, 2006; Lesaux, Kieffer, Faller, & Kelley, 2010; Nunes, Bryant, Pretzlik, Burman, Bell, & Gardner 2006), there have been several studies to date that have analyzed younger elementary-aged students (Carlisle & Nomanbhoy, 1993; Kirby, Deacon, Bowers, Izenberg, Wade-Woolley, & Parrila, 2012).

Carlisle and Fleming (2003) examined the impact of early lexical knowledge measured via analysis tasks (e.g., Rubin's (1998) Word Analysis Test which asks students to determine if words with similar endings are morphologically complex (e.g., *hilly*) or monomorphemic (e.g., *silly*)) on later reading comprehension for younger elementary-aged students. They found that Grade 3 participants were better able to process morphologically complex words than Grade 1 participants but the lexical knowledge of both groups was related to later successful application of morphological analysis and improved reading comprehension. It explained 23% of the variance in reading comprehension for first graders, which increased to 27% for the older group, after controlling for reading vocabulary.

The potential of reading instruction that incorporates morphological awareness at the lower elementary school level is also beginning to be more fully explored. Apel, Brimo, Diehm, and Apel (2013) measured the effectiveness of a morphological awareness intervention that focused on word structure, highlighting the root and affixes of polymorphemic words for Kindergarten students and those in Grades 1 and 2. Results were encouraging, yielding medium to very large statistically significant gains for all participants on measures of word identification, decoding, morphological awareness, phonological awareness, and reading comprehension. Interestingly, with regard to the increase in morphological awareness for emerging readers, the biggest gains were for the youngest students (K: d=2.26, 1st: d=1.40, 2: d=1.11).

Studies that replicate and extend these findings are needed to fully understand the developmental continuum of morphological awareness and potential instructional implications for the lower elementary grade levels. Beyond age, there is a large range of individual differences with regards to language and reading ability (Beck & McKeown, 1991; Perfetti, 2003; Stanovich, 1986) that differentially impact development. Different learner profiles may put a student at higher risk for reading difficulty or success.

At-Risk Readers

Readers who struggle to access and make meaning of grade level written text are considered struggling readers at-risk for reading difficulties (Snow et al., 1998). Reading difficulties can occur at the word level when reading text, during the meaning-making process, or present as a combination of both (Kieffer, 2014). At-risk readers constitute a population that deserves much research attention. Learning to read is of critical importance in a literate society. If a child lags behind peers in the beginning process of learning to read, she is unlikely to catch up; membership in this group appears to be static (Biemiller, 2010; Juel, 1998).

Considering that phonological awareness accounts for such a large proportion of variance in reading, if a student struggles with this metalinguistic ability she will likely experience difficulty learning to read, which is characteristic of students with dyslexia (Shaywitz, Morris, & Shaywitz, 2008). Much research has been dedicated to figuring out how to remediate the phonological deficit of these students (Shaywitz, Morris, & Shaywitz, 2008). However, if a student has a deficit in phonological awareness it may be more efficacious to target a different metalinguistic skill, one that may be an area of relative strength and as such pose an ideal access point. Given that the English language features both phonological and morphological elements, morphological awareness is an ideal candidate. In particular, morphological awareness is uniquely suited to address both types of reading difficulties (e.g., word level difficulties and meaning-making difficulties) because it contributes to accurate word recognition and the process of extracting meaning from words.

In a study designed to analyze whether morphological awareness, as measured by a pseudoword suffix choice task that was read aloud, differentiates struggling readers from proficient readers, Kieffer (2014) found that 11% of proficient readers had a weakness in morphological awareness compared to 45% of struggling readers. While morphological awareness ability of struggling readers may not be a strength relative to strong readers, it still may represent a skill that provides more value than phonology when accessing words because morphemes are generally less abstract than phonemes and help readers access meaning. For dyslexics specifically, a deficit in morphological awareness is not the cause of reading difficulty but rather may result from limited reading exposure (Law, Veispak, Vanderauwera, & Ghesquiere, 2018). So, the lower ability in morphological awareness for struggling readers may not be due to an impairment in this skill, but rather a lack of familiarity and practice with this skill. In fact, there is emerging evidence that struggling readers use morphological awareness as a compensatory strategy when reading (Catts, Adlof, & Weismer, 2006; Deacon, Tong, & Mimeau, 2016; Elbro & Arnbak, 1996).

Readers with lower reading abilities have lower morphological awareness than proficient readers, however, they benefit equally from morphological awareness interventions when compared to average ability peers (Tomesen & Aarnoutse, 1998) and in some studies have outperformed typically developing peers (Bowers, Kirby, & Deacon, 2010). Bowers et al. found that less proficient readers made greater gains than controls, suggesting that morphological instruction may actually be most appropriate for at-risk students. In their meta-analysis of the effectiveness of morphological instruction for students with learning difficulties, Goodwin and Ahn (2010) found that morphological interventions contributed to literacy gains for children with reading disabilities, children with learning disabilities, children with specific learning disabilities, English language learners, and struggling readers. Students with speech and language delays made the greatest gains (d=0.77). The results indicate that morphological interventions can contribute to improved outcomes for students who struggle with reading-related tasks.

Evidence suggests that student populations who are most at-risk for reading difficulty, students with special needs, not only benefit from morphological awareness intervention (Elbro & Arnbak, 1996; Kirk & Gillon, 2009), but may benefit more than their typically developing peers (Goodwin & Ahn, 2010). Developing metalinguistic awareness for these populations may help narrow the achievement gap and provide a means by which to help students access complex text.

METHODOLOGY

Statement of the Problem

Word identification, the access to and retrieval of the linguistic components of a word (Verhoeven & Perfetti, 2011), is the process during which a reader matches an orthographic pattern to its corresponding phoneme(s) and/or morpheme(s). While evidence of the role phonological awareness plays in word identification is robust, comparatively less research attention has focused on morphological awareness. Research on morphological awareness emerged in the 1970's (Brittain, 1970) but only in the past decade has the scientific investigation of this key construct in language and reading acquisition begun to flourish (Berthiaume, Daigle, & Desrochers, 2018). Carlisle (1995) provided some of the early and seminal work in this area. She operationalized morphological awareness as the "conscious awareness of the morphemic structure of words and the ability to reflect on and manipulate that structure" (Carlisle, 1995, p. 194).

Research on morphological awareness has focused on its contribution to decoding in general (Carlisle, 2003, 2010; Kuo & Anderson, 2006: Nagy, Berninger, & Abbott, 2006; Reed, 2008; Bowers, Kirby, & Deacon 2010); analysis of its specific role in the identification of different word types (i.e., morphologically complex words compared to non-morphologically complex words; real words compared to pseudowords) is limited and inconsistent. There is psycholinguistic evidence that morphology plays a role in word identification (Bybee, 1995; Caramazza, Laudannna, & Romani, 1988; Feldman, 2000; Milin, Feldman, Ramscar, Hendrix, & Baayen, 2017), but the role of morphological awareness is less understood. Although there is emerging evidence that morphological awareness contributes to the recognition of morphologically complex words, what is less understood is what role, if any, it plays in the recognition of non-morphologically complex words. The sequential processing account of word recognition asserts that words are morphologically decomposed before semantic processing occurs (Feldman & Milin, 2018; Rastle & Davis, 2008), suggesting that morphological awareness could potentially contribute to the recognition of non-morphologically complex words, if they contain a letter string that could be a plausible affix. Take for example the words, *prepaid* and *preach*. While *prepaid* is morphologically complex and *preach* is not, they both begin with the same three-letter sequence: *pre*. It is conceivable that a student may recognize the *pre* in *preach* due to awareness of the prefix *pre*, even though it holds no meaning in this word. The same argument applies to the pseudoword *preanch*. In this pseudoword the letter string *pre* may be recognized as an affix even though without knowing what this word means it is impossible to know if it is acting as a prefix. To fully understand the role morphological awareness plays in reading, it is necessary to parse out its contribution to the recognition of these different word types.

Also crucial to the budding field of morphological awareness research is a more developed understanding of the learner. Much of the research on morphological awareness has focused on upper elementary and middle school grade levels (see Abbot & Berninger, 1999; Baumann, Edwards, Baland, Olejnik, & Kame-enui, 2003; Bowers, 2006; Lesaux, Kieffer, Faller, & Kelley, 2010; Nunes, Bryant, Pretzlik, Burman, Bell, & Gardner 2006) because this was deemed developmentally appropriate (Adams, 1990; Ehri, 1995). However, this neglects younger students, who may also benefit from explicit instruction of this skill and early exposure to this key aspect of reading, particularly in a morphophonological language with an alphabetic writing system such as English (Carlisle, 2010). In a recent meta-analysis of literacy outcomes for morphological interventions (Goodwin & Ahn, 2013), only roughly a quarter of the included studies focused on students in Grade 2 or younger (Devonshire & Fluck, 2010; Filippini, 2007; Lovett, Lacerenza, Borden, Frijters, Steinbach, & De Palma, 2000; Lovett & Steinbach, 1997; Tyler, Lewis, Haskill, & Tolbert, 2003, Vadasy, Sanders, & Peyton, 2006). This sampling of the literature suggests that not as much is understood about the development of this ability during the younger elementary grade levels.

Many students struggle learning to read (Foorman, Francis, Fletcher, Schatschneider, & Mehta, 1998) so it is important to understand if there are different skill profiles that are more or less at-risk for later reading outcomes, which could in turn, inform instructional focus. For example, students with dyslexia, a reading disability characterized by a deficit in phonological awareness (Bradley & Bryant, 1983; Robertson, Joanisse, Desroches, & Terry, 2012; Wagner & Torgeson, 1987), would be expected to have weak phonological awareness, but it has not been conclusively determined if morphological awareness serves as a compensatory skill to help them attain reading proficiency, although there is emerging evidence that this may be the case for both children and adults with dyslexia (Deacon, Tong, & Mimeau, 2016; Elbro & Arnbak, 1996; Law, Wouters, & Ghesquiere, 2015; Law, et al., 2018). Thus, studies focused on word identification for various profiles of students with regards to phonological and morphological awareness ability during the early elementary school years are needed to determine which skills may benefit readers most and which profile(s) may signify potential future reading challenges.

