The Effect of Morphological and Syntactic Knowledge on Incidental Derived Word Learning

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This dissertation titled
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Abstract

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Vocabulary is an important component of literacy, and its development is widely believed to be due to incidental encounters with unfamiliar words during reading. The extent to which incidental encounters contribute to overall vocabulary growth is an area in need of further exploration. Because derived words are common in academic contexts, the present study examined how children in grade 5 acquired semantic and syntactic knowledge of unfamiliar derived words in incidental reading contexts. The present study also explored the relationship and contribution of morphological knowledge (relational, syntactic, and distributional) and general syntactic knowledge to incidental derived word learning. Children were administered three measures of morphological knowledge, a standardized measure of general syntactic knowledge, and an incidental word learning measure. The incidental word learning measure required the children to read short stories containing a stimulus word and then identify the correct semantic and syntactic usage of the stimulus word within four new contexts. The results supported the theory that children learn new words in incidental encounters during reading. Although there were greater semantic gains in word knowledge overall, there was evidence that suffix knowledge provided an advantage to syntactic knowledge of an unfamiliar word. Furthermore, relational and syntactic knowledge had a relationship with and predicted
incidental word learning. No relationship between distributional knowledge and incidental derived word learning was found. While there was a relationship between general syntactic knowledge and derived word learning, general syntactic knowledge did not predict derived word learning beyond the contributions of relational and distributional knowledge.
Dedication

This dissertation is dedicated to my parents, Robert and Diane Kneile, who instilled in me the values of a strong education and putting forth my best effort, and to my husband, Martin Schmerr, for his encouragement and patience.
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Chapter 1: Introduction

Word learning in children has attracted the attention of many researchers in the past four decades (Beck & McKeown, 1991; Carey & Bartlett, 1978; Jenkins, Stein, & Wysocki, 1984; Markman & Wachtel, 1988; Nagy, 2009). There are several reasons to study vocabulary development. Vocabulary is one aspect of language that continues to grow through and beyond the school years (Nippold, 2007), unlike, as Phythian-Sence and Wagner (2007) stated, the sound system and understanding of syntactical constructions of one's native language. Also, vocabulary is one of the five components recognized in the National Reading Panel Report (National Institute of Child Health and Human Development, 2000) as being crucial for effective educational reading instruction. (The other four components are phonemic awareness, phonics, fluency, and comprehension.)

Children learn up to an estimated 3,000 words per grade level with a total of up to 50,000 words by high school graduation (Nagy & Anderson, 1984). Given the magnitude of word learning during the school-age years, it is generally believed that incidental word learning accounts for most vocabulary growth (Nagy, Anderson, & Herman, 1987). Incidental word learning is the ability to gain knowledge about words without direct instruction. From a theoretical standpoint, incidental word learning can be explained using linguistic knowledge models (Brackenbury, Ryan, & Messenheimer, 2006; Golinkoff, Mervis, & Hirsh-Pasek, 1994; Mervis & Bertrand, 1994). These models propose that children use and apply knowledge of their native language when they encounter new, unfamiliar words in context. Part of this knowledge is related to derived
words, which children encounter at an increasing rate during the school-age years in the curriculum and within textbooks (Anglin, 1993; Nagy & Anderson, 1984; Nagy, Berninger, & Abbott, 2006; White, Power, & White, 1989). Derived words are words which include a base (or root) word and a suffix (e.g., playful, sharpness). Generally, the affixation of the suffix changes the grammatical class of the word (e.g., from a verb to an adjective, or from an adjective to a noun). There is growing research that children use morphological knowledge to determine meanings of unknown derived words in context (Larsen & Nippold, 2007; Marinellie & Kneile, 2012; Wysocki & Jenkins, 1987). There is also growing recognition of the significance of children’s morphological knowledge and its contributions to successful reading (Berninger, Abbott, Nagy, & Carlisle, 2010; Carlisle, 1995; Nagy, 2007; Nagy, Berninger, Abbott, Vaughn, & Vermeulen, 2003; Nagy & Scott, 2000; Singson, Mahony, & Mann, 2000). Furthermore, morphological knowledge is correlated with vocabulary size (Nagy et al., 2006).

The present study makes a contribution to understanding incidental word learning in school-age children with our focus on incidental learning of derived words in context. First, the extent to which children in Grade 5 gain semantic and syntactic knowledge of derived words in a written incidental word learning measure was determined. Second, children's performance was measured on three aspects of derivational morphological knowledge—relational, syntactic, and distributional. These three aspects of derivational morphological knowledge were first noted by Tyler and Nagy (1989). Relational knowledge is the ability to recognize that a set of words share a common base word as in sharp, sharply, and sharpness. Syntactic knowledge is the ability to recognize that a word
has changed grammatical class with the addition of a suffix (e.g., *kind*—adjective; *kindness*—noun). Distributional knowledge reflects recognition of the constraints on the formation of derived words with suffixes (e.g., *-able* can affix to verbs, but not to nouns). How performance on these aspects of derivational knowledge, as well as general syntactic knowledge, relate to performance on an incidental word learning measure was explored. The present study contributes to the understanding of word learning in school-age children from theoretical and educational standpoints.
Chapter 2: Literature Review

The central focus of the present study is derived word learning in school-age children without explicit vocabulary instruction. The literature review begins with an overview of word learning in school-age children with an emphasis on incidental word learning. This is followed by an examination of morphological knowledge in school-age children, especially as it relates to relational, syntactic, and distributional knowledge. The literature review then includes a brief synopsis of the part morphological knowledge plays in literacy. Finally, a rationale for the present study is provided, along with research questions and hypotheses.

Word Learning in School-Age Children

Nagy and Anderson (1984) estimated vocabulary growth to be up to 3,000 words a year between grades 3 and 12 with a total between 25,000 and 50,000 words by high school. Biemiller and Slonim's (2001) normative population of children from a range of socioeconomic backgrounds learned an estimated 8,400 base words from age 1 year through grade 5 while the subpopulation of children from upper-middle class families learned an estimated 11,900 base words during that same time. While exact estimates vary among researchers, several studies have estimated that most children's vocabularies double between grades 3 and 7 (Jenkins et al., 1984). Direct instruction, which accounts for some growth in vocabulary (Blachowicz & Fisher, 2000; Pany, Jenkins, & Schreck, 1982; Stahl & Fairbanks, 1986), can be provided in oral or written contexts including direct explanations of word meanings, vocabulary worksheets, and referencing a dictionary. It is generally believed that direct instruction cannot account for all the
estimated gains in vocabulary growth in school-age children. Rather, incidental word learning from reading and listening contexts is presumed to account for much of the vocabulary growth that occurs during the school-age years (Jenkins et al., 1984; Nagy & Anderson, 1984; Nagy & Herman, 1987; Nagy, Herman, & Anderson, 1985; Sternberg, 1987). Vocabulary acquisition through incidental word learning is defined as the ability to learn words in the absence of direct adult instruction. Furthermore, incidental word learning involves limited exposure to a word, sometimes a single exposure. Incidental word learning situations include oral contexts (such as in the classroom, watching television, and listening) and reading contexts.

Incidental word learning, or learning a word's meaning from a reading or listening context, is typically studied through experiments involving fast mapping. Fast mapping refers to the child's initial partial semantic and syntactic knowledge of a new word after one or a few exposures (Carey & Bartlett, 1978). Extended mapping, or slow mapping, refers to the added semantic and syntactic knowledge of the same word over time after several exposures to the word (Carey, 1978; McGregor, Friedman, Reilly, & Newman, 2002).

Fast and extended mapping highlight the incremental nature of word learning; multiple encounters with a word may be necessary for more complete knowledge of the word to develop. This incremental nature of word learning affects at least two separate aspects of a word—its meaning (semantic aspect) and its grammatical usage (syntactic aspect). These aspects may not develop at the same rate, even for a particular word (Marinellie & Kneile, 2012). It is possible that a child may recognize the part of speech
of a word without knowing its meaning, and, conversely, may know the meaning of a word but not know how to use it syntactically. With more complete knowledge of a word, a child is familiar with both a word's meaning and its syntactic category.

**Models of Incidental Word Learning**

Despite researchers’ interest in children’s word learning for the past several decades, it is still unclear how incidental word learning adds to children's overall vocabulary knowledge and what processes are involved. Generally, two types of models have been proposed: Communicative intention models and linguistic knowledge models (for a review of models see Brackenbury et al., 2006). Communicative intention models propose that incidental word learning occurs as a result of a child’s abilities to express and perceive communicative intentions, independent of the child’s developing linguistic knowledge. For example, theory of mind refers to a child's ability to understand the minds or perspectives of others (Bloom, 2000). In relation to word learning, a child would map a referent to its label if the child perceives that the adult is intending to provide the child with an object's name, such as by using the cues of pointing or eye gaze coupled with a label. Similarly, Tomasello and colleagues have experimentally demonstrated how children use social-pragmatic cues to learn word meanings in nonostensive contexts, such as by using situational context to determine that items that were new from the perspective of the adults were the targets of the novel name (Akhtar, Carpenter, & Tomasello, 1996) or by matching a verb label to an adult's intentional action and not an unintentional action (Tomasello & Barton, 1994).
Linguistic knowledge models propose that, as children gain information about their native language, they apply this knowledge to new and unfamiliar word learning contexts. There are several documented principles governing the child's learning of a word in early development, such as the novel name-nameless category (N3C) principle (Golinkoff et al., 1994; Mervis & Bertrand, 1994) and shape bias (Landau, Smith, & Jones, 1988). The N3C principle assists the child in learning labels for objects in situations where the child has labels for all objects present except for one. According to this principle, the child will seek out and link a new label to the object for which a label is unknown (Golinkoff et al., 1994; Mervis & Bertrand, 1994). According to this model, children need to have a minimum linguistic base (i.e., a vocabulary spurt) before they can begin fast-mapping labels to objects (Brackenbury et al., 2006; Golinkoff et al., 1994). The N3C principle is part of the second tier of the developmental lexical principles framework which organizes six linguistically-based word learning principles into two tiers based on the early vocabulary development of young children (Golinkoff et al., 1994). Shape bias assists in word learning in that there is evidence that children and adults have a bias over shapes of objects as compared to other perceptual characteristics such as texture or size. In cases where a label for an object is supplied, a child or adult is likely to extend that label to other objects with a similar shape. Shape bias is linguistically based in that it begins to appear developmentally when children are learning count nouns (Brackenbury et al., 2006; Landau et al., 1988).

In support of the linguistic knowledge models, several researchers have found that children’s incidental word learning can be facilitated by manipulating certain word
properties including phonotactic probability, concreteness, word familiarity, conceptual difficulty, grammatical class, and type of context clues (Carnine, Kameenui, & Coyle, 1984; Leung, 1992; Nagy et al., 1987; Storkel & Morrisette, 2002). Leung (1992) examined word-related variables such as the children’s familiarity with the concept of the target word, and the degree of concreteness or abstractness of the word. The children were read aloud two picture books which they then retold to an adult. The children's word learning was measured via the story retelling and pre- and post-book reading interviews. The familiarity of the target word's concept and the concreteness of the target word were found to assist in word learning.

Nagy et al. (1987) examined the effect of several word properties on incidental word learning of children in grades 3, 5, and 7. In this study, the children were assessed 6 days after reading from grade-level textbooks rather than immediately after reading. Still, small growth in word knowledge was measurable for all grade levels. One word property that was measured was the conceptual difficulty of the word; the words that were the most conceptually difficult (i.e., represented a new concept) did not lead to any measurable learning. The other word properties measured, including morphological transparency (i.e., the degree to which the individual morphemes of a word could be analyzed to determine word meaning) and grammatical class, did not yield significant results for word learning from context. In contrast, Schwanenflugel, Stahl, and McFalls (1997) found that the children in grade 4 had larger vocabulary growth for non-nouns than nouns for words in which the children has some previous knowledge.
Several researchers have investigated how other factors, such as supportive contextual information and children's vocabulary or reading abilities, affect children's ability to gain word knowledge of unfamiliar words in text. In their study with children in grades 4, 5, and 6, Carnine et al. (1984) found that children were better able to identify definitions of the target words when the supportive contextual information about the target word's meaning was within two sentences following the target word rather than three or more sentences away. In their study, the supportive contextual information varied in type: a synonym of the target word, an antonym of the target word, or by providing context in which the meaning is inferred through deduction. Of these three supportive contextual types, the children were better able to determine word meaning when a synonym was provided rather than when the meaning was inferred in the context. Interestingly, although the older children were better able to determine word meaning from context than the younger children, they were only able to do so about 40% of the time (based on a correction-for-chance score).

McKeown (1985) found that the grade 5 children with poor vocabulary skills had more difficulties using context to determine unfamiliar words' meanings than the children with normal vocabulary skills. In a study focusing on children's reading abilities, Cain, Oakhill, and Lemmon (2004) provided 9- and 10-year-old children with and without reading comprehension deficits with short stories, each containing a target nonsense word with a novel meaning. Content designed to help provide informative semantic information about the target words appeared either immediately after the target word or after some additional, irrelevant content. After reading each story, the children provided
an explanation of what the target word meant based on the story's content. Children who had weak reading comprehension skills were less able than their peers with strong reading comprehension skills to infer the target words' meanings when the informative semantic context was not provided immediately after the target word. These results (i.e., the effect of proximity of informative semantic context on children's ability to infer word meanings) were similar to those obtained by Cain, Oakhill, and Elbro (2003) in which younger children (7- and 8-year-old children) participated in a similar study.

**Studies in Incidental Word Learning**

Previous studies measuring incidental word learning have measured small, but noteworthy, gains in word knowledge. Beck and McKeown (1991) noted that incidental word learning is "prominent by default" (p. 799) as an explanation for vocabulary growth because there is a lack of "strong evidence that word meanings are routinely acquired from context" (p. 799). However, studies have shown that incidental word learning in written contexts can account for vocabulary growth (Jenkins et al., 1984; Nagy et al., 1985; Swanborn & de Glopper, 1999). One explanation provided by Beck and McKeown (1991) for incidental word learning as a source of vocabulary growth is that small gains in word knowledge growth can lead to ample vocabulary growth given a large number of incidental word learning opportunities. Additionally, gains in word knowledge measured in incidental word learning studies are affected by the number of exposures to a word and the aspects of word knowledge being measured.

In a meta-analysis of 15 incidental word learning studies (Swanborn & de Glopper, 1999), children were found to learn an estimated 15% of words in reading
contexts. Because reading is a source for vocabulary growth, it stands to reason that the more children read, the more they will encounter unfamiliar words leading to greater opportunity for vocabulary growth. Although written contexts are attributed with more opportunities for vocabulary growth in school age children, incidental word learning in oral contexts, such as in a science classroom, have also been shown to lead to word learning (Carlisle, Fleming, & Gudbrandsen, 2000).

In an effort to study vocabulary growth via incidental word learning in differing contexts, Jenkins et al. (1984) provided children in grade 5 with a particular target word within a short written paragraph with strong contextual support 10, 6, or 2 times. The researchers found evidence of word learning, and that word learning increased with increased exposure to the target words, although the gains were deemed not to be large even after 10 exposures. In contrast with the incidental word learning condition, the children were given a list of half the target words. This list of words contained a synonym and a sentence for each word on the list, and the children were instructed to review the list prior to reading the paragraphs. Because of this, the children had prior knowledge of the words on the list, and the largest increase in word learning occurred with these words.

Nagy et al. (1985) were also able to measure small gains in word learning with children in grade 8. The children were assessed on their word knowledge approximately 15 minutes after reading the provided texts by means of an interview and a multiple-choice task. The results led the researchers to conclude that incidental learning from reading contexts does account for vocabulary growth in school-age children.
More recently, Wagovich and Newhoff (2004) measured five aspects of word knowledge in children in grade 6 on an incidental word learning measure. The areas of partial word knowledge (PWK) included: word discrimination (i.e., identifying the word as a real word), syntactic knowledge, general and detailed semantic knowledge, and expressive knowledge. The children read four grade-level stories which contained unfamiliar nouns and verbs appearing one time each, and were then assessed on their knowledge of these words 2 to 3 days later. There was evidence of PWK growth in the form of word discrimination for verbs, but not nouns, but this was not related to children's reading level, vocabulary, or general language ability. No significant findings of PWK growth were found for syntactic, general semantic, or detailed semantic knowledge.

**Word Learning and Morphological Knowledge**

Linguistic knowledge models acknowledge the role of children’s knowledge of morphology during incidental word learning. That is, children use morphological analysis to gain word knowledge (Anglin, 1993; Bertram, Laine, & Virkkala, 2000; McCutchen & Logan, 2011; Nippold, 2007). Morphological analysis is described as the process by which the components of a word—the base word and any inflectional or derivational affixes—are separately scrutinized in order to hypothesize the meaning of the word as a whole (Nippold, 2007; White et al., 1989). Given that derived words have been estimated to outnumber base words in school-age texts (Nagy & Anderson, 1984), the ability to analyze a word's morphological structure is essential to word learning. In the sections that follow, we further define morphology, various types of morphological
knowledge, studies that support children’s use of morphological analysis, and the connection to literacy development.

**Derivational morphology.** Morphology encompasses the rules or principles governing words and their formation. At the basic level of word structure are monomorphemic words (i.e., base or root words), such as *run* or *kind*. Base words and affixes can then be combined in the processes of compounding, inflection, and derivation. Compounding occurs when base words are combined to form new words, such as in the formation of *doghouse* from *dog* and *house*. Additionally, affixes can be added to base words to create words in a process of inflection (e.g., *running*) or derivation (e.g., *kindness*). The stimulus words in the present study will be words created through the process of derivation.

The derivational process produces derived words of varying structural complexity and words that differ from the base word in one or more ways. Derivation involves the addition of either a prefix (e.g., *un-*) or a suffix (e.g., *-able*) to a base word to create a derived word. The affixation process results in polymorphemic words that can be more or less complex in terms of structure. For example, derived words can be comprised of a base word and a suffix (e.g., *kindness*), which is the structure of the derived words in the present study, a base word and a prefix (e.g., *unkind*), or a base word and multiple affixes (e.g., *unforgettable, respectfully*). Additionally, the derivational process creates a word with a new meaning that is related to the base word (e.g., *unkind*), and often results in changing the part of speech (e.g., *kindly, kindness*).
During the affixation process, the base word may undergo changes in pronunciation or syllable stress. Transparent, or neutral, derived words are those in which the base word is not affected phonetically after affixation (e.g., \textit{happy} / \textit{happiness}), and opaque, or nonneutral, derived words are those in which the base word has a syllable stress change (e.g., \textit{fragile} / \textit{fragility}), a phonological change (e.g., \textit{deprave} / \textit{depravity}) or both (e.g., \textit{admire} / \textit{admirable}) (McCutchen, Green, & Abbott, 2008; Nippold, 2007).

\textbf{Development of morphological knowledge.} Morphological knowledge can be divided into inflectional knowledge and derivational knowledge. Inflectional knowledge is developed earlier than derivational morphological, typically mastered by grade 1 (Carlisle, 1995). In contrast, derivational knowledge makes the greatest developmental gains between the ages of 9 and 14 (Nippold, 2007).

Leonard (1998) and Pinker (1984) describe a process whereby children use models or patterns, referred to as paradigms by Pinker (1984), to apply inflectional morphemes to new words. Early versions of the paradigms consist of inflected words as a whole unit (e.g., \textit{dogs} as a variant of \textit{dog}; \textit{cats} as a variant of \textit{cat}). Eventually, children's paradigms become more general and children learn, for example, that the \textit{s} in \textit{dogs} and \textit{cats} represents plurality and that other nouns can be made plural by affixing the inflectional \textit{-s}. Although Pinker's model of paradigm representation is described only with inflectional affixes, it could potentially be used to describe children's expanding knowledge of derivational morphemes. As children's knowledge of derivational morphemes increases, they acquire the semantic and syntactic information contributed to the base word by the affix and move from a whole unit (base + derivational affix)
paradigm to the ability to affix derivational suffixes to a variety of base words. In the present study, the children completed a task that demonstrated their understanding of the semantic and syntactic contribution of derivational suffixes to unfamiliar base words in the incidental word learning measure.

Spontaneous use of inflectional and derivational morphological skills of children in written contexts was examined by Green et al. (2003). In this study, the children from grades 3 and 4 wrote narratives based on a picture in both fall and spring of the academic year, and the prevalence and accuracy of their productions of inflectional and derivational forms were analyzed. With regard to prevalence of morphological forms, the use of inflectional forms outnumbered derived forms of words in both grades. With regard to accuracy, the children in grades 3 and 4 had mastered the inflectional forms used, and accuracy of derivational forms not only increased with grade, but also increased from fall to spring of grade 4. Additionally, the children primarily used the same seven suffixes classified as derivational by the researchers (including -ly, -y, -ful, and -er), and they only used transparent derived forms in their productions. Studies have consistently found that children find transparent derived words easier than opaque derived words (Nippold, 2007).

Although knowledge of derivational morphology is later developing as compared to inflectional morphology, research has shown that young children possess an emerging knowledge base for derivational morphology. In seminal work by Berko (1958), early morphological development of children was examined. It was found that the children in the study, who ranged in age from 4 to 7, possessed varying degrees of morphological
knowledge and were able to extend this knowledge to novel words. By using novel words, the ability for children to rely on words they may have memorized in their inflected or derived form was eliminated, thereby demonstrating the children's ability to apply knowledge of morphological rules to novel contexts. The children were primarily assessed on inflectional morphemes, such as those that indicated plural, past tense, third person singular, and possessive forms of words. On inflectional items, children in grade 1 significantly outperformed the children in preschool on almost half the items.

Comparatively, a few derivational morphemes were also assessed, such as a diminutive suffix (e.g., wuggie), agentive suffix -er (e.g., zibber), and suffix -y to form adjectives (e.g., quirky). With respect to the derivational items, none of the children produced a derivational suffix to form a diminutive form of wug or to form the adjective quirky. The agentive noun zibber was produced by less than 15% of the children; in contrast, all of the adult subjects produced this form.

As children progress through the school years, their morphological knowledge continues to expand. In a similar approach to Berko's (1958) study, Windsor (1994) examined morphological knowledge from children in grades 3 through 8 in two different measures—a production task and a comprehension task. As part of the study, Windsor examined suffix productivity. A suffix can be described as more or less productive depending on the degree to which a particular suffix can affix to a variety of base words (Aronoff, 1976). For example, the agentive suffix -er (as in gardener) is considered to be more productive than its counterparts that have a similar meaning and function (e.g., -ist as in arborist; -ian as in guardian) because it affixes to more base words. The tasks in
Windsor's study directly examined the children's ability to either produce derived words with nonsense base words (based on a presented context) or to select an appropriate derived word with a nonsense base word given four choices. There were three main findings of this study: (a) the children were less accurate than the adult comparison group; (b) the children performed better on the comprehension task than the production task; and (c) there was a general trend of an increase in accuracy as grade level increased. Also important was the finding that, in the productive task, a derived word with a more productive suffix was more likely to be produced than a derived word with a less productive suffix. In a modified replication experiment with children in grades 4-8 (Lewis & Windsor, 1996), the children also demonstrated better comprehension than production and a more productive suffix was more likely to be used than a less productive suffix in the production task. Also, a second experiment of this study involved the children providing definitions for low-frequency derived words. In this task, the children were able to provide meanings that conveyed suffix meaning 60% of the time.