In sum, research analyzing the contribution of morphological awareness to both morphologically complex and non-morphologically complex real and pseudoword reading for emerging readers is needed. Additionally, and more important for struggling readers, a high need group, a better understanding of the metalinguistic skills that contribute to reading success and put students at-risk for reading failure in the elementary school years is crucial. This will help inform teachers about how and for whom reading intervention should be prioritized as well as provide additional information about which word types should be the focus of instruction.

Present Study

To add to the field of morphological awareness research, two separate but complementary paths of inquiry were featured in this study. First, consistent with the theoretical model proposed by Berthiaume and colleagues (see Figure 2; 2018), I analyzed the role of oral morphological awareness in the recognition of morphologically complex and non-morphologically complex real and pseudowords (see research questions 1 and 2). As previously reviewed, evidence suggests morphological awareness contributes to recognition of morphologically complex real words but less is known about its role in the recognition of non-morphologically complex real words. The evidence is mixed with regard to the role it may play in the recognition of both morphologically complex and non-morphologically complex pseudowords. Although this was a longitudinal study, the subset of Grade 2 data was selected to answer the first two research questions because this is a developmental time period during which early readers are not typically highly skilled readers, yet they are proficient enough to independently read morphologically complex words and pseudowords. There is converging evidence that skilled readers rely on morphological awareness but less is known about emerging readers' use of this skill. Additionally, it marks a time when readers begin to shift from relying on single letter grapheme-phoneme correspondence to recognizing larger chunks (e.g., rimes, morphemes), making students in this grade level a uniquely suited population for analysis focused on the contribution of phonological and morphological awareness to word identification.

Second, although previous studies have explored struggling readers' use of morphological awareness in word identification, few have considered the learner's ability profile with regard to phonological *and* oral morphological awareness when analyzing accurate word identification for both real and pseudo morphologically complex words and non-morphologically complex words (see research question 3). Therefore, this study was designed to model differing ability profiles and analyze if performance on these reading outcome measures changes over time, based on profile membership (see research questions 4). Group characteristics were analyzed to see if there was a subgroup that had higher achievement and if there was a more at-risk group for low achievement in reading. It was hypothesized that students with higher phonological awareness would outperform students with lower phonological awareness on pseudoword recognition because recognizing these words depends primarily on knowledge of phonology as they are divorced from meaning. Conversely, students with higher morphological awareness were predicted to be more accurate recognizing morphologically complex real word measures. Of particular interest was if the latent profile analysis would yield a group of students with low phonological awareness and high morphological awareness and a group with the inverse, so differences in group performance on reading outcomes could be compared, shedding light on the process of word recognition for these different profile types. If students with high morphological awareness performed comparatively to the group with high phonological awareness this would suggest that students are able to effectively use morphological awareness as a compensatory strategy for recognizing words, which could ultimately inform instructional decisions and help educators understand how to leverage a strength in morphological awareness. Lastly, if there was a group that was more at-risk for later reading challenges this would help teachers determine which students need more intensive intervention earlier in schooling in an effort to prevent later challenges.

To extend our understanding of the role of morphological awareness in word identification for different learners the following research questions were explored with a longitudinal study sample of elementary school-aged students:

1. How does oral morphological awareness contribute to word identification of real words compared to pseudowords, when controlling for phonological awareness and verbal cognitive ability for students in Grade 2?
2. How does oral morphological awareness contribute to word identification of morphologically complex words compared to non-morphologically complex words, when controlling for phonological awareness and verbal cognitive ability for students in Grade 2?
3. Can empirically-based subgroups of students be identified based on oral morphological awareness and phonological awareness ability that are theoretically meaningful?
4. Does initial level and growth of reading skills differ across these subgroups?
    a. Is there a subgroup of students that achieve higher on measures of word reading?
    b. Is there a subgroup of students that achieve lower and thus are at-risk for low achievement in reading?

Methods

Participants and Setting

This data is a subset of data collected for a longitudinal reading study (Deacon, Benere, & Castles, 2012; Deacon, Benere, & Pasquerella, 2013; Deacon, Kieffer, & Laroche, 2014; Sparks & Deacon, 2013) conducted with students across seven schools in northeastern North America. Participation rate across schools was 62% and there was no significant difference among students who participated from the different schools ($p < .05$). All children for whom data were obtained at Grade 2 were included, resulting in 102 participants across three grade levels (i.e., grades 2 through grade 4). These grade levels were selected because this is a developmental period during which readers develop proficiency. There were three data collection time points, once each year roughly 12 months apart. At the initial testing timepoint, participants ranged in age from 91 to 98 months ($M = 94.94$, $SD = 3.37$). Just over half of the sample was female (55%). All participants spoke English as a first language; however, data on bilingual or multilingual status was not obtained.

The subset of students in Grades 2 through 4 were selected because this age represents a key developmental shift in reading. The field needs more research to understand when the shift from relying on phonology to other aspects of language (e.g., morphology) occurs (see Developmental Perspective in the Models of Word Recognition section). Research has shown that upper elementary students are in the process of developing morphological awareness (Nagy et al., 2006) but less is understood about this ability for lower grade elementary students. It was hypothesized that selecting this period of time would potentially illuminate a crucial time period of morphological development that would contribute to the field of reading research.

Measures

One background measure of verbal cognitive ability was included in the analysis, and two measures were used to determine profile membership (i.e., membership in a group of learners with similar abilities): level of phonological, and morphological awareness. These data were collected at timepoint one, in second grade. Performance of these profiles were subsequently analyzed on several longitudinal reading variables across second through fourth grade. Reliability for each broad outcome measure is reported below. Split-half reliability is reported for the measures that utilized a stop rule (M-PPVT, Letter Word Identification, Word Attack, and Reading Comprehension) and Cronbach's alpha was computed for those without (the measures of morphological awareness and phonological awareness). Reliabilities are reported for the broad measures (e.g., Letter Word Identification and Word Attack) but not for the measures that were subsets of those assessments (e.g., morphologically complex words, etc.) because these included the same items. Since this study analyzed specific word types, several of these measures included subsets of words from broader measures. For clarity measures used to assess each variable are included in Table 2.

Table 2

Measures Used for Study Variables

		Measures					
		M-PPVT	Researcher-created MA	Rosner and Simon's PA	WJ word ID	WJ word attack	WJ RC
Background Verbal cognitive		X					
Profile							
MA			X				
PA				X			
Reading outcomes							
Word ID	Real				X		
	Pseudo					X	
	Composite				X	X	
Morpho complex	Real				X		
	Pseudo					X	
	Composite				X	X	
Non-morpho complex	Real				X		
	Pseudo					X	
	Composite				X	X	
Reading comprehension							X

Note. MA = Morphological Awareness, PA = Phonological Awareness, ID = Identification, RC = Reading Comprehension.

Background variable. Verbal cognitive ability was included as a background variable to assess participants' general ability level on a measure that links to reading ability but is not a reading measure and as a means to compare profiles to determine if groups significantly differed cognitively from one another. It was assessed with the Peabody Picture Vocabulary Test—Third Edition (PPVT-III; Dunn & Dunn, 1997), as it has been used in previous research (Echols, West, Stanovich, & Zehr, 1996), in modified form (M-PPVT). Previous research has validated the use of this shortened version of the PPVT-III for research purposes (Pasquarella, Chen, Lam, Luo, & Ramirez, 2011; Wang, Yang, & Cheng, 2009). For the modified version, as with the full assessment, children are presented with four pictures. A word is read aloud and the child is asked to point to the corresponding picture. The modified version contains one quarter of the original items, for a total of 51 items. Of those items, 35% are morphologically complex, allowing for a broad sampling of participants' verbal ability across both morphologically complex and non-morphologically complex words, ideal for the purposes of the present study. Testing was discontinued after six consecutive errors. Split-half reliability, with the Spearman-Brown correction, was .86 (compared to .94 reported for the full PPVT-III for this age group; Dunn & Dunn, 1997).

Profile variables. For this analysis, profile membership was based on participants' performance on the profile variables, i.e., phonological awareness and morphological awareness, at the first time point in Grade 2. Then performance of these profiles on the outcome variables were analyzed and compared across groups and across time.

Morphological awareness. Students were administered a researcher-created oral measure of morphological awareness at the word level. The task followed the common analogy A:B::C:D structure (see Appendix A). A puppet was used to present the stimulus for this assessment. Three sample tasks were performed before proceeding onto the task. The task had 21 items. Total number of items correct was tallied for the overall score. This score was then transformed into a standardized z-score by subtracting the mean score from the raw score and dividing that number by the standard deviation. Reliability was acceptable; Cronbach's alpha was .77.

Phonological awareness. Phonological awareness was measured with an elision measure based on Rosner and Simons (1971). Elision refers to the omission of either a sound or syllable from a spoken word. For this measure, students were orally presented with a word and asked to repeat it. They were then asked to delete a specific sound or syllable and say the remaining syllable or word. Once a student missed four consecutive items testing was discontinued. The task was comprised of 20 items and correct answers were totaled for the overall score (see Appendix B). This raw score was then converted into a standardized z-score using the same procedure as detailed in the morphological awareness variable description. Split-half reliability with the Spearman-Brown correction was good, .90.

Reading outcome variables. Accuracy reading real words and pseudowords were measured with two subtests of the Woodcock Reading Mastery Test-Revised (Woodcock, 1998) in Grades 2, 3, and 4. Each subtest was discontinued after six consecutive errors were made.

Real words. Reading accuracy of real words was assessed using the Word Identification subtest (Woodcock, 1998). The same form, Form A, of the Letter Word Identification subtest was used for Grades 2 and 3, while an alternate form, Form B, was used for Grade 4. Form A and B are both comprised of 106 words. The split-half reliability computed with the Spearman-Brown correction was .97.

Pseudowords. Reading accuracy of pseudowords was assessed using the Word Attack subtest (Woodcock, 1998). The same form, Form A, was used for grades 2 and 3, while an alternate form, Form B, was used for Grade 4. Form A and B are both comprised of 45 pseudowords. The split-half sample specific reliability computed with the Spearman-Brown correction was .94.

Composite. A composite score for decoding accuracy was created by summing the raw score for both *real words* and *pseudowords* on both measures of word reading: The Letter Word Identification and the Word Attack subtests of the Woodcock Reading Mastery Test-Revised assessment.