By using an interview method in which children defined various words types, including derived words, Anglin (1993) found that the greatest word knowledge growth from grades 1 through 5 occurred with derived words as compared to the other word types (i.e., compound, root, inflected, idiomatic) examined. Nagy, Diakidoy, and Anderson (1993) provided these two explanations for the later development of derived words: (a) the addition of a derivational suffix to a base word increases the abstractness of a word, and (b) derived words are more common in written texts and in formal oral language contexts such as lectures.
To summarize morphological development as presented thus far, derivational knowledge is acquired later than inflectional knowledge. With regard to derivational knowledge, children acquire knowledge of more productive forms earlier than less productive forms and have less difficulty with transparent derived forms than with opaque forms.

In continued exploration of the development of morphological knowledge of children through the school years, Tyler and Nagy (1989) delineated morphological knowledge into three separate subskills: relational, syntactic, and distributional. The results ultimately showed that these separate subskills develop at different ages.

**Relational knowledge.** Relational knowledge refers to recognizing a common morpheme in a set of words, such as identifying that *kind, kindly* and *kindness* share a common base form whereas *lad* and *ladder* are not morphologically related despite similarities in phonological structure. The youngest children assessed in the Tyler and Nagy (1989) study were in grade 4, and relational knowledge was largely already intact in these children. If children encounter an unfamiliar derived word in text, they may apply relational knowledge of derived words by recognizing a familiar base word to assist in inferring the meaning of the derived word. Some of the children in Anglin's (1993) study exhibited the strategy of identifying base words within the derived variation by using a "part to whole pattern" (p. 92) in which they indicated recognition of the base word to define given derived words they initially stated were unfamiliar. While this strategy was not common with the children in grade 1, its use increased among the children in grades 3 and 5.
Larsen and Nippold (2007) tapped into the ability of children in grade 6 to use morphological analysis to provide definitions for low-frequency derived words containing high-frequency base words. The task yielded a wide range of performance with about 20% of the children having difficulty with spontaneous use of morphological analysis to provide word meanings. Additionally, a correlation analysis found that the children who had stronger word knowledge and reading comprehension skills had better performance on the morphological analysis task.

In a recent study (Marinellie & Kneile, 2012), children in grade 4 read several short stories, each containing an unfamiliar derived word and its base form, as part of an incidental word learning measure. Each story was followed by a multiple-choice item in which four sentence options were manipulated for correct and incorrect use of the derived word for semantics and syntax. Overall, results indicated an advantage for gain of semantic knowledge as compared to syntactic knowledge. It was also found that performance on a morphological knowledge measure of relational knowledge (e.g., pity is related to pitiful; let is not related to letter) was significantly correlated with the children's performance on the derived nominals of the incidental word learning measure.

**Syntactic knowledge.** Syntactic knowledge refers to recognizing the effect a suffix has on the grammatical class of a resulting derived word. For example, the base word kind is an adjective, but is an adverb when it is derived as kindly and a nominal when derived as kindness. In Tyler and Nagy's (1989) study, syntactic knowledge was shown to develop somewhat later than relational knowledge. In their study, the children in grade 4 demonstrated that although they possessed syntactic knowledge, the children
in the later grades had more accuracy. In support of Tyler and Nagy's (1989) findings, Nippold and Sun (2008) conducted a study with children in grades 5 and 8 which primarily tapped their syntactic knowledge of derived words. The researchers used a cloze test in which children selected the appropriate derived word from four options, each with the same base word, to complete a sentence. The older children performed better at this measure than the younger children, and, interestingly, both groups of children had more difficulty with the derived nominals than the derived adjectives.

Nagy et al. (1993) postulated that change in grammatical class is the main effect that derivational suffixes have on the base word. This aspect of morphological knowledge coincides with children's general syntactic knowledge because they need to recognize how the addition of the suffix has changed a word's usage within a context (Nagy & Scott, 2000; Tyler and Nagy, 1990). Identifying the change in grammatical class signaled by the suffix is a developing skill, even in high school, especially for poor readers. For example, in Tyler and Nagy (1990), children in grades 10 and 11 were asked to select the correct paraphrase of a sentence containing either a target derived word or base word. The children made fewer errors for base word items than for items containing derived words. This indicates that they were less skilled at recognizing the syntactic cues provided by the suffixes in the sentences containing derived words. Nagy et al. (1993) found similar results in their study which compared performance between derived words and similar monomorphemic word items. The children in their study were in grades 4 and 7 and in high school. It was found that children in all grades performed better on the monomorphemic word items than the derived word items. Also, the greatest
developmental difference in performance on derived items was between the children in grade 4 and the children in grade 7.

The ability to use sentence structure and inflections to gain word knowledge has been referred to as syntactic bootstrapping (e.g., Gertner, Fisher, & Eisengart, 2006; Gleitman, 1990; Naigles, 1990; Yuan & Fisher, 2009). Naigles (1990) demonstrated that young children use sentence structure to learn intransitive verbs (e.g., *The duck and bunny are gorping*) and transitive verbs (e.g. *The duck is gorping the bunny*). While much of the syntactic bootstrapping literature has focused on how children learn verbs using knowledge of verb argument structure (e.g., Gleitman, 1990), other studies have shown that children use syntactic information to learn a variety of words, including nouns and adjectives (Hall, Lee, & Bélanger, 2001; Jaswal & Markman, 2001; Katz, Baker, & Macnamara, 1974). For example, Katz et al. (1974) and Hall et al. (2001) examined how young children distinguished common nouns from proper nouns, primarily through the use of the English articles of *a* and *the* prior to common nouns. In another study (Jolly & Plunkett, 2008), young children were able to use an inflectional marker for English plurality to learn novel nouns. With respect to gaining word knowledge about unfamiliar derived words presented in a context, individuals who use sentence structure to gain syntactic information about an unfamiliar derived word may gain more word knowledge than those individuals who do not take advantage of these syntactic cues. The present study expands this literature by investigating the influence that children's general syntactic knowledge has on the syntactic gains they make in learning derived words.
**Distributional knowledge.** Distributional knowledge refers to recognizing the constraints on forming derived words with suffixes, such as being able to form new adjectives from verbs with the addition of the suffix *-able* (e.g., *forget, forgettable*) but not being able to affix *-able* to nouns (e.g., *horseable*). This skill was the latest developing skill of the children in the Tyler and Nagy (1989) study, with evidence that children in grade 6 were still developing this knowledge. This ability may prove advantageous in deciphering word meaning in that prior knowledge of the suffix can assist in morphological analysis leading to knowledge about the word. For example, if a child reads the phrase “an axiomatic truth,” the child might recognize that the suffix *-ic* affixes to nouns but not to adjectives or verbs. The child would then know that the base is a noun which provides the child with more information about the base word than before the analysis.

McCutchen et al. (2008) examined the contributions of relational, syntactic, and distributional knowledge to the reading skills of word reading (real words and non-words) and reading comprehension. With regard to the three morphological areas, the children in grade 6 had better overall performance than the children in grade 4, and all students had better performance on the relational measure than the measures assessing syntactic and distributional knowledge. These results support the results of Tyler and Nagy’s (1989) study in showing the growth of morphological skills, especially in the domains of syntactic and distributional knowledge, in the later elementary years. In the statistical models of McCutchen et al. (2008), morphological skill uniquely contributed to
real and nonword reading and to reading comprehension until vocabulary knowledge was added to the model.

**Morphological Skill and Literacy**

There is growing documentation that morphological knowledge contributes to literacy skills in the areas of word reading, reading comprehension, and spelling (Carlisle, 2000; Carlisle, 2003; Nagy et al., 2006; Nippold, 2007; Tong, Deacon, Kirby, Cain, & Parrilla, 2011; Wolter, Wood, & D'zatko, 2009), similar to the well-documented contribution of phonological awareness.

In one study (Mahoney, 1994), college and high school students were given a Morphological Sensitivity Test (MST) which assessed knowledge of the relational and syntactic properties of derived words and the ability to read derived words with phonological shifts. It was found that strong morphological skills correlated with stronger reading skills. In a similar study with children in grades 3-6, Singson et al. (2000) found that syntactic derivational knowledge measured via a sentence-completion task increased with grade level (with the largest increase between grade 3 and the other grades) and was related to decoding ability. In a subsequent study with children in grades 3-6, Mahony, Singson, and Mann (2000) found that relational morpheme knowledge also increased with grade level and was also related to decoding ability.

In her study to investigate the relationship between children’s morphological knowledge and reading, Carlisle (2000) found that, in children in grades 3 and 5, relational knowledge contributed to the ability to read derived words and that morphological knowledge also contributed to reading comprehension. In a study
including older children in grades 4-9, Nagy et al. (2006) also found that morphological knowledge contributed to reading comprehension. In addition, morphological knowledge contributed to vocabulary and spelling.

In another study exploring the degree to which morphological skill accounts for word reading and comprehension in children in grades 4 and 6, McCutchen et al. (2008) used a measure which contained a series of tasks to tap into relational, syntactic, and distributional knowledge and compared those results with various measures of literacy. Overall morphological skills positively contributed to word reading and nonword reading. Morphological skills also contributed to reading comprehension, but only when vocabulary skill was not included in this analysis.

Additionally, a few studies have examined the connection between morphological knowledge and literacy skills in younger elementary children. In a morphological knowledge task with children in grade 1, Wolter et al. (2009) asked children to complete sentences by verbally providing the appropriate inflected or derived form of a given base word. The children demonstrated morpheme awareness with the highest accuracy for inflections, followed by transparent derived words (e.g., teach - teacher), then opaque derived words (e.g., long - length). Morphological knowledge was predictive of word reading skills and influenced spelling. In a different study with children in grades 1-3 (Kirby et al., 2012), morphological knowledge was measured via a word analogy task (e.g., paint: painter:: bake: baker). Morphological knowledge was found to contribute unique variance to measures of word reading and reading comprehension. In an intervention study (Nunes, Bryant, & Olsson, 2003), 7- and 8-year-old children
demonstrated improvements in decoding and spelling after receiving morphological training consisting of classification, segmenting, blending, and analogy activities.

Summary

The literature suggests that vocabulary gains during the school years are primarily due to incidental encounters, especially in written contexts (Nagy et al., 1987). Initial exposures to unfamiliar words may lead to partial word knowledge which gradually develops to fuller word knowledge with increased encounters. Linguistic knowledge models propose that children apply what they already know about language to add to their developing lexicons, and linguistic properties such as grammatical class, supportive contextual information, and morphological structure influence word learning (Carnine et al., 1984; Nagy, 2009; Schwanenflugel et al., 1997). Morphological knowledge consists of inflectional knowledge, which is acquired in early childhood (Berko, 1958), and derivational knowledge which develops throughout the school years (Anglin, 1993). Derivational knowledge is further subdivided into three discrete aspects with relational knowledge being acquired earlier than syntactic or distributional knowledge (Nagy & Tyler, 1989). Lastly, vocabulary and morphological knowledge continue to develop through the school years and influence literacy which is essential for academic success (Carlisle, 2003; Nippold, 2007).

The Present Study

There are few studies which have specifically studied the acquisition of derived words in incidental encounters in written contexts, despite the high number of derived words estimated to be in texts. With the development of morphological knowledge,
children have an advantage in acquiring semantic and syntactic word knowledge of
derived words in incidental encounters by virtue of the semantic and, especially, syntactic
contribution of suffixes to the base word. The present study provides novel insights into
children's vocabulary growth by examining previously unexplored areas such as how
children's knowledge of the different aspects of derivational morphology (relational,
syntactic, and distributional) contributed to incidental derived word learning and the
relationship between general syntactic knowledge skills of children and word learning.
Additionally, knowledge of how typically developing children learn derived words in
context should help researchers interpret the findings of future studies that include
children with language learning impairments.