Morphologically complex words. Reading accuracy for morphologically complex words was assessed with a subset of words from the Word Identification and Word Attack subtests of the Woodcock Reading Mastery Test-Revised (Woodcock, 1998). To categorize words as morphologically complex the researcher and the principal investigator from the original study reviewed the lists separately on their own and then met to discuss any differences. A working definition was adopted, as follows: any compound, inflected, or derived word with or without a bound root and containing a productive affix was categorized as morphologically complex. The Oxford English Dictionary (OED; Simpson & Weiner, 1989) was consulted to confirm word categorization. For real words, the word was entered in the OED online version, and if there was an affix that could be recognized by an average reader affix found in the word origin information, it was classified as morphologically complex. For pseudowords, potential affixes were entered into OED to determine if a word could plausibly be morphologically complex.

Additionally, there was one word (*cigbet*) that the researchers agreed could conceivably be a compound word and thus it was included as a morphologically complex word.

Real words. The same form, Form A, of the Letter Word Identification subtest was used for grades 2 and 3, while an alternate form, Form B, was used for grade 4. Form A is comprised of 106 real words, of which 45 are morphologically complex (42%). Form B is comprised of 106 words of which 42 are morphologically complex (40%).

Pseudowords. The Word Attack subtest is comprised of 45 nonwords. A total of 15 of these words contain plausible affixes (33%) on Form A. Form B has 10 words with plausible affixes (22%). Each subtest was discontinued after six consecutive errors were made.

Composite. A composite score of the sum of the total morphologically complex words read correctly on each of these subtests was computed for a total raw score.

Non-morphologically complex words. Reading accuracy for single morpheme words was assessed with a subset of the words from the Word Identification and Word Attack subtests of the Woodcock Reading Mastery Test-Revised (Woodcock, 1998).

Real words. The same form, Form A, of the Letter Word Identification subtest was used for grades 2 and 3, while an alternate form, Form B, was used for grade 4. Form A is comprised of 106 real words, of which 61 are not morphologically complex (58%). Form B is comprised of 106 words of which 64 are not morphologically complex (60%).

Pseudowords. The Word Attack subtest is comprised of 45 nonwords. A total of 15 of these words do not contain plausible affixes (67%) on Form A. Form B has 10 words that do not contain plausible affixes (78%).

Composite. A composite score of the sum of the total of non-morphologically complex words read correctly on each of these subtests was computed for a total raw score.

Reading comprehension. Reading comprehension was measured in Grades 3 and 4 using the Passage Comprehension subtest of the Woodcock Reading Mastery Test-Revised (Woodcock, 1998). For this cloze assessment participants were asked to read a short passage and provide the missing words. Testing was discontinued after six consecutive errors. Reliability was good, Cronbach's alpha was .92.

Research Design

This was a quantitative longitudinal study that examined reading outcomes for specific ability profiles of students and additionally utilized multiple regression to analyze a particular subset of students.

Procedures. All students for whom parental consent and student consent was obtained were included in the study with the additional inclusion criteria that all participants must be able to understand the tasks' instructions. Participants were assessed by a trained research assistant in a 1:1 testing environment each year between January and April in second through fourth grade, with approximately 12 months between testing periods. The total testing session lasted about 1.5 hours, administered over two sessions or more, as needed, and included other measures not reported on in this study. The included measures were consistently administered in the same order: verbal cognitive measure, real word reading, pseudoword reading, phonological awareness, morphological awareness, and reading comprehension. Non-varying order is suggested when analysis considers relationships between measures (Deacon, Kieffer, & Laroche, 2014).

Data analytic plan. Data were prepared for analysis by screening for missing scores, incorrectly entered scores, and outliers. There was less than 1% missing data across all measures, which was an acceptable level. Maximum Likelihood Estimation (MLE) was used to account for missing data using Mplus 8.2. MLE is a method that uses observed values to estimate the parameter values for missing data. It assumes uniform distribution of the parameters. There was one outlier, but this participant was kept in for analysis because the performance did not appear to represent testing error so excluding this participant solely on the basis of being an outlier was not warranted. Normality was analyzed by reviewing the skewness and kurtosis of the data. To determine normality, both the skewness and the kurtosis value were divided by their standard error which was considered normal if it was less than |3.0|, as suggested by Tabachnick and Fidell (2007). These guidelines were met for all of the variables. The variables analyzed for each research question are listed in Table 3.

Table 3

Variables Analyzed by Research Question

		Research question				
Variable		1	2	3	4a	4b
Verbal cognitive		X	X			
MA		X	X	X	X	X
PA		X	X	X	X	X
Word identification	Real	X			X	X
	Pseudo	X			X	X
	Composite				X	X
Morpho complex	Real				X	X
	Pseudo				X	X
	Composite		X		X	X
Non-morpho	Real				X	X
	Pseudo				X	X
	Composite		X		X	X
Reading comp						X
Grade level	2^{nd}	X	X	X	X	X
	3^{rd}				X	X
	4^{th}				X	X

Regression analysis was used to answer the first three research questions: a) how does morphological awareness contribute to word identification, beyond verbal cognitive ability and phonological awareness for students in Grade 2?; b) how does morphological awareness contribute to word identification of real words compared to pseudowords, when controlling for phonological awareness and verbal cognitive ability for students in Grade 2?; and c) how does morphological awareness contribute to word identification of morphologically complex words compared to non-morphologically complex words, when controlling for phonological awareness and verbal cognitive ability for students in Grade 2? Latent profile analysis (LPA) was used to answer the remaining two primary research questions: (a) can empirically-based subgroups of students that are practically meaningful be identified based on level of phonological and oral morphological awareness and (b) does initial level and growth of reading skills differ across these subgroups? LPA finds patterns in scores on continuous indicators to form person-centered profiles, or groups (Lonigan, Goodrich, & Farver, 2017). This is different than profile analysis because with LPA, latent profiles are empirically revealed and in profile analysis the researcher sets the groups a priori, which may not be empirically sound. The model after which there is no improvement in fit is considered the appropriate model for the data. There are several fit indices to consider when analyzing model fit with LPA. Although there is not consensus in the field regarding which and how many fit indices are appropriate, Nylund, Asparouhov, and Muthént (2007), suggest that the best indices for continuous outcomes are Bayesian Information Criterion (BIC), sample-size adjusted Bayesian Information Criterion (ABIC), and a significance measure such as the bootstrapped likelihood ratio test (BLRT). A chi-square significance test using loglikelihood can also be used (Satorra & Bentler, 2010). Smaller values are favored for BIC and ABIC and a meaningful decrease in value is about 10 units (Kass & Raftery, 1995).

RESULTS

Descriptive statistics are reported in Table 4. Raw scores (total correct) are reported for all measures, organized by grade. Profile variables were transformed to z-scores for analysis, but all other variables were kept in raw form. Standardizing the scores for interpretability was considered but because these were not standardized measures it was determined that the raw score was more meaningful and more easily interpreted across all of the outcome variables. For the regression analysis both raw and the standardized z-score coefficients were reported. The score for most variables increased across grade level. The score for morphologically complex words slightly decreased from Grade 3 to Grade 4 for the composite score (-0.41) and the two subcomponents of the composite, the real word score (-0.05), and the pseudoword score (-0.34).

The zero-order correlations between the background variable, the profile variables, and the broad longitudinal variables are presented in Table 5. All of the correlation coefficients are statistically significant ($p < .05$) except the correlation of verbal cognitive ability with all other measures. This provides evidence that it was an appropriately selected background variable because it was not correlated with the outcome variables analyzed for this study. As is expected, there are high correlations between the same measures at the different time points and there are high correlations between the two word reading measures.

Contribution of Morphological Awareness to Word Identification

Regression analysis was conducted to analyze the contribution of oral morphological awareness to reading outcomes for Grade 2 students (see research question 1 and 2). Both the raw beta coefficients and the standardized betas are reported (see Table 6). The first model included real words as the outcome variable. The results of the regression indicated that these three predictors explained 51% of the variance (R^2=.51, F(3,89)=30.86, $p < .001$). Both phonological awareness ($\beta = .59$, $p < .001$) and oral morphological awareness ($\beta = .25$, $p < .005$) significantly predicted real word reading for Grade 2 students when controlling for each other and verbal cognitive ability.

Accuracy reading pseudowords was the outcome variable for the second model and the same predictor variables were included. Taken together these predictors explained 49% of the variance ($R^2 = .49$, $F(3,89) = 27.99$, $p < .001$). In this model phonological awareness was the only significant predictor of pseudoword reading ($\beta = .08$, $p <.001$) when controlling for oral morphological awareness and verbal cognitive ability.

Taken together these three variables explained roughly 50% of the variance in each model. To more fully explore the specific contribution of oral morphological awareness to accuracy reading real words and pseudowords the change in model explanatory power was analyzed when this variable was added (see Table 7). Model 1 included verbal cognitive ability and phonological awareness and Model 2 included those variables and oral morphological awareness. This allowed the contribution of oral morphological awareness to be isolated for analysis. The change in variance explained by Model 2, as compared to Model 1, is due to oral morphological awareness. Although this contribution was weak for pseudowords ($F(1, 89) = 3.07$, $p = .083$), it was statistically significant for real words ($F(1, 89) = 9.84$, $p < .005$) and explained 6% of the variance, in alignment with previous research.

Table 4

Descriptive Statistics for Sample

			Raw scores		
			Grade 2	Grade 3	Grade 4
Variable type	Variable		*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
Background	Age		94.94 (3.37)	107.11 (3.23)	119.02 (3.25)
	Verbal cognitive ability		30.16 (4.76)	NA	NA
Profile	Morphological awareness		6.77 (2.23)	NA	NA
	Phonological awareness		9.44 (5.12)	NA	NA
Outcome	Real words		52.55 (14.27)	61.91 (11.33)	68.69 (14.29)
	Pseudowords		18.25 (10.39)	24.34 (9.04)	28.84 (9.68)
	Decoding composite		70.80 (23.73)	86.17 (19.90)	90.64 (18.75)
	Morphologically complex	Composite	15.10 (9.32)	21.74 (8.81)	21.33 (9.69)
		Real	11.67 (6.22)	15.80 (5.60)	15.75 (7.53)
		Pseudo	3.40 (3.49)	5.93 (3.62)	5.59 (2.52)
	Non-morphologically complex	Composite	56.36 (15.29)	65.01 (11.90)	75.30 (14.38)
		Real	41.63 (8.65)	46.77 (6.30)	53.00 (7.59)
		Pseudo	14.78 (7.29)	18.35 (5.87)	22.35 (7.28)
	Reading comprehension		NA	33.81 (6.96)	37.31 (7.12)

Table 5

Correlation Statistics

	ppvt_2	maword_2	pa_2	lwid_2	lwid_3	lwid_4	wa_2	wa_3	wa_4	rcWJ_3	rcWJ_4
ppvt2	—										
maword_2	.0496	—									
pa_2	-.0239	.3775	—								
lwid_2	.0345	.4960	.6757	—							
lwid_3	.0779	.5026	.6633	.9076	—						
lwid_4	.1304	.2700	.4537	.5602	.5947	—					
wa_2	.0064	.3982	.6835	.8490	.7867	.5315	—				
wa_3	.1004	.4294	.6525	.8393	.9008	.6330	.8287	—			
wa_4	.0458	.2455	.4538	.5430	.5902	.9075	.5433	.6319	—		
rcWJ_3	.0178	.5549	.5254	.7786	.8136	.4679	.6526	.6806	.4758	—	
rcWJ_4	.2538	.5272	.4805	.6755	.7361	.4563	.5394	.6100	.4558	.7769	—

Table 6

Regression Analysis for Real and Pseudowords

	Real words			Pseudowords		
	B	*SE B*	β	*B*	*SE B*	β
Verbal cognitive	0.96	0.22	0.03	0.02	0.17	0.08
Phonological awareness	1.63	0.22	0.59**	1.27	0.17	0.08**
Morphological awareness	1.59	0.51	0.25*	0.65	0.37	0.08
R^2	0.51			0.49		

*$p < .005$, **$p < .001$.

Table 7

Explained Variance by Model

Outcome variables	Model 1		Model 2			
	R^2	*F*	R^2	ΔR^2	*F*	Δ *F*
Real words	0.45	37.51	0.51	0.06*	30.86	6.65
Pseudowords	0.47	40.81	0.49	0.02	27.99	12.82
Morphologically complex	0.40	29.74	0.48	0.08**	26.79	-2.95
Non-morphologically complex	0.40	29.40	0.50	0.10***	28.59	0.81

*$p < .005$, **$p < .0005$, ***$p < .0001$.

After real and pseudoword reading was analyzed, these same word lists were reorganized into morphologically complex words and non-morphologically complex words, so each word type included real and pseudo words (see Table 7). Both models included the same predictor variables as previously included: verbal cognitive ability, phonological awareness, and oral morphological awareness. For the first model, reading morphologically complex words, these variables accounted for 48% of the variance ($R^2 = .48$, $F(3,88) = 26.79$, $p < .001$). Both phonological awareness ($\beta = .53$, $p < .001$) and oral morphological awareness ($\beta = .29$, $p < .001$) were statistically significant predictors of reading morphologically complex words when controlling for each other and verbal cognitive ability. Oral morphological awareness explained an additional 8% of variance (see Table 7), which was statistically significant ($F(3,88) = 12.93$, $p < .0005$).

The final regression model analyzed was for the outcome variable reading non-morphologically complex words. The predictors remained the same and considered together explained 50% of the variance ($R^2 = .50$, $F(3,87) = 28.59$, $p < .001$). In this model both phonological ($\beta = .51$, $p < .001$) and oral morphological awareness ($\beta = .32$, $p < .001$) were significant predictors of reading non-morphologically complex words when controlling for the other covariates but verbal cognitive ability was not when controlling for the other covariates. When oral morphological awareness was added to the model, it accounted for an additional 10% of the variance (see Table 8), which was statistically significant ($F(3,87) = 16.57$, $p < .0001$).

Table 8

Regression Analysis for Morphologically and Non-Morphologically Complex Words

	Morphologically complex words			Non-morphologically complex words		
	B	*SE B*	β	*B*	*SE B*	β
Verbal cognitive	0.06	0.15	0.03	0.12	0.24	0.04
Phonological awareness	0.95	0.15	0.53**	1.49	0.24	0.51**
Morphological awareness	1.23	0.34	0.29**	2.22	0.55	0.32**
R^2	0.48			0.50		

**$p < .001$.

Latent Profiles of Readers

Latent profile analysis (LPA) was conducted using Mplus 8.2 (Muthén & Muthén, 2018) to answer research question 3. With LPA an additional profile is added to the base model, which for these analyses was one group or profile, and model fit is considered for each subsequent model. Model fit was considered for one-through five-profiles (see Table 9). Since there was no meaningful change in fit for the five-profile model as compared to the four-profile model, analysis of additional models was discontinued. The fit statistics used to evaluate model fit for this study included ABIC, chi square significance, entropy, and profile size.

For these data the two-profile model is a better fit than the single profile model, based on the decrease in ABIC. The changes in ABIC for the three- and four-profile models suggests a better fit for the four-profile model because the ABIC value continues to decrease. A chi-square test of significance was computed to determine if the model with *k* profiles versus the model with *k*-1 profiles fit the data significantly better. All of the models except the five-profile model had significant chi-square values. Entropy, a measure indicating how well profile membership represents actual membership in the model, should also be considered when interpreting fit. It ranges from 0-1, with higher values indicating better model classification certainty. A value of .80 is has been suggested as a cut-off for model selection (Hart, Logan, Thompson, Kovas, McLoughlin, & Petrill, 2016), a criterion all of these models except the 2-profile model met. Regarding profile size, Lonigan, Goodrich, and Farver (2017) employed a rule that a model would not be selected that had a profile with less than 1% of the total sample, which the four and five-profile models do not have. A consideration of the ABIC value and the associated chi-square significance as well as entropy and profile size indicate that either the three- or four-profile model was the best fit for these data, depending on which fit statistics were prioritized. Because the goal of the present study was to find common profiles for Grade 2 readers to better understand their reading development, the three-profile model was selected. This model was chosen based on profile size; the smallest profile had 16 (~16% of the total sample) students which was preferred over the smallest profile of 9 (~9% of the total sample) students in the four-profile model. Once it was determined that this model empirically best fit the data given the current research aims, its theoretical plausibility and meaningfulness was considered.

Table 9

Fit Statistics for Latent Profile Analysis (One Time Point: Oral Morphological Awareness, Phonological Awareness)

No. of latent profiles	ABIC	Δ ABIC	Entropy	X^2 *p*	PP	Smallest profile size
1	555	NA	1.00	NA	1.00	102
2	537	-18	0.79	< .001	.91-.99	21
3	530	-7	0.84	< .005	.89-.95	16
4	522	-8	0.86	< .005	.84-.96	9
5	524	+2	0.87	.145	.62-.96	3

Note. ABIC = Sample Size Adjusted Bayesian Information Criterion; PP = Posterior probabilities; NA = Not able to estimate with only one profile.

For the three-profile model, the standardized means of each group on the profile variables (e.g., morphological awareness and phonological awareness) were converted to percentiles and classified according to rank. A percentile score in the range of 25-75 was labeled as average ability, 76 and above was above average, and a score of 24 and below was labeled as below average. Then each profile was named according to these ability levels relative to each other within the profile. (see Table 10). Groups were labeled as *Morphologically Dominant*, *Phonologically Dominant*, and *Commensurate Development*. Standardized scores were used for interpretability purposes, but while both of these measures are commonly used in research settings they are not normed so the corresponding percentiles are relative to the current sample. The *Morphologically Dominant* and *Commensurate Development* groups had the same number of students, (n=43) which was 42% percent of the total sample. The *Commensurate Development* group was comprised of 16 students, which equated to 16% of the total sample; although this was comparatively smaller than the other groups it still met the minimal size criterion set forth for selecting profiles (e.g., more than 10% of the sample; see Lonigan, Goodrich, & Farver, 2017).

Table 10

Profile Membership

Profile/Class name	Morphological awareness			Phonological awareness			No. in profile
	z-score	Percentile	Classification	z-score	Percentile	Classification	
Morphologically Dominant	0.12	45th	Average	-0.76	22nd	Below average	43
Phonologically Dominant	-1.68	5th	Below average	-0.42	34th	Average	16
Commensurate Development	0.51	70th	average	1.01	84th	Above average	43

For this sample, a difference of .8 of a standard deviation between abilities, as represented by the profile's mean z-score, constituted a different ability level. Rather than using a typical 1 standard deviation difference, this cut-off was adopted due to the somewhat limited range of scores in the data; no student scored above or below 2 standard deviations from the mean for phonological awareness and no student scored 2 standard deviations above the mean for morphological awareness and only three students scored below 2 standard deviations (but not more than three standard deviations) below the mean for morphological awareness.

Missingness for each profile was examined for all broad outcome variables at each time point (e.g., scores on the letter word identification and word attack subtests were analyzed but the subcategories of morphologically complex words and non-morphologically complex words as well as pseudowords and real words were not independently analyzed because they included subsets of words from the broad reading measures), including letter word identification, word attack, and reading comprehension. Because the *Commensurate Development* group had fewer members relative to the number of outcome variables analyzed, the letter word identification and word attack subtests were collapsed to create one "decoding" variable for purposes of the missingness analysis. There was 2% missing data for the *Morphologically Dominant* group, 17% for the *Phonologically Dominant* group, and 24% for the *Commensurate Development* group. These data were missing completely at random within each group (χ^2 [16] = 4.17, p = .51, χ^2 [43] = 1.92, p = .96, χ^2 [43] = 2.97, p = .97, respectively). Therefore, maximum likelihood estimation was used to run models to maintain statistical power that would have been sacrificed with listwise deletion for missing data (Cole, 2008; Collins, Schafer, &, Kim, 2001; Graham, Taylor, Olchowski, & Cumsille, 2006; Muthén, Kaplan, & Hollis, 1987).