In the present study, three aspects of derivational knowledge and their relationship
to incidental derived word learning were examined. Children in grade 5 were selected for
the present study because this age presents an opportune time to assess two of those
aspects, syntactic and distributional knowledge. At this grade level, children's emerging
syntactic and distributional knowledge of morphology can be more readily captured as
compared to earlier grades. Tyler and Nagy (1989) reported that syntactic knowledge of
morphology begins to develop around grade 4. On Tyler and Nagy's syntactic knowledge
task, the children in grade 4 did not perform above chance levels for nonce words (which
were the word types used in the present study). Due to the emphasis on the syntactic
aspects of derived word learning in the present study, it was especially important to
assess children's syntactic and distributional skills which are later developing than
relational knowledge (Tyler & Nagy, 1989). If older children participated, there was a
potential for ceiling effects on the relational knowledge measure, making it difficult to determine the contribution of relational knowledge to the incidental word learning measure. Children who were typically developing were chosen because there is a paucity of research related to incidental word learning studies specifically with derived words. The present study was conducted to address the following questions:

1. To what extent can children gain semantic and syntactic knowledge of derived words in a measure of incidental word learning?

Word learning has been shown to be incremental, and part of word knowledge includes both the syntactic and semantic aspects of a particular word. The measure in the present study was designed to be sensitive enough to capture partial word knowledge as it pertains to semantic and syntactic aspects of word knowledge. It was expected that, in the incidental word learning condition, the children would be able to gain semantic and syntactic word knowledge based on the given context. Furthermore, for the derived words, the children probably would be able to use morphological analysis as an additional tool to gain word knowledge. Similar to Tyler and Nagy (1990) and Nagy et al. (1993), items containing monomorphemic words were included in the measure for comparison purposes. That is, the items with monomorphemic words were included as a baseline to better understand children’s acquired knowledge with respect to the syntactic contribution of the suffixes in the derived words. It was expected that the children would show greater syntactic knowledge on the derived word items because of the familiarity of the suffixes, and, as previously mentioned, the affixation process primarily affects the syntactic class of the base word.
2. How does performance on measures of morphological knowledge (relational, syntactic, distributional) relate to performance on a measure of incidental word learning involving derived words?

The measures of morphological knowledge assessed the children's knowledge of the relational, syntactic, and distributional aspects of derivational morphology. Given the results of Marinellie and Kneile (2012) in which a moderate positive relationship between relational knowledge and the incidental word learning task performance was found, the same result was expected in this study. A moderate positive relationship between syntactic knowledge and performance on the measure of incidental word learning was expected, especially with respect to syntactic knowledge of the stimulus word, because the children should be able to apply contextual knowledge plus their knowledge of the derivational suffix to assist with determining the derived word's part of speech. A weak, but significant, relationship for performance on the distributional knowledge and the incidental word learning measures was expected. Also, we were interested in which of the aspects of morphological knowledge (relational, syntactic, and distributional), if any, accounted for unique variance in incidental word learning of derived words.

3. How does performance on a general measure of syntax relate to performance on a measure of incidental word learning involving derived words?

The general measure of syntax was a standardized assessment of syntax used to assess the children on a variety of sentence structures and function words. These syntactic aspects of language are distinct from the syntactic aspect assessed by the measure of syntactic knowledge of derivational morphology because derivational morphology
involves an affixation process. We expected to find a moderate relationship between performance on the general measure of syntactic knowledge and the incidental word learning measure. It was hypothesized that children with stronger general syntactic skills would be able to utilize these skills to take advantage of the structure of the sentence containing the derived word to gain syntactic knowledge of that word. Additionally, these children were likely to be more sensitive to the syntactic change of a word from its base form to its derived form and would, therefore, demonstrate higher performance on the syntactic measure of incidental word learning.
Chapter 3: Methodology

Participants

The participants for the present study were typically developing, monolingual children in grade 5. A total of 147 children participated in the study; however, 48 children were excluded from the final analyses based on several factors. Thirty-seven children were excluded from the analyses because they had a history of a learning, speech, language, attention, or behavioral deficit as verified by a written questionnaire returned by each child's parent (see Appendix A) and by teacher report. In addition, 4 additional children whose language skills were below normal limits, as measured by the Receptive Language index of the Clinical Evaluation of Language Fundamentals-4 (CELF-4; Semel, Wiig, & Secord, 2003), were excluded from the analyses. The CELF-4 subtests that comprised the Receptive Language index were Concepts and Following Directions and Word Classes 1-Receptive, and these subtests were administered individually. The Concepts and Following Directions subtest required the children to listen to a series of instructions and point to given illustrations in the order indicated by the instructions. The Word Classes 1-Receptive subtest required the children to determine which two of four given concepts were semantically related. The Receptive Language index has an average test-retest reliability coefficient of 0.86 and an internal consistency reliability coefficient of 0.89. Lastly, 7 additional children were excluded because they had a score lower than 33 on the comprehension questions of the incidental word learning measure. The mean score for the comprehension questions was 34.77 (out of 36 possible
points; SD = 1.76); 33 was chosen as the cut-off score because it was the closest whole number to 1 standard deviation of the mean.

A final total of 99 children (42 males, 57 females; 45 children from School 1, 54 children from School 2) were included in the analyses. The average age of the children participating was 10.28 years (SD = 0.41 years; range = 10.5 - 12.42 years). According to the Ohio Department of Education's Local Report Card data for 2011-2012 (Ohio Department of Education, 2012a, 2012b), both participating schools were rated as "Effective." The student population in School 1 was reported to be 96.9% “White, non-Hispanic,” and the student population in School 2 was reported to be 94.9% “White, non-Hispanic.” The race and ethnicity of the children participating in the present study were representative of the race and ethnicity of the population in the region. Both schools were classified as having a medium-high poverty status with the percentage of economically disadvantaged students in School 1 and School 2 as 60.3% and 50.8%, respectively. The Ohio Department of Education defines a child as economically disadvantaged if he or she is: a) eligible to receive free or reduced-price lunch, b) the resident of a household in which another member is eligible for free or reduced-price lunch, c) the recipient of public assistance or has a guardian who receives public assistance, or d) part of a household that meets income guidelines specified by Title I (Ohio Department of Education, 2013). Additionally, the children in both school districts were exposed to the same curriculum because curriculum standards in Ohio dictate academic content for each grade in all subject areas.
Measures of Derivational Knowledge

Relational knowledge. To measure relational knowledge, a task similar to the "comes from" tasks used by McCutchen et al. (2008), Derwing and Baker (1979), and Mahoney (1994) was used. In this 20-item task, students were asked a question such as "Does singer come from sing?" or "Does summer come from sum?" (see Appendix B). This task was modified from its predecessors to include more items with suffixes used in the present study. Half of the items were transparent derived words and half were opaque to reflect the inclusion of both types of derived words as done by McCutchen et al. (2008).

Syntactic knowledge. Syntactic knowledge was measured using a variation of the task used in Tyler and Nagy (1989) and Mahoney (1994). This was a 20-item multiple-choice task in which the children selected the derived word, from a choice of four, that best completed a sentence based on the syntactic constraints of a sentence. The base words of the derived words were nonce words that were consistent with English orthography and were 1- or 2-syllables in length. By using nonce words, the children had only their knowledge of the syntactic properties of the suffix to assist them in making the correct choice. This measure was modified from those of the previous studies to include the familiar (productive) suffixes used in the IWL measure. See Appendix C for examples of task items.

Distributional knowledge. The measurement of distributional knowledge was done by means of a lexical decision task similar in structure to those used by Tyler and Nagy (1989) and by McCutchen et al. (2008). It was modified from those versions to
include only the suffixes used in the present study. Children were presented with 20 words using base and suffix combinations that are possible (e.g., *playful*) or that violate morphological rules of English (e.g., *playity*) and were asked to determine if the word was a word in English or not. Based on the standard frequency index (SFI) reported in the *Word Frequency Book* (Carroll, Davies, & Richman, 1971), the base words used had a relatively high frequency (i.e., had an SFI \( \geq 39.0 \)), and the possible English derivations were of such low frequency they did not appear in the book at all. The calculation of SFI is based on a base-10 logarithm, with an SFI of 90 equating to an occurrence of approximately one time per 10 words, and an SFI of 80 equating to approximately once per 100 words, with the pattern continuing down to an SFI of 10 equating to approximately once per billion words (Breland, 1996). See Appendix D for examples of task items.

**Measure of General Syntactic Ability**

To obtain information about each child's general syntactic ability, a standardized measure of syntax, the *Test for Reception of Grammar-2* (TROG-2; Bishop, 2003) was administered individually. The TROG-2 required children to choose the one picture, from a set of four, that matched a sentence (e.g., *The girl is sitting*) spoken by the examiner. The TROG-2 was reportedly standardized with 894 individuals, ages 4;0 to 85;11 from the United Kingdom and 146 children, ages 6 to 12, from Australia from a range of social classes. With regard to reliability, the TROG-2 reports an internal consistency correlation of 0.877 and a correlation of parallel forms of 0.741 for raw scores and 0.707 for scaled scores.
Measure of Incidental Word Learning

The materials for the experimental incidental word learning measure (IWL) were modified from the Derivational Acquisition in Context Evaluation (DAICE) used in Marinellie and Kneile (2012). The following includes a description of the stimulus words, reading passages, the partial word knowledge multiple-choice question, and the comprehension questions.

**Stimulus words.** The IWL measure contained a total of 12 derived words, along with their base forms (see Table 1 for the list of the derived words with their base forms). A total of 11 (of 12) base words were two syllables in length, and a total of 9 (of 12) derived words were three syllables in length. The suffixes of the derived words are considered to be high productive suffixes (Marinellie & Kneile, 2012; Windsor, 1994), neutral (Champion, 1997), and occur frequently per data collected by Becker, Dixon, and Anderson-Inman (1980). All base and derived words had an SFI of less than 38.0 or were so rare as to not appear in the Carroll et al. (1971) corpus. Stimulus words also included a total of 6 monomorphemic words, each having two syllables: abstruse, allay, foment, largess, plaudits, torpid. Similar to the derived words, each monomorphemic word had an SFI of less than 38.0 or were so rare as to not appear in the Carroll et al. (1971) corpus.
Table 1

*Suffixes, Base Words, and Derived Words in the Incidental Word Learning Measure*

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Base words</th>
<th>Derived words</th>
</tr>
</thead>
<tbody>
<tr>
<td>-able</td>
<td>perdure, succor</td>
<td>perdurable, succorable</td>
</tr>
<tr>
<td>-ence</td>
<td>abscond, advert</td>
<td>abscondence, advertence</td>
</tr>
<tr>
<td>-ful</td>
<td>rebuke, vaunt</td>
<td>rebukeful, vauntful</td>
</tr>
<tr>
<td>-ment</td>
<td>efface, regale</td>
<td>effacement, regalement</td>
</tr>
<tr>
<td>-ness</td>
<td>contrite, hirsute</td>
<td>contriteness, hirsuteness</td>
</tr>
<tr>
<td>-ous</td>
<td>dolor, sapor</td>
<td>dolorous, saporous</td>
</tr>
</tbody>
</table>

To further ensure that the words chosen for the stories were likely to be unfamiliar to students in grade 5, the words were pretested for familiarity with 33 undergraduate college students. The college students were given a written list including the base words (for each derived word) and the monomorphemic words. They were asked to read the list themselves and rate their familiarity with each word on the list by indicating if they knew the word (i.e., "Yes, I know this word. It means . . . "), if they thought the word was familiar (i.e., "It looks a little familiar. I think it means . . . "), or if they did not know the word (i.e., "No, I don't know this word"). If the college students knew the word or thought it was familiar, they were asked to provide a written definition of the word. The most familiar word to the college students, with 9.1% of the students indicating accurate knowledge of the word's meaning, was the word *rebuke*. As the words were largely unknown to this group, they were likely to have also been unfamiliar to the children who participated in the present study.
**Reading passages.** The IWL measure in the present study consisted of a series of reading passages, or short stories, written by the principal investigator. There were 18 stories to account for the 12 derived words and 6 base words being assessed. The stories were ordered so that two stories containing derived words were followed by one story containing a monomorphemic word. Each passage was between 100-123 words ($M = 110$ words; $SD = 7.64$ words) in length and was calculated by the Flesch-Kincaid readability formula built into Microsoft Word to be within the grade level range of 3.4 - 4.4 ($M = 4.0; SD = 0.34$) which was below the grade level of the participating children. The words in the reading passages (with the exception of the stimulus words) were high frequency and familiar to the students so as not to impede the children’s overall comprehension of the passage (Gardner, 2004).