Students in the first profile, *Morphologically Dominant*, scored at the 45^{th} percentile on the morphological awareness task and at the 22^{nd} percentile on the phonological awareness measure. This corresponded to average morphological awareness and below average phonological awareness. Because there was a discrepancy of .88 of a standard deviation between these abilities for this group, they were named for their relative strength, morphological awareness. Students in the second profile, *Phonologically Dominant*, scored at the 5^{th} percentile on the morphological awareness task and at the 34^{th} percentile on the phonological awareness task. This equated to below average morphological awareness and average phonological awareness. The discrepancy between these abilities was 1.26 standard deviations so this profile group was named according to their relative strength, phonological awareness. Students in the last profile, *Commensurate Development*, scored at the 70^{th} percentile for morphological awareness and at the 84^{th} percentile for phonological awareness. Thus, this group had average morphological awareness and above average phonological awareness. The difference between these abilities was only .51 of a standard deviation so they were considered commensurate with each other and labeled *Commensurate Development*, representing parallel development of both of these skills. It should also be noted that not only did this group have relatively equal morphological and phonological abilities, but they scored higher than the other groups on both tasks and thus represented a higher performance group overall.

Although latent profile analysis provided evidence that these profiles exist empirically, it was important to also consider if membership in these groups is plausible for second grade students, and thus practically relevant, and if longitudinal analysis of the performance of these ability profiles on reading outcome measures had the potential to yield findings that could contribute to the field. So, this model met both empirical and practical criterion and was thus selected for subsequent analysis.

Longitudinal Reading Outcomes by Profile

Broad Reading Measures

Mean broad reading outcomes for each profile were analyzed (see Table 11; Figures 5 and 6) to answer research question 4. Significant differences between groups were considered. Paired t-tests were run to determine if the change in mean score over time on a given measure was significant. Profile performance on the broad word reading measures, real words and pseudowords, and reading comprehension were analyzed (see Table 11). The increase in accuracy reading both real words and pseudowords from Grade 2 to Grade 3 and from Grade 3 to Grade 4 was statistically significant for all groups, as was the increase for reading comprehension from Grade 3 to Grade 4. Reading comprehension data was not procured in Grade 2 so this outcome measure was added at the second time point, Grade 3.

Table 11

Profile Groups Performance on Broad Reading Outcome Measures

	Real words			Pseudowords			Reading comprehension	
Grade	2^{nd}	3^{rd}	4^{th}	2^{nd}	3^{rd}	4^{th}	3^{rd}	4^{th}
M	45.90 (11.88)	57.35*** (9.66)	64.47*** (12.94)	13.57 (7.55)	20.56*** (7.72)	26.14*** (8.51)	32.45 (6.23)	35.95*** (6.63)
P	40.77 (11.79)	51.57*** (11.15)	62.95** (14.63)	9.86 (8.10)	17.32*** (9.63)	25.11** (13.34)	26.40 (8.67)	30.62*** (9.57)
CD	63.40 (10.15)	70.01** (7.89)	74.66* (13.83)	25.91 (9.06)	30.25*** (6.75)	32.69* (8.30)	37.66 (4.54)	40.92*** (4.45)

Note. M = Morphologically dominant group, P = Phonologically dominant group, CD = Commensurate development group.

***$p < .001$, **$p < .005$, *$p < .05$.

Morphologically Dominant group. This group consisted of 43 students who had a strength in morphological awareness, relative to their phonological awareness. The mean change over time was significant on all broad reading measures at all time points. These students performed above the *Phonologically Dominant Group* and below the *Commensurate Development* on all reading outcome measures at time point one, Grade 2. This group's performance was not statistically significantly different from the *Phonologically Dominant Group* on the measures of broad word reading.

At the second timepoint, in Grade 3, this group performed similarly to their second-grade performance. They again scored between the other two groups on the real word and pseudoword reading tasks and there was not a statistically significant difference between this group and the *Phonologically Dominant Group*. However, there was a significant difference between groups on the reading comprehension measure. Because data were not obtained for this skill at the first time point it is not clear if this represents a shift over time or if group difference was maintained. At the third time point, Grade 4, the *Morphologically Dominant Group* scored between both groups but did not perform statistically differently from the *Phonologically Dominant Group* on any of the measures.

The *Morphologically Dominant* group increased by 11.45 words on the real word measure between Grade 2 and 3, which was statistically significant ($t(40) = 11.03$, $p < .001$). Students in this group increased by an average of 7.12 words between Grade 3 and 4, which was statistically significant ($t(40) = 4.39$, $p < .001$). On the measure of pseudowords this group increased by 6.99 words between Grade 2 and 3, which was statistically significant (($t(39) = 7.71$, $p < .001$). They increased by an average of 5.58 from Grade 3 to 4, which was statistically significant ($t(39) = 4.55$, $p < .001$). Lastly, this group improved by an average increase of 3.5 on their reading comprehension score, which was statistically significant ($t(40) = 4.15$, $p < .001$).

Phonologically Dominant group. This group of 16 students performed higher on the phonological awareness task than the morphological awareness task and thus, had a relative strength in phonological awareness. They performed the lowest on the real and pseudoword reading outcome measures at all time points, but as previously mentioned, this was not statistically significantly different from the *Morphologically Dominant Group*'s performance.

The *Phonologically Dominant* group increased by 10.80 words on the real word measure between Grade 2 and 3, which was statistically significant ($t(14) = 9.17$, $p < .001$). Students in this group increased by an average of 11.38 words between Grade 3 and 4, which was statistically significant ($t(14) = 4.00$, $p < .005$). On the measure of pseudowords this group increased by 7.46 words between Grade 2 and 3, which was statistically significant (($t(14) = 7.73$, $p < .001$). They increased by an average of 7.79 from Grade 3 to 4, which was statistically significant ($t(14) = 3.51$, $p < .005$). Lastly, this group improved by an average increase of 4.22 on their reading comprehension score, which was statistically significant ($t(14) = 4.44$, $p < .001$).

Commensurate Development group. Students in this group performed similarly well on both of the morphological and phonological awareness measures (N = 43). The group mean phonological awareness score was higher than the group morphological awareness mean score but the difference was 0.51 of a standard deviation, so for purposes of this study these abilities were considered to be relatively matched, so the group was named *Commensurate Development Group*, representing the alignment in development of both of these skills. They scored higher than both of the other groups on both profile measures. Their performance on all of the reading outcome measures began higher than the other two groups at time point one and remained higher throughout the duration of the study.

The *Commensurate Development* group increased by 6.61 words on the real word measure between Grade 2 and 3, which was statistically significant ($t(41) = 8.77$, $p < .001$). Students in this group increased by an average of 4.65 words between Grade 3 and 4, which was statistically significant ($t(41) = 2.15$, $p < .05$). On the measure of pseudowords this group increased by 4.34 words between Grade 2 and 3, which was statistically significant ($t(42) = 4.99$, $p < .001$). They increased by an average of 2.44 from Grade 3 to 4, which was statistically significant ($t(42) = 2.11$, $p < .05$). Lastly, this group improved by an average increase of 3.26 on their reading comprehension score, which was statistically significant ($t(42) = 5.03$, $p < .001$).

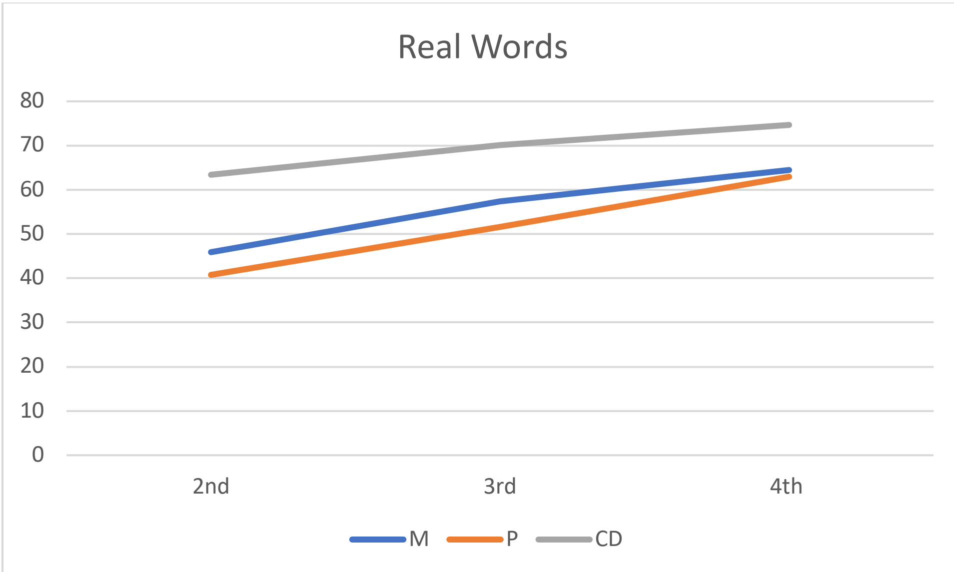

Figure 5. Accuracy reading real words across time by profile group.

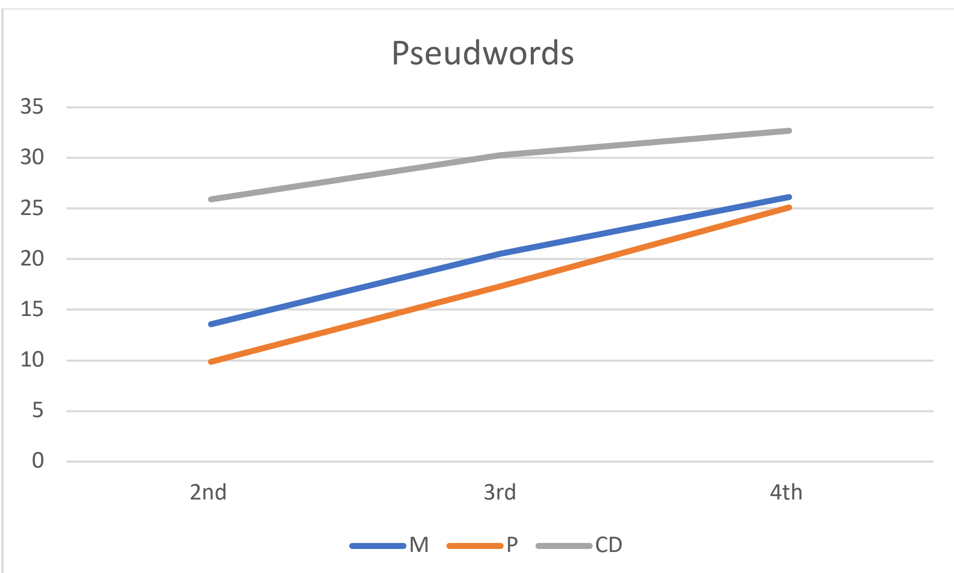

Figure 6. Accuracy reading pseudowords across time by profile group.

The performance of all three profile groups on the word level reading measures are represented graphically in Figure 5 and Figure 6. Students in the *Commensurate Development* group were more accurate than the other groups of students when reading both real words and pseudowords across all grade levels. They displayed greater gains when reading real words however as compared to pseudowords. All three groups had a relatively similar growth trajectory with both word types. Although the *Phonologically Dominant* group scored below the other two groups at all time points, the gap between it and the *Morphologically Dominant* group appears to maintain between Grade 2 and Grade 3 but narrows by Grade 4, suggesting differences in word reading outcomes based on group membership may become less pronounced over time.

Morphologically Complex Word Reading Measures

After considering group performance on the broad reading measures, analysis was conducted specifically with accuracy reading morphologically complex words and non-morphologically complex (see Table 12). Mean reading outcomes for both morphologically complex and non-morphologically complex real and pseudowords for each profile were analyzed (see Table 12; Figures 7 and 8). There was a significant difference between the groups for non-morphologically complex words and the difference approached significance for morphologically complex words. Paired t-tests were run to determine if the change in mean score for each group over time on a given measure was significant (see Table 12). The increase in accuracy reading both morphologically complex real words and pseudowords from Grade 2 to Grade 3 was statistically significant for all groups as was the increase reading non-morphologically complex real and pseudowords from Grade 2 to Grade 3 and Grade 3 to Grade 4. Interpret in a sentence or 2.

Morphologically Dominant group. The *Morphologically Dominant* group increased by 4.45 words on the morphologically complex real word measure between Grade 2 and 3, which was statistically significant ($t(38) = 8.24$, $p < .001$). Students in this group decreased by an average of .23 words between Grade 3 and 4, but this was not statistically significant. On the measure of morphologically complex pseudowords this group increased by 2.48 words between Grade 2 and 3, which was statistically significant ($t(37) = 5.87$, $p < .001$). On the measure of non-morphologically complex real words this group increased by an average of 5.78 words from Grade 2 to 3, which was statistically significant ($t(37) = 7.01$, $p < .001$). They then increased an average of 6.94 words from Grade 3 to 4, which was statistically significant ($t(38) = 12.23$, $p < .001$). Lastly, with the non-morphologically complex pseudowords this group increased from Grade 2 to 3 and Grade 3 to 4, both of which were statistically significant increases $t(38) = 5.54$, $p < .001$ and $t(40) = 4.92$, $p < .001$, respectively.

Phonologically Dominant group. The *Phonologically Dominant* group performed the lowest on the real and pseudoword reading outcome measures at all time points, but as previously mentioned, this was not statistically significantly different from the *Morphologically Dominant Group*'s performance, except at time point one on the measure of non-morphologically complex words. Notably, this group was the only group to increase in accuracy reading morphologically complex words from Grade 3 to Grade 4 on both the real word and pseudoword measure, although neither of these were statistically significant gains.

The *Phonologically Dominant* group increased by 3.88 words on the morphologically complex real word measure between Grade 2 and 3, which was statistically significant ($t(14) = 5.73$, $p < .001$). On the measure of morphologically complex pseudowords this group increased by 3.36 words between Grade 2 and 3, which was statistically significant (($t(14) = 4.34$, $p < .001$). On the measure of non-morphologically complex real words this group increased by an average of 7.51 words from Grade 2 to 3, which was statistically significant ($t(14)= 4.71$, $p < .001$). They then increased an average of 8.63 words from Grade 3 to 4, which was statistically significant ($t(14) = 7.06$, $p < .001$). Lastly, with the non-morphologically complex pseudowords this group increased an average of 5.26 words from Grade 2 to 3 and an average of 6.47 words Grade 3 to 4, both of which were statistically significant increases $t(14) = 4.90$, $p < .001$ and $t(14) = 3.49$, $p < .005$, respectively.

Table 12

Profile Group Performance on Reading Outcomes by Morphological Complexity

	Morphologically complex						Non-morpho complex					
	Real words			Pseudowords			Real words			Pseudowords		
	2nd	3rd	4th	2nd	3rd	4th	2nd	3rd	4th	2nd	3rd	4th
M	8.91	13.36**	13.13	2.08	4.56**	4.97	38.65	44.43**	51.37**	12.41	16.00**	20.29***
	(4.61)	(4.12)	(5.99)	(0.38)	(2.79)	(4.42)	(8.09)	(6.12)	(5.44)	(5.44)	(5.39)	(6.19)
P	6.86	10.74**	12.79	0.64	4.00**	4.66	34.02	41.53**	50.16**	7.93	13.19**	19.66**
	(3.37)	(4.30)	(7.64)	(0.46)	(3.64)	(3.08)	(7.53)	(6.92)	(7.58)	(5.94)	(6.11)	(10.13)
CD	16.28	19.86**	19.25	5.75	7.87**	6.49*	47.51	50.89**	55.42**	19.69	22.41**	25.24**
	(5.88)	(4.73)	(7.73)	(0.56)	(3.57)	(2.19)	(5.64)	(3.55)	(7.20)	(6.48)	(3.82)	(6.32)

Note. M = Morphologically dominant group, P = Phonologically dominant group, CD = Commensurate development group.

***$p < .001$, **$p < .005$, *$p < .05$.

Commensurate Development group. The *Commensurate Development* group increased by 3.58 words on the morphologically complex real word measure between Grade 2 and 3, which was statistically significant ($t(40) = 4.84$, $p < .001$). Students in this group decreased by an average of .61 words between Grade 3 and 4, but this was not statistically significant. On the measure of morphologically complex pseudowords this group increased by 2.12 words between Grade 2 and 3, which was statistically significant ($t(41) = 5.33$, $p < .001$). Students in this group statistically significantly decreased by 1.38 words on this measure between Grade 3 and 4 ($t(42) = -2.61$, $p < .05$). On the measure of non-morphologically complex real words this group increased by an average of 3.38 words from Grade 2 to 3, which was statistically significant ($t(39) = 6.46$, $p < .001$). They then increased an average of 4.53 words from Grade 3 to 4, which was statistically significant ($t(40) = 3.93$, $p < .001$). Lastly, with the non-morphologically complex pseudowords this group increased 2.72 words from Grade 2 to 3 and 2.83 words from Grade 3 to 4, both of which were statistically significant increases $t(41) = 3.61$, $p < .001$ and $t(42) = 3.06$, $p < .005$, respectively.

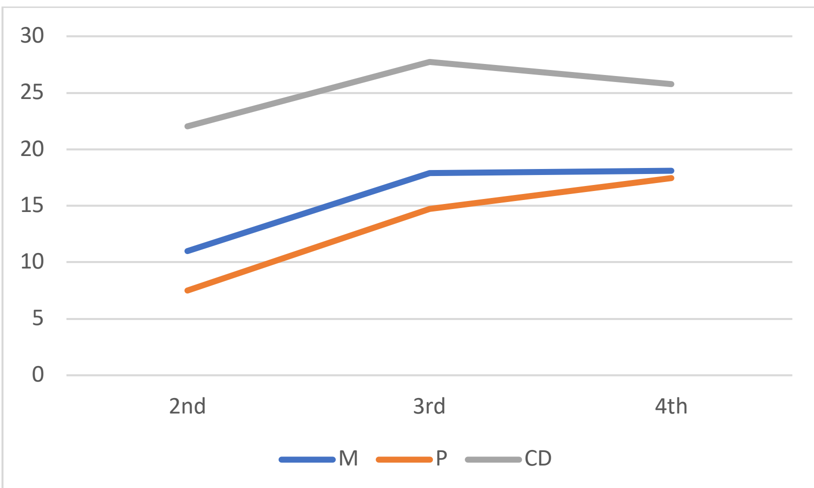

Figure 7. Accuracy reading morphologically complex words across time by profile group.

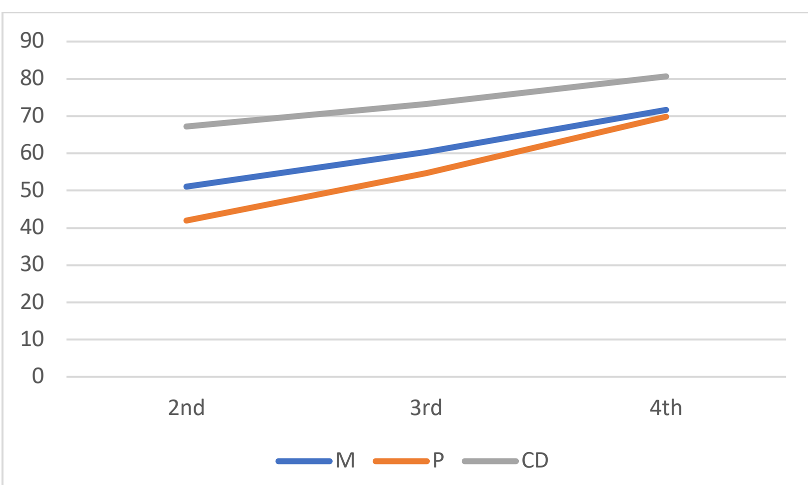

Figure 8. Accuracy reading non-morphologically complex words across time by profile group.

The profile group performance on both morphologically complex and non-morphologically complex words is represented visually in Figure 7 and 8. When reading morphologically complex and non-morphologically complex words, students in the *Commensurate Development* group were more accurate than the other groups of students across all time points. All three groups showed somewhat similar growth trajectories for each word type but when reading morphologically complex words, the highest performing group, the *Commensurate Development* group, decreased from Grade 3 to Grade 4. The *Morphologically Dominant* group appeared to reach a plateau from Grade 3 to Grade 4 while the *Phonologically Dominant* group was the only group to improve during this time points. Comparatively, accuracy reading non-morphologically complex words steadily increased across time and the difference in performance between the *Morphologically Dominant* and the *Phonologically Dominant* groups almost disappeared by Grade 4, again providing evidence that differences in word reading outcomes by group may become less evident between Grades 2 and 4.

DISCUSSION

The study had two overarching goals. The first goal was to understand the contribution of oral morphological awareness to reading outcomes for young readers (see research questions 1 and 2). This second aim was to determine if there are latent profiles of learners based on phonological and morphological awareness ability (see research question 3) and analyze group performance on reading outcomes across time to ascertain if there is a group of readers who are more or less at-risk for later reading challenges (see research question 4).