Each of 12 stories included one instance of a base word and one instance of its derived form. Each suffix was used in two different passages. Each of the derived words appeared once within a short reading passage and were preceded by the base word, also used once within the passage. Previous studies (Nagy et al., 1985) have found that children can gain word meaning knowledge from context after a single exposure, thus supporting the number of times each stimulus word appeared in the passages of the present study. One instance of informative context was provided between the base word and the derived word. The informative context was similar to the context provided in Carnine et al. (1984) in the inference condition, meaning that there was a phrase or sentence which provided opportunity for the child to gain semantic information about the stimulus word. As in the reading passages of the *DAICE* (Marinellie & Kneile, 2012), the
amount of information supporting the stimulus word's meaning was controlled across passages and did not contain explicit word meaning explanations, synonyms, or antonyms of the stimulus word.

The remaining six stories (of the total 18 stories) contained the monomorphemic words. As these words could not be preceded by a base form (like the derived words), the same word appeared twice within each passage. The informative context provided in these passages was provided in the same way as for the passages containing the derived words with the exception of the informative context appearing between the 2 occurrences of the monomorphemic words instead of between the base word and derived word.

**Partial word knowledge multiple-choice item.** Similar to the DAICE (Marinellie and Kneile, 2012), following each reading passage was a multiple-choice item which measured partial word knowledge, in the form of semantic and syntactic knowledge, gained about the stimulus word in each passage. The measurement of semantic and syntactic aspects of word knowledge in the present study encompassed three of the five aspects of word knowledge measured in Wagovich and Newhoff (2004): syntactic knowledge, general semantic knowledge, and detailed semantic knowledge. In the present study, the children were asked to determine in which of four given sentences the stimulus word was best used. The four options represented different combinations of knowledge about the word that was gained: (a) both semantic and syntactic knowledge gained (+semantic/+ syntactic), (b) semantic but not syntactic knowledge gained (+semantic/-syntactic), (c) syntactic but not semantic knowledge gained (-semantic/+syntactic), and (d) neither semantic nor syntactic knowledge gained (-
semantic/-syntactic). The sentences representing these combinations of word knowledge were presented in random order as a multiple-choice item. Children were asked to determine the best use of the stimulus word within a given sentence, as opposed to a definition of the word. Following the reasoning of Nagy et al. (1993), it is unlikely that children in grade 5 understand the contribution of a suffix in a formal definition found in dictionaries (such as "the state of" for the suffix -ness).

Following each story (but prior to the partial word knowledge multiple-choice item described above) were questions designed to assess the children's general comprehension of the content of the passage. These questions were also in multiple-choice format (see Appendix E). Similar to Marinellie and Kneile (2012), the comprehension-based questions were not scored, but used to ensure that the children were attending to the content of the passages. Thus, performance on these items was only used to exclude a child from the present study in cases in which the child did not adequately answer a sufficient number of the questions (i.e., answered fewer than 33 of 36 questions correctly) and was not otherwise used in the analyses.

**Scoring**

There were 5 measures that were scored for purposes of the analyses: each of the derivational knowledge measures (relational, syntactic, distributional), the measure of general syntactic ability (i.e., TROG-2), and the partial word knowledge item of the IWL measure. The three derivational knowledge measures were scored in the same manner. One point was assigned for each item answered correctly and no points were given if answered incorrectly. Each measure contained 20 items with a possible range of scores
from 0 to 20. The standardized assessment of general syntactic abilities (i.e., TROG-2) was scored in accordance with the publisher's guidelines and a standard score was calculated.

The scoring for the IWL measure focused on children’s answers to the partial word knowledge multiple-choice item. This item pertained to the measurement of semantic and syntactic knowledge gained about a stimulus word. Responses to these items were scored as 0, 1, or 2 points depending on the knowledge gained: 2 points for semantic and syntactic knowledge gained, 1 point for either semantic or syntactic knowledge gained, and 0 points for no semantic or syntactic knowledge gained. This is referred to as *standard scoring* in Table 2. For some analyses, a separate semantic score and a separate syntactic score were determined. As shown in Table 2, for the semantic score, if either response that demonstrated gained semantic knowledge of the stimulus word was selected (i.e., selection of the +semantic/+syntactic sentence or the +semantic/-syntactic sentence), 1 point was awarded. A separate syntactic score was calculated in the same manner as the semantic score with response items that were +semantic/+syntactic and -semantic/+syntactic being considered evidence of gained syntactic knowledge.

Hereafter, these scores will be referred to as the *semantic score* and the *syntactic score*. Finally, a semantic-only and a syntactic-only score was determined as shown in Table 2, and will be referred to as the *semantic-only* or *syntactic-only score*, respectively.
Table 2

<table>
<thead>
<tr>
<th>Multiple-choice option</th>
<th>Standard scoring</th>
<th>Semantic score</th>
<th>Syntactic score</th>
<th>Semantic-only score</th>
<th>Syntactic-only score</th>
</tr>
</thead>
<tbody>
<tr>
<td>+semantic/+syntactic</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>+semantic/-syntactic</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>-semantic/+syntactic</td>
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<td>1</td>
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<td>-semantic/-syntactic</td>
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</tbody>
</table>

The point range for the IWL measure was from 0 to 36 points with a maximum possible score of 24 points for derived word items (12 items x 2 points each) and 12 points for monomorphemic words items (6 items x 2 points each). For the derived word items and the monomorphemic word items, the semantic or syntactic score range was 0-12 points (12 items x 1 point each) and 0-6 points (6 items x 1 point each), respectively.

Procedure

The TROG-2 and the Receptive Language index of the CELF-4 were given individually to students. Six assistants who were undergraduate students with a background in communication sciences and disorders assisted with administering these measures. Training for the administration of the CELF-4 and TROG-2 included a meeting whereby the principal investigator provided verbal instructions and a demonstration of the administration and scoring of each measure. Prior to administering the measures to the children, the assistants were given written directions to review and
they practiced administering the measures. The principal investigator supervised the
administration of the measures by the assistants and was within visual view of the
assistants at all times so as to be available for consultation about any item during the
administration. The assistants made written record of the child's response and
determination of credit as each item was administered (e.g., circling 1 or 0 if the child
said the correct pair of words or not for the Word Classes 1-Receptive subtest of the
CELF-4 or writing the number (1, 2, 3, or 4) of the picture identified by the child for the
TROG-2), but the principal investigator performed all the calculations in determining the
final score for the measures. The assistants administered 12.6% of these measures (11.1%
of the CELF-4 measure; 14.1% of the TROG-2 measure) for the present study.

The principal investigator administered all the measures of derivational
morphology (relational, syntactic, and distributional) and the IWL measure. These
measures were given to groups of children in a classroom setting. Children in the group
setting were provided with identical task booklets, and all students completed the tasks in
the booklets in the same order: relational knowledge measure, syntactic knowledge
measure, distributional knowledge measure, IWL measure. The children were asked to
follow along with the written instructions for each measure as they were read aloud by
the examiner. Sample items for each measure were completed together as a group to
confirm understanding of the measures before the children were directed to work
individually. All items of the measures of derivational morphological knowledge and the
IWL measure were presented via prerecorded audio of the text being read by the principal
investigator while the children read the same items in their test booklets. It took
approximately 15 minutes to complete the measures of derivational knowledge and about 30 minutes to complete the IWL measure.

**Design and Analysis**

In the present study, the main variables of interest included: (a) the children's performance on the three measures of derivational knowledge, relational (REL), syntactic (SYN), and distributional (DIST); (b) the standardized measure of general syntactic abilities (GEN SYN); and (c) the children's performance on the IWL measure (IWL).

Preliminary analyses were conducted to determine the distribution, central tendency, and dispersion of the scores for each of the measures.

To answer the first research question with regard to the extent that semantic and syntactic knowledge of the stimulus words was gained, the analyses centered on the children's performance on the IWL measure. Means and standard deviations for the selected sentence type of the partial word knowledge item (i.e., +semantic/+syntactic, +semantic/-syntactic, -semantic/+syntactic, -semantic/-syntactic) were calculated. To compare the semantic or syntactic knowledge gained, the semantic score and syntactic score were used and a coefficient of correlation between these two scores was calculated.

The primary goal of the second research question was to determine which of the morphological knowledge measures (REL, SYN, DIST), if any, accounted for unique variance in IWL abilities. For these analyses, the three continuous predictor (or independent) variables were REL, SYN, and DIST. First, to determine the type and strength of the relationship between each of the morphological knowledge measures and the IWL measure performance, coefficients of correlation were calculated between IWL
and REL, SYN, and DIST. Additional coefficients of correlation were calculated between each of the morphological skills: REL and SYN, REL and DIST, SYN and DIST. To gain information about the unique variance accounted for by each of these three predictor variables in predicting IWL performance, hierarchical linear regression was used. Given the expected significant correlations, the variables were entered into models one at a time with the order of the variables based on the expected moderate positive relationships between REL and SYN with IWL and the developmental order of REL, SYN, and DIST.

Lastly, the third research question pertained to how children's general syntactic ability related to, and predicted, their performance on an IWL measure. To do this, a coefficient of correlation was calculated between GEN SYN and IWL. Additionally, GEN SYN was added to the last model of the regression analysis to determine the impact children's relational, syntactic, and distributional knowledge had on IWL performance in the presence of their general syntactic abilities.
Chapter 4: Results

Reliability

Inter-rater reliability and internal consistency were determined in the same way for the measures of morphological knowledge and the IWL measure. Inter-rater reliability was calculated by having a trained assistant score 10% of randomly selected data from each measure. There was 99.6% agreement between the trained assistant and the examiner, and the data were corrected as needed. A Cronbach alpha coefficient was used to determine internal consistency of each of the morphological knowledge measures and the IWL measure. The Cronbach alpha coefficient for the relational, syntactic, and distributional knowledge measures was 0.53, 0.72, and 0.02, respectively. For the IWL measure, the Cronbach alpha coefficient was 0.47 for the whole measure, 0.26 for only the derived word items, and 0.37 for the monomorphemic word items.

Measures of Derivational and General Syntactic Knowledge

Descriptive statistics for the performance on measures of derivational knowledge and general syntactic knowledge are provided in Table 3. For the three measures of derivational morphology knowledge (relational, syntactic, distributional), a repeated measures ANOVA determined that the children’s performance on each of the three tests was significantly different, $F (2, 196) = 131.43, p < 0.01, \eta^2_p = 0.77$. The effect size, measured by partial eta squared ($\eta^2_p$), was large as characterized using Cohen’s (1988) criteria (small = 0.01-0.05; medium = 0.06 -0.13; large > 0.13).