Contribution of Oral Morphological Awareness to Reading for Young Readers

Addressing research question 1, both phonological and oral morphological awareness were significant predictors of reading real words, when controlling for each other and verbal cognitive ability, but only phonological awareness was a significant predictor of reading pseudowords when controlling for the same variables. This model explained 51% of the variance for real word identification. The proportion of that variance explained by morphological awareness was 6%, which was statistically significant, suggesting that although the role it plays in word recognition is comparatively small when phonological awareness is included, it nonetheless is an empirical as well as theoretical predictor of real word identification. This confirms our theoretical predictions; morphological awareness contributes to the recognition of real words. But when words lack meaning (e.g., pseudowords) morphological awareness does not contribute to word recognition.

However, the empirical support for this is inconsistent. As shown by Deacon and Kirby (2004), morphological awareness contributed variance to pseudoword word identification, but not real word identification. In attempting to understand their results, they proposed that children may process pseudowords via morphemic units (e.g., the suffixes *-ing* and *-ful* in the word *mancingful*), although this was out of the scope of their study. It is puzzling they did not find that that morphological awareness contributed to real word identification, something they acknowledged. Perhaps these inconsistent findings can be attributed to the different measures used to asses morphological awareness. The measure Deacon and Kirby used was a sentence analogy task that featured morphologically regular and irregular past tense verbs, which may have unwittingly tapped a different aspect of morphological awareness than the single word measure used in the current study, offering further support for the multidimensionality of morphological awareness at the word level (Tighe & Schatschneider, 2015). This has important practical implications because some researchers opt to use pseudoword stimuli (e.g., see Affix Identification task; Apel, Diehm, & Apel, 2013) for measures of morphological awareness in an attempt to isolate the skill from the confound of vocabulary knowledge. However, the findings here suggest that this may not be an ideal way to assess this skill, as it may not be utilized when recognizing these word types or it may only tap one dimension of this skill. Consequently, real words should be used when measuring morphological awareness in addition to or in place of pseudowords.

To answer research question 2, the role of oral morphological awareness during word identification of morphologically complex and non-morphologically complex words was analyzed. Interestingly, both phonological and oral morphological awareness were significant predictors of both word types when controlling for each other and verbal cognitive ability. This may be due to the fact that both reading and morphological awareness are developing during this age and as such students utilize whatever knowledge they have available to recognize words, similar to the argument Deacon and Kirby proposed for why morphological awareness may contribute to pseudoword recognition. morphological awareness may assist in the recognition of non-morphologically complex words. Taken together both of these models suggest that Grade 2 students utilize oral morphological awareness when reading real words as well as morphologically complex words and non-morphologically-complex words. Considering the findings presented here, Grade 2 may present an ideal developmental period to begin instruction in morphological awareness.

The variance explained was greater for non-morphologically complex words as compared to morphologically complex words, 10% and 8%, respectively. However, this difference was not statistically significant. Interestingly, given that the same explanation may be applied to the use of morphological awareness in the identification of both pseudowords and non-morphologically complex words: children use morphemic units to process these word types even though they are not meaningful in this context, the finding here that participants utilized morphological awareness when reading non-morphologically complex words but not pseudowords is surprising. It may be that participants found the potential morphemic units in the non-morphologically complex words easier recognize than those featured in the pseudowords. Students were not asked about this so it is offered only as a possible explanation for the current results. Another potential explanation could be that reading real words tapped readers' morphological awareness, making them more likely to use that skill even when reading non-morphologically complex words but this skill was not activated when reading pseudoword stimuli.

Learner Profiles

The second research aim of this study (see research questions 3 and 4) was to explore latent profiles of learners based on oral morphological awareness and phonological awareness and analyze reading performance over time for the profile groups. Based on empirical findings matched with theoretical plausibility, it was determined that there were three distinct profiles in the data. The groups were labeled based on members' oral morphological awareness and phonological abilities, relative to each other for each given group. The first group had superior oral morphological awareness compared to their phonological awareness ability. The second group had superior phonological awareness, as compared to their morphological awareness ability. The third and final group had commensurate skills for both.

The phonologically superior group performed the lowest of the groups on all of the reading outcomes. However, this can not necessarily be attributed to the discrepancy between phonology and morphology for this group; rather it must be noted that they performed, on average, at the 5th percentile on the oral morphological awareness task, which was much lower than any other group on any other profile variable. Although comparatively they performed better on the measure of phonological awareness, averaging at the 34th percentile, this is still in the average range. This group was thus the lowest performing group and maintained this status across all outcome measures.

As reviewed in the results section, the phonologically superior group did not perform statistically differently than the morphologically superior group on any of the outcome measures, except Grade 3 reading comprehension. While this was not what was originally hypothesized: that the morphologically superior group would perform better on tasks involving morphologically complex words while the phonologically superior group would perform better on tasks involving pseudowords, it may be explained by the fact that both of these groups were average to below average performers (on the profile variables). The phonologically superior group was average in phonological awareness and below average in oral morphological awareness; the morphologically dominant group scored in the average range on the oral morphology measure, at the 45th percentile, and below average on the phonological awareness measure, at the 22nd percentile. Both groups scored in the average to below average range and therefore were lower performing groups that had similar reading outcomes. To isolate the contribution of phonology as compared to morphology and vice versa, higher performing groups with more pronounced differences between these skills is needed.

The *Commensurate Development* group was named for group members' relatively aligned development in both oral morphological awareness and phonological awareness. While it may be expected that to have both develop in tandem would be ideal and result in better reading outcomes, it must also be noted that this group was in fact higher than both of the other groups on both profile measures, so in fact, relative to these profiles, they were high performers, and perhaps at a different phase of reading development. They scored in the average range, at the 70th percentile on oral morphological awareness and above average on phonological awareness, at the 84th percentile. Not surprisingly, they scored above both of the other two groups on all reading outcomes. What was interesting about this group's performance was that the mean score on morphologically complex real words and pseudowords decreased from Grade 3 to Grade 4. Only the decrease for the pseudowords was statistically significant. Unfortunately, this is likely due to a limitation of the current study. The alternate form that was used to assess word reading in Grade 4 had fewer morphologically complex words on both the real word (2%, or 3 fewer words) and pseudoword (10%, or 5 fewer words) measures. Thus, this decrease should not be interpreted unless future research replicates these findings.

When looking at the visual representation of the data in Figures 5, 6, 7, and 8, a trend is apparent. Although it was not a statistically significant difference between the *Morphologically Dominant* and *Phonologically Dominant* groups at any time point, the difference between the means between these groups narrows by Grade 4 for real and pseudowords as well as morphologically complex and non-morphologically complex word reading outcomes. To find group differences, it may be helpful to look at a younger age group. Perhaps these readers were too advanced to find differences in the role these metalinguistic skills play in reading development for the timespan for which data was collected. It is a promising finding that regardless of relative dominance of morphological or phonological awareness, children appear to have similar growth profiles in reading outcomes by Grade 4, suggesting that they are able to make use of their particular strengths to develop word reading proficiency.

Of note is that there were fewer group differences across all three profiles on Grade 4 measures including real morphologically complex words and real and pseudo non-morphologically complex words. This suggests that perhaps group differences in accurate word reading may begin to disappear by Grade 4, a point in development when learning to read is hypothesized to be largely concluded, as it shifts to a "reading to learn" paradigm. That there was not a difference between the morphologically dominant and the phonologically dominant group in Grade 3 on the reading comprehension measure but there was a difference between all groups at Grade 4, an inverse of the convergence for the word reading measures, also fits neatly with current reading research. As grade level increases, so too does the sophistication of reading material and thus reading comprehension becomes more difficult.

Limitations and Future Research

The goal of this study was to add to the growing field of research on morphological awareness. This research inquiry has deepened our understanding of younger readers' use of oral morphological awareness while reading real and pseudowords as well as when reading morphologically complex and non-morphologically complex words. Additionally, it utilized an innovative statistical analysis technique to better understand the learner engaged in the reading task. Groups of learners were identified and their reading outcomes analyzed longitudinally. Although both of these are important contributions to the field, there were several limitations of the current study that can be addressed in future studies to further our budding understanding of morphological awareness.

Limitations inherent in the assessments included in this study posed the main constraint of this study as they do in the literature. There were several issues with the measurement tools. The first was that although the phonological awareness and oral morphological awareness measures were both selected in part for their short duration, which is ideal for conducting research with younger students, having fewer items resulted in a lack of variability in participants' scores on these measures, which in turn may have limited the profiles found in the data. While phonological awareness measures abound, there are fewer morphological awareness measures, particularly for younger elementary-aged students, which makes this a more difficult task. In addition, as mentioned in the review of the literature, many assessments claim to measure morphological awareness but only assess in the oral modality. Until research has confirmed that an oral measure adequately measures this construct, researchers need to consider assessing additional modalities to accurately represent this ability and make appropriate inferences from data. For this study, a subset of words from the real word and pseudo word measure, were categorized as morphologically complex or not to serve as the outcomes measure of the corresponding task. Although these lists were taken from a common normed assessment used in educational research, it was not created for the purposes used here. So, to better analyze this, it would be ideal to create a word list of morphologically complex words and non-morphologically complex words that can be crafted to include an equal amount of words matched on frequency and other word difficulty indexes. Additionally, words with different affix types (e.g., prefix, suffix), word origin (e.g., Greek, Latin, etc.), and word types (e.g., inflected, derivational, compound) could be included to see if these word characteristics differentially impact word recognition or are differentially impacted by level of morphological awareness. As previously mentioned, the alternate form used in Grade 4 to minimize test-retest effects, had the unintentional consequence of potentially causing a decrease in scores in Grade 4 because there were fewer morphologically complex words on both the real and pseudoword measure.

Previous research has reached consensus that morphological awareness is developing across the school years, however, when this begins is less clear. Given the findings of this study which provide evidence that younger readers, in Grade 2, utilize oral morphological awareness when reading, it would be worthwhile to explore this with Grade 1 students. There have been a handful of studies with this population but too few to draw strong conclusions. Our understanding of the developmental trajectory of this skill is continuing to grow.