The relational knowledge measure consisted of 10 transparent and 10 opaque word pairs. Subscores of the transparent and opaque items were calculated and compared
using a paired samples t-test. Results showed that mean performance was significantly higher for the transparent word pairs ($M = 9.47, SD = 0.77$) than the opaque word pairs ($M = 7.55, SD = 1.42$), $t(98) = 14.70, p < 0.01, d = 1.68$. The effect size, measured by Cohen's $d$, was large, per Cohen's (1988) criteria (small = 0.2; medium = 0.5; large > 0.8).

Table 3

**Measures of Morphological Knowledge and General Syntax: Means, Standard Deviations, and Ranges**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relational knowledge</td>
<td>17.03</td>
<td>1.88</td>
<td>11-20</td>
</tr>
<tr>
<td>Syntactic knowledge</td>
<td>11.87</td>
<td>3.85</td>
<td>3-20</td>
</tr>
<tr>
<td>Distributional knowledge</td>
<td>14.38</td>
<td>1.77</td>
<td>9-18</td>
</tr>
<tr>
<td>TROG-2</td>
<td>98.09</td>
<td>10.05</td>
<td>65-116</td>
</tr>
</tbody>
</table>

*Note. TROG-2 = Test for Reception of Grammar-2.*

**Measure of Incidental Word Learning (IWL)**

In the IWL measure, the selection of one of the four sentence types containing the stimulus word—either the derived word or the monomorphemic word—indicated the semantic and syntactic knowledge gained by the children. Table 4 shows the means for
the frequency each sentence type was chosen (disregarding the 0, 1, 2 point standard scoring) for each sentence type chosen.

Table 4

IWL Measure: Selection of Sentence Type, Mean (Standard Deviation)

<table>
<thead>
<tr>
<th>IWL Measure</th>
<th>+ Semantic/+ Syntactic</th>
<th>+ Semantic/- Syntactic</th>
<th>- Semantic/+ Syntactic</th>
<th>- Semantic/- Syntactic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total measure (18 items)</td>
<td>8.74 (2.59)</td>
<td>5.25 (2.08)</td>
<td>2.48 (1.45)</td>
<td>1.53 (1.35)</td>
</tr>
<tr>
<td>Derived words (12 items)</td>
<td>5.31 (1.75)</td>
<td>3.92 (1.63)</td>
<td>2.05 (1.26)</td>
<td>0.73 (0.94)</td>
</tr>
<tr>
<td>Monomorphemic words (six items)</td>
<td>3.42 (1.37)</td>
<td>1.33 (0.99)</td>
<td>0.44 (0.67)</td>
<td>0.80 (0.85)</td>
</tr>
</tbody>
</table>

*Note.* IWL = Incidental Word Learning.

The total IWL measure contained 18 items with a possible score of 36 points (2 points maximum per item). Twelve items contained derived words and six items contained only monomorphemic words. Thus, the total possible score for only the derived word items of the IWL measure was 24, and the total possible score for only the monomorphemic word items was 12. For comparison purposes between the derived word items and the monomorphemic word items, six of the 12 items containing the derived words were selected (i.e., every other derived word item was selected) to account for the difference in total number of items for each; these items are listed as "Derived words (six items)" in Table 5. The means, standard deviations, and ranges of the total IWL measure,
the separated six derived word items, and the monomorphemic items are depicted in Table 5. Also, this table displays the semantic and syntactic scores (please refer to Table 2 for a summary of the determination of these scores).

Table 5

*IWL Measure: Means, Standard Deviations, and Ranges*

<table>
<thead>
<tr>
<th>IWL measure</th>
<th>Maximum score</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Measure (18 items)</td>
<td>36</td>
<td>25.21</td>
<td>3.43</td>
<td>14-34</td>
</tr>
<tr>
<td>Derived Words (12 items)</td>
<td>24</td>
<td>16.60</td>
<td>2.24</td>
<td>10-23</td>
</tr>
<tr>
<td>Derived words (semantic score)</td>
<td>12</td>
<td>9.23</td>
<td>1.57</td>
<td>6-12</td>
</tr>
<tr>
<td>Derived words (syntactic score)</td>
<td>12</td>
<td>7.36</td>
<td>1.69</td>
<td>3-12</td>
</tr>
<tr>
<td>Derived words (6 items)</td>
<td>12</td>
<td>7.88</td>
<td>1.55</td>
<td>4-12</td>
</tr>
<tr>
<td>Six items: Derived words (semantic score)</td>
<td>6</td>
<td>4.26</td>
<td>1.22</td>
<td>0-6</td>
</tr>
<tr>
<td>Six items: Derived words (syntactic score)</td>
<td>6</td>
<td>3.62</td>
<td>1.16</td>
<td>1-6</td>
</tr>
<tr>
<td>Monomorphemic words (6 items)</td>
<td>12</td>
<td>8.63</td>
<td>1.98</td>
<td>2-12</td>
</tr>
<tr>
<td>Monomorphemic words (semantic score)</td>
<td>6</td>
<td>4.76</td>
<td>1.06</td>
<td>1-6</td>
</tr>
<tr>
<td>Monomorphemic words (syntactic score)</td>
<td>6</td>
<td>3.87</td>
<td>1.28</td>
<td>0-6</td>
</tr>
</tbody>
</table>

*Note.* IWL = Incidental Word Learning.
Pearson correlation analyses were used to determine the relationships between the semantic and syntactic scores of the partial word knowledge items for the derived words, indicating semantic and syntactic knowledge gained. The first analysis using the semantic ($M = 9.23, SD = 1.57$) and syntactic ($M = 7.36, SD = 1.69$) scores showed that there was not a significant relationship between semantic and syntactic knowledge gained for derived words ($r = -0.06, p = 0.56$).

To better isolate either semantic and syntactic knowledge gained, another analysis was conducted which counted responses that indicated gained semantic-only or syntactic-only knowledge, but not both. These are the semantic-only and syntactic-only scores summarized in Table 2. When the semantic-only ($M = 3.92, SD = 1.63$) and syntactic-only ($M = 2.05, SD = 1.26$) scores were compared using a Pearson correlation analysis, there was a significant moderate negative relationship ($r = -0.34, p < 0.01$).

Several analyses were conducted to provide further insight into differences in performance between derived word items of the IWL and the monomorphemic word items, especially with regard to gains in syntactic knowledge. As previously mentioned, the scores from half of the derived word items were used to make the comparisons with the data from the monomorphemic word items because there were twice as many derived word items as monomorphemic word items in the IWL measure. Paired-samples $t$-tests were used to compare the derived word items and the monomorphemic word items on their overall scores, the semantic scores, and the syntactic scores. The overall performance on the derived and monomorphemic word items was significantly different, $t(98) = -3.16, p < 0.01, d = 0.42$ (small effect size) with performance on the
monomorphemic word items \(M = 8.63, SD = 1.98\) significantly higher than the derived word items \(M = 7.88, SD = 1.55\). When the subscores of semantic and syntactic knowledge gained were compared, it was found that the semantic score for the monomorphemic words \(M = 4.76, SD = 1.06\) was significantly greater, \(t(98) = -3.07, p < 0.01, d = 0.67\) (medium effect size), than the semantic score for the derived words \(M = 4.26, SD = 1.22\); however, the syntactic score for the monomorphemic words \(M = 3.87, SD = 1.28\) was not significantly different from the syntactic score for the derived words \(M = 3.62, SD = 1.16\), \(t(98) = -1.60, p = 0.11\). Again, to isolate the syntactic performance on the items, an additional comparison was made between the syntactic-only scores of the derived words and the monomorphemic words. In this case, there was a statistically significant difference, \(t(98) = 6.60, p < 0.01, d = 0.95\) (large effect size), and this was the only comparison in which the derived word items had a higher mean \(M = 1.30, SD = 1.09\) than the monomorphemic word items \(M = 0.44, SD = 0.67\).

**Correlation and Regression Analyses**

Table 6 shows the Pearson correlations between each of the four predictor variables (relational, syntactic, and distributional knowledge and general syntactic knowledge) and the dependent variable (performance on the IWL measure). With regard to the derived word items of the IWL and the predictor variables, there was a significant positive relationship between each of the variables with the exception of there being no significant relationship between distributional knowledge and the derived word items of the IWL measure. With regard to the monomorphemic word items of the IWL and the predictor variables, there was a significant positive relationship between each of the
variables with the exception of there being no significant relationship between general syntactic knowledge and the monomorphemic word items of the IWL measure. Cohen's (1988) guidelines were used to interpret effect size for correlation based on the benchmarks for $r$ with 0.10 indicating a weak relationship, 0.30 indicating a moderate relationship, and 0.50 and greater indicating a strong relationship. With regard to relational knowledge, there was a moderate-to-strong relationship between both relational and syntactic knowledge, $r = 0.49, p < 0.01$, and relational knowledge and performance on the derived word items of the IWL measure, $r = 0.34, p < 0.0$, and a weak-to-moderate relationship between relational and distributional knowledge, $r = 0.24, p < 0.05$, relational and general syntactic knowledge, $r = 0.28, p < 0.01$, and relational knowledge and the monomorphemic word items of the IWL measure, $r = 0.25, p < 0.05$. With regard to syntactic knowledge, there was a moderate-to-strong relationship between syntactic knowledge and distributional knowledge, $r = 0.31, p < 0.01$, syntactic knowledge and general syntactic knowledge, $r = 0.48, p < 0.01$, and syntactic knowledge and performance on the derived word items of the IWL measure, $r = 0.36, p < 0.01$, and a weak-to-moderate relationship between syntactic knowledge and performance on the monomorphemic word items of the IWL measure, $r = 0.25, p < 0.05$. Distributional knowledge had a weak-to-moderate relationship to general syntactic knowledge, $r = 0.27, p < 0.01$, and to performance on the monomorphemic word items of the IWL measure, $r = 0.20, p < 0.05$, and a nonsignificant relationship to performance on the derived word items of the IWL measure, $r = 0.17, p = 0.10$. General syntactic knowledge had a weak-to-moderate relationship to performance on the derived word items of the IWL measure, $r$
= 0.23, \( p < 0.05 \), and a nonsignificant relationship to performance on the monomorphemic word items of the IWL measure, \( r = 0.17, p = 0.09 \). There was a moderate-to-strong relationship between performance on the derived word items and monomorphemic word items of the IWL measure, \( r = 0.32, p < 0.01 \).

Table 6

*Correlations Between Variables*

<table>
<thead>
<tr>
<th></th>
<th>REL</th>
<th>SYN</th>
<th>DIST</th>
<th>GEN SYN</th>
<th>IWL: Derived words</th>
<th>IWL: Monomorphemic words</th>
</tr>
</thead>
<tbody>
<tr>
<td>REL</td>
<td>--</td>
<td>0.49**</td>
<td>0.24*</td>
<td>0.28**</td>
<td>0.34**</td>
<td>0.25*</td>
</tr>
<tr>
<td>SYN</td>
<td>--</td>
<td>0.31**</td>
<td>0.48**</td>
<td>0.36**</td>
<td>0.25*</td>
<td></td>
</tr>
<tr>
<td>DIST</td>
<td>--</td>
<td>0.27**</td>
<td>0.17</td>
<td>0.20*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEN SYN</td>
<td>--</td>
<td></td>
<td></td>
<td>0.23*</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>IWL: Derived words</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td>0.32**</td>
<td></td>
</tr>
<tr>
<td>IWL: Monomorphemic words</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>--</td>
</tr>
</tbody>
</table>

**\( p < 0.01 \); *\( p < 0.05 \).

*Note.* REL = relational knowledge; SYN = syntactic knowledge; DIST = distributional knowledge; GEN SYN = general syntactic knowledge; IWL = Incidental word learning measure.

A hierarchical linear regression analysis was conducted to investigate the effects of the predictor variables of relational knowledge, syntactic knowledge, and general syntactic knowledge on performance of the derived word items of the IWL measure (see
Table 7). As there was no significant relationship between distributional knowledge and the IWL measure, distributional knowledge was not entered as a variable to any of the models. Effect size ($f^2$) was calculated as $f^2 = \Delta R^2/(1-R^2)$ and Cohen's (1988) guidelines were used to interpret effect size (small = 0.02; medium = 0.15; large = 0.35). The first model contained only relational knowledge as a variable, and this accounted for a significant amount of variance in the IWL measure ($F(1, 97) = 12.77, p < 0.01$) with a medium effect size. The second model contained relational and syntactic knowledge, and this also accounted for a significant amount of variance in the IWL measure ($F(1, 96) = 9.38, p < 0.05$) with a small effect size. Overall, Model 2, containing relational and syntactic knowledge, explained 16% of the variance in the IWL measure. After controlling for relational knowledge, syntactic knowledge contributed a unique variance of 5% to the IWL measure ($\beta = 0.25, p < 0.05$). In the third model, with the addition of general syntactic knowledge, there was not a significant increase in explained variance as general syntactic knowledge did not contribute to performance on the IWL measure beyond relational and syntactic knowledge as expected ($F(1, 95) = 6.31, p = 0.58$).
Table 7

*Summary of Hierarchical Linear Regression Analysis*

<table>
<thead>
<tr>
<th>Variable</th>
<th>$B$</th>
<th>$SE$ $B$</th>
<th>$\beta$</th>
<th>$p$ value</th>
<th>$f^2$</th>
<th>$F$</th>
<th>$\Delta F$</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.19</td>
<td>12.77</td>
<td>12.77**</td>
<td>0.12</td>
</tr>
<tr>
<td>REL</td>
<td>0.41</td>
<td>0.11</td>
<td>0.34</td>
<td>$&lt; 0.01$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.06</td>
<td>9.38</td>
<td>5.40*</td>
<td>0.16</td>
</tr>
<tr>
<td>REL</td>
<td>0.26</td>
<td>0.13</td>
<td>0.22</td>
<td>$&lt; 0.05$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYN</td>
<td>0.14</td>
<td>0.06</td>
<td>0.25</td>
<td>$&lt; 0.05$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
<td>6.31</td>
<td>0.18</td>
<td>0.17</td>
</tr>
<tr>
<td>REL</td>
<td>0.26</td>
<td>0.13</td>
<td>0.22</td>
<td>$&lt; 0.05$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYN</td>
<td>0.13</td>
<td>0.07</td>
<td>0.22</td>
<td>$= 0.06$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEN SYN</td>
<td>0.01</td>
<td>0.02</td>
<td>0.06</td>
<td>$= 0.58$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**p $< 0.01$; *p $< 0.05$.

*Note.* REL = relational knowledge; SYN = syntactic knowledge; GEN SYN = general syntactic knowledge.
Chapter 5: Discussion

The present study investigated children's acquisition of semantic and syntactic knowledge during incidental derived word learning and expanded on a previous study (Marinellie & Kneile, 2012). Specifically, the present study examined how children in grade 5 perform on three measures of morphological knowledge and relate to, and predict, incidental derived word learning. The contribution of the children's general syntactic abilities to derived word learning was also examined. The main findings corroborated previous literature in that morphological knowledge was found to be in a period of development for children in grade 5 (Anglin, 1993; Nagy et al., 2006; Nippold, 2007). Furthermore, the children in this study were able to acquire semantic and syntactic information about unfamiliar words presented in context (Nagy et al., 1987; Wagovich & Newhoff, 2004). With respect to the relationship between morphological knowledge and general syntactic knowledge to incidental derived word learning, all were found to have a significant relationship with incidental derived word learning with the exception of distributional knowledge.

Morphological Knowledge of Children in Grade 5

Prior to completing the IWL measure, the children were given three morphological knowledge tasks, each designed to measure a different component of morphological knowledge as outlined by Tyler and Nagy (1989). The children exhibited the highest performance on the relational knowledge measure and the lowest performance on the syntactic knowledge measure. The performance on the relational knowledge measure was unsurprising as relational knowledge is considered to be an earlier acquired
morphological skill (Carlisle & Fleming, 2003; Tyler & Nagy, 1989). The results of the comparison between opaque and transparent items in the relational measure were also in line with previous literature that often reports that opaque derivations are more difficult for children (Carlisle, 2000; Tyler & Nagy, 1989). The relational knowledge measure had the highest overall performance of the morphological knowledge measures despite being the only measure that contained opaque derivations. It appears that while the opaque items were more difficult, they were not so challenging that overall task performance was affected. This is evident by the relatively high mean for these items (i.e., the children, on average, correctly answered about 75% of the opaque items), which is higher than performance on either of the other two morphological knowledge measures (syntactic, distributional).

Distributional knowledge is reported to be a later developing skill than syntactic knowledge (Tyler & Nagy, 1989), but the children did not perform as well on the syntactic knowledge measure as the distributional knowledge measure. It may be that the nonce words used as the base form of the derived words in the syntactic knowledge measure caused the children to perceive this measure as more difficult. The nonce word items used in several studies measuring syntactic knowledge (Champion, 1997; Singson et al., 2000; Tyler & Nagy, 1989) were more difficult for the children than the real word items.

The Cronbach alpha coefficient for the distributional knowledge measure was very low; however, this could be the result of several factors rather than being a poor reflection on the internal consistency of the measure. One factor could be that the
coefficient reflects the specific population (the children in grade 5) rather than the measure itself. The coefficient could be a result of the difficult nature of the task as distributional knowledge is still developing in children of the age of those in the present study. Also, the nature of the task itself, such as having only 20 items and results based on a yes/no response, could contribute to the low value.

In summary, the children's performance on the three morphological knowledge tasks (relational, syntactic, distributional) reflected findings of previous research, mainly that relational knowledge is an earlier developing skill compared to syntactic and distributional knowledge (Berninger et al., 2010; McCutchen et al., 2008; Nippold & Sun, 2008; Singson et al., 2000; Tyler & Nagy, 1989).

**Incidental Derived Word Learning in Children in Grade 5**

The first research question pertained to the extent to which children in grade 5 exhibited semantic and syntactic knowledge of derived words in an incidental word learning condition. The partial word knowledge items of the IWL measure were designed to be sensitive enough to capture partial word knowledge gained with respect to the semantic and syntactic domains of a target word. The sentence type selected by the child—the sentence with correct semantic and syntactic use of the target word (+semantic/+syntactic), the sentence with either correct semantic (+semantic/-syntactic) or syntactic (-semantic/+syntactic) use of the target word, or the sentence with incorrect use of both (-semantic/-syntactic)—indicated the degree of partial knowledge gained (see Table 4).
The children in the present study demonstrated the ability to gain semantic and syntactic word knowledge in incidental word learning contexts supporting previous literature that children gain word knowledge during incidental encounters (Jenkins et al., 1984; Marinellie & Kneile, 2012; Nagy et al., 1987; Sternberg, 1987; Swanborn & de Glopper, 1999). In contrast with the results of Wagovich and Newhoff (2004) where there were not significant syntactic or semantic knowledge gains for the experimental words in the incidental word learning situation, the results of the present study demonstrated knowledge in both those areas. Given the results of the frequency with which individual sentence options were chosen (see Table 4), the results showed that children selected the sentence that used the target word correctly both semantically and syntactically (+semantic/+syntactic) most often. This indicates that the children were able to gain both semantic and syntactic knowledge notably after just one encounter with a base word and the related derived word.

The next most frequently chosen responses were the sentence types that used the target word correctly with regard to its semantic domain (+semantic/-syntactic) followed by the sentences that used the word correctly with regard to the syntactic domain (-semantic/+syntactic). When these two scores (i.e., the semantic-only score and the syntactic-only score) were compared with a correlation analysis, there was a significant negative relationship. The negative relationship is due to the nature of the semantic and syntactic aspects of words which are nonoverlapping. It was also found that children had significantly lower syntactic-only scores. This is interesting because the suffixes chosen for the target words in the present study were those that are considered the most
frequently encountered. As a primary function of derivational suffixes is to alter the syntactic category of the base word, it was expected that children in grade 5 would recognize the syntactic property of the suffix and, as a result, choose that option (i.e., syntactic-only) at least as frequently as the semantic-only sentences; however, that was not the case. This may indicate that the children are better able to gain semantic knowledge of derived words than syntactic knowledge despite what should be an advantage to gaining syntactic knowledge because of the familiar suffix.

Given only this information, it appeared that the children in the present study had difficulty with capitalizing on the syntactic contribution of the suffixes as was also noted by Tyler and Nagy (1990) and Nagy et al. (1993); however, in the absence of gaining semantic knowledge, the children in the present study used their knowledge about the syntactic contribution of familiar suffixes to aid comprehension. When the selection of the syntactic-only sentences (-semantic/+syntactic) between derived words and monomorphemic words was examined, the children were more likely to select this sentence type (i.e., -semantic/+syntactic) for derived words than for monomorphemic words (see Table 4). Furthermore, when the frequency that the children selected the syntactic-only sentence is compared with the frequency that they selected the -semantic/-syntactic sentence (i.e., the sentence in which semantic and syntactic were both incorrect), it suggests that the suffixes gave the children a syntactic advantage over the monomorphemic words. For derived word items, children selected the sentence in which the word was used correctly syntactically more often than the sentence in which the derived word was not used correctly semantically or syntactically, but it was the reverse
situation for monomorphemic word items. In summary, semantic knowledge appears to be more salient for the children than syntactic knowledge, but in the absence of being able to gain semantic knowledge, children use the syntactic information provided by the suffixes to apply word knowledge.

The Relations and Contributions of Morphological Knowledge and General Syntactic Knowledge to Incidental Derived Word Learning

The second and third research questions were comparable in that both aimed to gain insight into the relationship of performance on morphological knowledge measures (relational, syntactic, and distributional knowledge) and on a general syntactic knowledge measure to incidental derived word learning. Based on the presence of significant correlations, the regression analysis included three models (1 = relational knowledge; 2 = relational and syntactic knowledge; 3 = relational, syntactic, and general syntactic knowledge). Results indicated that relational and syntactic knowledge explained unique variance in performance on the IWL task.

As the stories in IWL measure were constructed to include an occurrence of the base form prior to the derived word, the children likely recognized the base word in the derived word and took advantage of this to acquire knowledge of the unfamiliar derived word; this would be utilizing relational knowledge. These findings corroborate those of Marinellie and Kneile (2012) who found a significant relationship between a relational knowledge measure and the derived nominals presented in a similar incidental word learning context.
The findings of the present study also highlight the importance of syntactic knowledge in learning new and unfamiliar words in context. The children appeared to use knowledge of the syntactic contribution of the suffixes to demonstrate word knowledge, especially when semantic knowledge was lacking. Thus, this study has added to the literature pertaining to syntactic bootstrapping, that is, children’s ability to use syntactic cues to aid word learning (Gertner et al., 2006; Jaswal & Markman, 2001; Naigles, 1990).

Interestingly, there was no significant correlation between performance on the distributional knowledge and IWL measures. Distributional knowledge most directly applies to contexts where an individual needs to produce a new derived form or make judgments pertaining to the permissibility of novel derived words. Our original hypothesis predicted only a weak relationship because the IWL measure did not require the children to form new derived words or encounter impermissible base and suffix combinations. It was thought, however, that if a child had a deeper understanding of the distributional properties of the suffixes used in the present study, it would lead to increased word knowledge through morphological analysis. It is possible that either distributional knowledge is an unnecessary skill or that children were not using morphological analysis beyond syntactic knowledge of suffixes for gaining semantic or syntactic word knowledge of newly encountered derived words.