The profile analysis variables used for the current study can be used in future studies to analyze growth of these profiles over time. This would allow researchers to determine if group membership remains the same across time. Not only would this inform our understanding of morphological awareness but it would be of practical use to teachers. If a student with a certain profile was more likely to change over time and another student was less likely and had a more at-risk profile, an intervention could be tailored to that individual and others with a similar profile.

Conclusion

It is of critical importance that we understand the process of word recognition, as it a crucial part of reading. National test scores provide evidence that students in the United States struggle with reading tasks. Only 34% percent of American 4th and 8th graders tested at or above proficient on an assessment of English Language Arts, according to results of the National Assessment of Educational Progress (NAEP, 2013), suggesting that about one-third of the nation's fourth and eighth graders have not mastered grade-appropriate reading skills. Thus, the current educational system in the United States is failing a large portion of its students. It seems clear that something is missing in current reading instruction.

As previously discussed, English is an alphabetic language that is morphophonological. As such, both phonology and morphology play an important role in word identification and should be given instructional attention. Phonology is widely taught in elementary school classrooms (Phillips, Clancy-Menchetti, & Lonigan, 2008), but explicit instruction in morphological awareness is lacking and often neglected in curriculum and instruction (Nunes & Bryant, 2009). This is despite the fact that morphological awareness has been shown to make an independent contribution to reading (Bowers, Kirby, & Deacon 2010; Carlisle, 2003, 2010; Kuo & Anderson; 2006; Nagy, et al., 2006; Reed, 2008; Verhoeven & Perfetti, 2003) and numerous studies have documented significant improvement in morphological awareness for treatment groups when compared to control groups (Baumann, Edwards, Font, Tereshinski, Kame'enui, & Olejnik, 2002; Chow, McBride-Chang, Cheung, & Chow, 2008; Packard, Chen, Li, Wu, Gaffney, Li, et al., 2006; Tomesen & Aarnoutse, 1998). Theoretically and empirically it has been demonstrated that children attend to morphological structures within words when reading (Bowers, Kirby, & Deacon, 210; Nagy, Carlisle, & Goodwin, 2013).

Morphological awareness may provide the key to unlocking meaning for students, who are expected to read and understand morphologically complex texts in school, and therefore warrants instructional focus. Instruction in morphological awareness has been found to be effective in improving word recognition, vocabulary knowledge, and potentially reading comprehension (Carlisle & Goodwin, 2014; Elbro & Arnbak, 1996; Kirk & Gillon, 2009). Promisingly, readers of lower reading ability benefit equally (Tomesen & Aarnoutse, 1998) from morphological awareness interventions and may even outperform typically developing peers (Bowers, Kirby, & Deacon, 2010). Usually, instruction in morphology is not present until later elementary or middle school grade levels. However, there is evidence that younger student populations are developmentally ready for and may benefit from instruction in explicit morphological awareness (Apel, Brimo, Diehm, & Apel, 2013; Vadasay, Sanders, & Peyton, 2006), lending empirical support for the inclusion of this focus in lower elementary grade level classrooms. To make effective use of limited instructional time, instruction needs to be thoughtfully tailored to incorporate those elements that translate to gains for students; there is empirical support for reading gains due to explicit morphological awareness instruction.

Interestingly, the goal of morphological instruction, like instruction in phonological instruction, is to make the process so automatic that skilled readers essentially no longer need to rely on this skill in most contexts and instead can access a large mental lexicon of words that are effortlessly recognized as a whole word, facilitating quick and accurate reading. This can be thought of in relation to dual route model of word recognition (see Computational Models in the Models of Word Recognition section) in which both the lexical and the non-lexical route are theorized to operate in parallel and as word parts (e.g., phonemes and morphemes) become more automatically recognized it in turn facilitates a speedier recognition of the entire word (Caramazza, Laudanna, & Romani, 1988; Schreuder & Baayen, 1995). Therefore, even though whole word reading does not rely on metalinguistic awareness at the moment of recognition, it may be that whole word reading is in fact an artifact of a solid foundation of both morphological awareness and phonological awareness.

Narrowing the Research to Practice Gap

Although morphological awareness is not yet as prominent in school curricula and classroom instruction as phonological awareness, knowledge about its potential role in reading is beginning to move from the research sphere to the classroom. A National Institute for Literacy (2007) report described the key role morphology plays in reading. The five key areas of reading development put forth were: decoding/phonemic awareness and phonics, morphology, vocabulary, fluency, and text comprehension (NICHD, 2007). This is distinct from the finding of the National Reading Panel report from 2000, which stated that the five key areas of reading are: phonemic awareness, phonics, fluency, vocabulary, and reading comprehension. No specific mention of morphology was made in that earlier report. This evidences a change in the perception of the role of morphology in reading within the time span between reports.

Following the release of the National Institute for Literacy report, the Common Core State Standards (CCSS) initiative was released, which also recognized the importance of morphological awareness. It called for three key shifts in English Language Arts, one of which pertained to morphology and focused on the interaction of the learner with complex texts and the rich academic language contained in those texts (CCSS, 2014). Complementarily, multiple standards pertaining to morphology are presented under both the reading foundational skills and language subcategories across elementary school grade levels, suggesting its integral role in reading and importance in classroom curriculum. Hopefully this trend continues so that instruction is informed by current research, ensuring that students have access to high quality instruction, and so that research is not conducted in isolation from those whom it is meant to benefit.

Implications of the results of the current study can be translated to classroom practice in several key ways. First, teachers of younger elementary grade levels should include morphological awareness instruction in their reading curriculum. Secondly, when assessing students' morphological awareness real words should be prioritized over pseudowords. Lastly, but most importantly, teachers should be aware of students' strengths and weaknesses with regard to phonological and morphological awareness and seek to remediate both if needed since these findings suggest it is the students with commensurate development of both skills that are most likely to achieve reading success.

Final Thoughts

Research on morphological awareness is in its adolescence, making it a rich and rewarding time to conduct research on this topic. There are hurdles for the field to overcome: adopting a consistent definition, the creation and use of comprehensive assessments of this construct, understanding how a learner's ability in this skill can be best remediated or called upon to compensate for other weaknesses, but there have already been many rigorous, high quality studies conducted on these issues and as we move towards convergence we together are constructing a more highly developed understanding of the reading process which will serve all of our students.

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APPENDIX A

ENGLISH PHONOLOGICAL AWARENESS

ADMINISTRATION NOTES: Speak clearly, but do not stress any particular sounds.

INSTRUCTIONS AND EXAMPLES:
Say: **"Let's play another game with words."**

A. **"Say 'cowboy'. Now say it again, but don't say 'boy'."**
B. **"Say 'steamboat'. Now say it again, but don't say 'steam'."**

- If correct *say*: **"That's right, let's try the next one."**
- If incorrect *say*: **"That's not quite right. COWBOY without saying BOY is COW."**
  - Try to explain it to the child. Demonstrate with hands to show the separation of the two sounds.

Start:	Everyone starts at the beginning.
Scoring:	Circle number for correct response; slash for incorrect and write response.
Ceiling:	Discontinue after 4 consecutive errors.

To administer test items, ask the child to "say the word, but don't say /…/" (a single sound between the parentheses)-- say the **sounds**, not the letter names.

"We are going to do some more like the ones you just did! There are some that are the same, some new ones and some different ones. Listen carefully and keep trying hard!"

Examples:

A. cow(boy) I		B. (steam)boat II	

Test Items:

1. (car)pet I		11. g(l)ow IV	
2. (m)an II		12. (st)rain III	
3. to(ne) III		13. Es(ki)mo II	
4. (p)ray IV		14. de(s)k I	
5. (l)end III		15. auto(mo)bile II	
6. plea(se) II		16. re(pro)duce IV	
7. (c)lip I		17. s(k)in III	
8. ti(me) IV		18. lo(ca)tion II	
9. (b)reak II		19. cont(in)ent IV	
10. (t)rail III		20. car(pen)ter I	

APPENDIX B

MORPHOLOGICAL AWARENESS: WORD ANALOGY

Instructions: Use two finger puppets

Say: **"Let's get out the puppets again. As you know, these puppets like to play talking games. This time, this one is going to say just one word, and this one is going to copy him by changing the word a bit. For example, if this one says 'push', the other says 'pushed'. Then if this one says 'jump', the other says 'jumped'. They'll make a change to one word, and then I'd like for you to try to make the same kind of change to another word. Does that sound ok? Let's try a few for practice."**

To administer practice and test items, read the word pairs with both puppets. Prompt the child to say the last word (fourth in the pair of pairs) by asking **"What would this puppet say?"**

Administer all of the practice items. Provide feedback in the practice items (giving the correct answer and repeating the set of pairs together if the child gets it wrong). Be clear to the child that she/he needs to listen to the first example before making a change to another word.

Practice Items:

Item	Puppet 1	Puppet 2	Error (Write response)	Score (0 = wrong, 1 = correct)
a	**run** **walk**	**ran** *walked*		
b	**child** **bird**	**children** *birds*		
c	**sleep** **cloud**	**sleepy** *cloudy*		

Administer all test items. The child needs to generate the last word in each quadruplet set.

Do not provide feedback for the test items. To encourage the child to respond, ask him to answer the question **"What would this puppet say?"**

Item	Puppet 1	Puppet 2	Error (Write response)	Score (0 or 1)
1	**tall** **strong**	**tallest** *strongest*		
2	**smell** **chill**	**smelly** *chilly*		
3	**art** **write**	**artist** *writer*		
4	**luck** **curl**	**lucky** *curly*		
5	**cover** **store**	**coverage** *storage*		
6	**chew** **bite**	**chewing** *biting*		
7	**duck** **goose**	**ducks** *geese*		
8	**intelligent** **obedient**	**intelligence** *obedience*		
9	**sweet** **strong**	**sweetness** *strength*		
10	**serve** **clean**	**servant** *cleaner*		
11	**wide** **deep**	**width** *depth*		
12	**doll** **mouse**	**dolls** *mice*		
13	**scrape** **scratch**	**scraped** *scratched*		
14	**mad** **true**	**madness** *truth*		
15	**swim** **farm**	**swimmer** *farmer*		
16	**sad** **mild**	**sadly** *mildly*		
17	**creep** **sing**	**crept** *sang*		
18	**build** **science**	**builder** *scientist*		
19	**wreck** **shrink**	**wreckage** *shrinkage*		
20	**rude** **bold**	**rudely** *boldly*		
21	**check** **fly**	**checking** *flying*		