The general syntax measure used in the present study (i.e., TROG-2) primarily pertained to comprehension of overall sentence structure and inflectional morphemes. A significant relationship between general syntactic knowledge and the IWL measure was found. Thus, it appears the children gained derived word knowledge from utilizing the
larger syntactic structure of the sentence. However, when the measure of general syntax was added to the regression model containing syntactic knowledge, there was no additional predictive contribution to IWL performance. It may be that the general measure of syntax was not sensitive enough to measure the children's ability to detect the syntactic category of a particular word better than that of the syntactic knowledge measure or that the child's use of general syntactic knowledge is not as essential as syntactic knowledge in gaining derived word knowledge.

**Theoretical Implications**

The findings of the present study are in line with the linguistic knowledge models of incidental word learning. These models posit that children apply their prior linguistic knowledge to novel word learning situations. The data from the present study showed that children are able to use linguistic context to acquire semantic and syntactic information of unfamiliar words. Additionally, the children used existing knowledge of familiar suffixes to apply word knowledge of unfamiliar derived words containing those suffixes. The shape bias principle describes how young children are able to extend a label for a previously unnamed object (e.g., the word *car* for a red toy car in a toy chest) to other items that are shaped similarly but are in different contexts (e.g., using the label *car* for a blue car seen moving down the road) (Smith, 2000). School-age children in the present study demonstrated that they are able to extend a previously unfamiliar word to new linguistic contexts. After reading stories that contained unfamiliar target words, the children were able to demonstrate the ability to select which of four sentence types used the target word when it was presented in a new linguistic context. Unlike with the shape
bias principle which applies to objects, and, therefore, nouns, in the present study, the children were able to identify the semantic and syntactic aspects of adjectives (e.g., *succorable, dolorous*) when they were presented in new linguistic contexts in the partial word knowledge item. While models such as the developmental lexical principles framework (Golinkoff et al., 1994) provide a developmental perspective for word learning principles, the evidence is primarily from young language learners. The present study provided additional evidence demonstrating the extent to which school-age children use refined word learning strategies to gain derived word knowledge in incidental word learning contexts. As Hansen and Markman (2009) reported, children use multiple strategies to learn new words, including morphological cues.

**Clinical and Educational Implications**

Given the results of the present study, clinicians and educators can be encouraged by the children's application of both the semantic and syntactic aspects of unfamiliar words in incidental encounters. The results of the present study support previous literature that suggest that providing children access to language-rich texts has the potential to increase their vocabularies (Cunningham & Stanovich, 1998; National Institute of Child Health and Human Development, 2000). Many of the children in the present study exhibited the ability use morphological analysis, which gives additional support for the recommendation that providing direct instruction in morphological analysis to gain information about new derived words may be a worthwhile use of instructional time (Nagy & Scott, 2000; McCutchen & Logan, 2011; White et al., 1989). However, clinicians and educators should not expect children in early grades (below
grade 5) to be fully proficient in the syntactic properties of suffixes, even those suffixes that are familiar. Despite this, clinicians and educators should focus on encouraging the development of syntactic properties of suffixes to increase word knowledge by explicitly discussing how suffixes change the syntactic class of a base word.

**Limitations and Future Directions**

The limitations in the present study provide direction for future research in the area of incidental derived word learning. The derived words in the present study were limited to derived words formed with neutral, productive suffixes. It could provide more insight into children's acquisition of suffixes to include less productive or nonneutral suffixes (i.e., suffixes which cause a change in pronunciation or a syllable stress shift to the base word) for comparison purposes because these derived words are encountered by school-age children. Second, the children in the present study were asked to demonstrate their knowledge of the derived word immediately after it was presented. It might be beneficial to explore the extent to which children retain knowledge of words in incidental encounters over time. Also, there was much variability in the children's understanding and application the syntactic contribution of the suffixes used in the present study. Given the prevalence of derived words in school-age texts and the contribution of syntactic knowledge to the incidental derived word learning measure, it would be beneficial to explore how direct instruction of the syntactic contribution of suffixes contributes to vocabulary growth. Finally, an error analysis of the distributional measure might be helpful in explaining the low internal consistency on this measure and provide direction for revising this measure.
References


Appendix A: Parent Questionnaire

We look forward to working with your child. Please fill out the questionnaire below so that we can better understand your child’s performance in the project. This information will be kept confidential.

Name of Child: _____________________________ (please print)

Child’s date of birth: _________________________

Child’s race/ethnicity---please check one:

☐ American Indian/Alaskan Native ☐ Asian/Pacific Islander ☐ Black / Non-Hispanic

☐ Hispanic ☐ White / Non-Hispanic ☐ Multi-Racial

1. Is English your child's first language? YES ☐ NO ☐

2. Is English the primary language spoken at home? YES ☐ NO ☐

3. My child achieved all his/her physical developmental milestones (standing, sitting, walking, etc.) at expected ages. YES ☐ NO ☐
   If yes, please explain:
   ______________________________________________________________________
   ______________________________________________________________________

4. Currently, my child has difficulty with hearing, or has had a history of hearing difficulty. YES ☐ NO ☐
   If yes, please explain:
   ______________________________________________________________________
   ______________________________________________________________________
5. Currently, my child receives speech language therapy to help with speech and language skills, or has had a history of speech or language difficulties (e.g., late talker, difficulty with producing sounds correctly, not talking enough, or any other special services to help with speech or language skills). YES □ NO □

If yes, please explain:
___________________________________________________________________
___________________________________________________________________

6. Currently, my child receives special services in school for difficulties with learning, or has had a history of learning problems (i.e., learning disability, attention deficit disorder, behavioral disorder, etc.) YES □ NO □

If yes, please explain:
___________________________________________________________________
___________________________________________________________________
Appendix B: Items Used to Measure Relational Knowledge

(Note: Correct responses are in bold type.)

1. Does singer come from sing?        YES  NO  (transparent)
2. Does loveable come from love?      YES  NO  (transparent)
3. Does adventurous come from adventure? YES  NO  (transparent)
4. Does endless come from end?        YES  NO  (transparent)
5. Does government come from govern?  YES  NO  (transparent)
6. Does blindness come from blind?    YES  NO  (transparent)
7. Does discussion come from discuss? YES  NO  (opaque)
8. Does spacious come from space?     YES  NO  (opaque)
9. Does dutiful come from duty?       YES  NO  (opaque)
10. Does comparable come from compare?YES  NO  (opaque)
11. Does preference come from prefer? YES  NO  (opaque)
12. Does neutrality come from neutral?YES  NO  (opaque)
13. Does summer come from sum?        YES  NO  (transparent)
14. Does ladder come from lad?        YES  NO  (transparent)
15. Does silly come from sill?        YES  NO  (transparent)
16. Does pigment come from pig?       YES  NO  (transparent)
17. Does question come from quest?    YES  NO  (opaque)
18. Does flourish come from flour?    YES  NO  (opaque)
19. Does mother come from moth?       YES  NO  (opaque)
20. Does callous come from call?      YES  NO  (opaque)
Appendix C: Items Used to Measure Syntactic Knowledge

(Note: Correct responses are in bold type.)

1. The _____ vampire followed the pretty woman to the costume ball.
   a. tanement
   b. taneful
   c. tanity
   d. taneness

2. Hailey's grandfather is a _____ man who has a big laugh.
   a. wittenize
   b. wittenist
   c. wittenship
   d. wittenous

3. William borrowed Adam's _____ car to pick up Bella for their date.
   a. blannerter
   b. blannertize
   c. blannertable
   d. blannertation

4. The _____ made the dark night especially scary for the campers.
   a. groodly
   b. groodless
   c. groodable
   d. groodence

5. The student could not get the book because of the _____.
   a. mardleness
   b. mardleful
   c. mardlely
   d. mardleless

6. Claire didn't get to the movie on time because of the _____.
   a. pleavable
   b. pleaveless
   c. pleavy
   d. pleavement
7. Mark was ___ that day and decided to go to the restaurant.
   a. strimmonence
   b. strimmonous
   c. strimmonship
   d. strimmoner

8. The next day, everybody was talking about the ____ of the party.
   a. shampness
   b. shampable
   c. shampless
   d. shamply

9. A _____ made it possible for the detective to solve the crime.
   a. brongable
   b. brongless
   c. brongment
   d. brongize

10. Kelly wanted to get the ____ one, but it was sold out.
    a. prendable
    b. prendness
    c. prendist
    d. prendment

11. All it took was a _____ to get it working again.
    a. harsistly
    b. harsistful
    c. harsistive
    d. harsistence

12. We had to wait until the janitor could clean the ____ classroom.
    a. drappleful
    b. drappleness
    c. drappleship
    d. drapplement

13. He wanted to give Nora the gift but it was _____.
    a. lutterist
    b. lutterous
    c. lutterment
    d. lutterize
14. The ceremony's ____ was all anybody talked about the next day.
   a. dantize
   b. dantable
   c. dantness
   d. dantful

15. With a ____ of good weather, we could go to the park.
   a. sambleless
   b. samblement
   c. samblelike
   d. samblic

16. The new boss hired a ____ employee to do the job.
   a. plistism
   b. plisten
   c. plistable
   d. plishood

17. Nobody wanted to challenge the man to fight because of his ____.
   a. brondive
   b. brondish
   c. brondly
   d. brondence

18. We built sand castles and picked up seashells on the ____ beach.
   a. lubbitment
   b. lubbitful
   c. lubbitly
   d. lubbitship

19. The art critic praised the artist for his ____ and color choice.
   a. drithness
   b. drithable
   c. drithlike
   d. drithless

20. She thinks that TV show is ____, so she never watches it.
   a. duttenship
   b. duttenment
   c. duttenous
   d. duttener
Appendix D: Example Items Used to Measure Distributional Knowledge

(Note: Correct responses are in bold type.)

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
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<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>flowerful</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>woodable</td>
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<td>NO</td>
</tr>
<tr>
<td>3.</td>
<td>silverness</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>4.</td>
<td>gettable</td>
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<td>NO</td>
</tr>
<tr>
<td>5.</td>
<td>luckence</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>6.</td>
<td>tanglement</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>7.</td>
<td>blueful</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>8.</td>
<td>cloudence</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>9.</td>
<td>feverous</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>10.</td>
<td>youngness</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>11.</td>
<td>eagerment</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>12.</td>
<td>attemptable</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>13.</td>
<td>bottleness</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>14.</td>
<td>rumorous</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>15.</td>
<td>transference</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>16.</td>
<td>cleverous</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>17.</td>
<td>dreamful</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>18.</td>
<td>consistence</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>19.</td>
<td>birdable</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>20.</td>
<td>arrestment</td>
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</tr>
</tbody>
</table>
Appendix E: Sample Item Used in the IWL Measure

Story

Last night, Sara's house caught on fire. The firefighters came and put out the fire. The smoke and water ruined everything. Sara missed her boots the most. Sara was worried that her family couldn't buy a new house. Sara's teachers wanted to succor Sara's family. They gave Sara's family clothes, dishes, bath towels, and gift cards. Also, one box even had a pair of boots for Sara just like the ones lost in the fire! Sara thanked her teachers and friends for the gifts. Mrs. White told Sara that it was a succorable situation because all the teachers worked together.

Questions for Story

1. What did Sara miss the most?
   a. Her dog.
   b. Her boots.
   c. Her house.
   d. Florida.

2. What happened to Sara's house?
   a. It was ruined in an earthquake.
   b. It was ruined in a tornado.
   c. It was ruined in a fire.
   d. It was ruined by a flood.

3. Select the sentence that is the best use of the word succorable.
   a. Telling your teacher about a bully is a succorable act.
   b. I wanted to succorable the soup kitchen, so I gave them canned food.
   c. The succorable girl bought herself a blue shirt.
   d. He is going to succorable the car.