Developing Knowledge of Polysemous Vocabulary

by

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I hereby declare that I am the sole author of this thesis.

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Abstract

This study investigated the development of knowledge of vocabulary including multiple meanings of words during the school years. Twenty children from each of Grades 2, 5, 8, and 11 were tested for their knowledge of all the meanings of a large random sample of words from an unabridged dictionary (Webster's Third, 1981). Approximately 47% of the words had more than one meaning. Total average estimated vocabulary increased from 17,970 words in Grade 2 to 83,871 words in Grade 11. The estimated number of known derived words increased at the greatest rate throughout the school years. There was evidence that participants may have used morphological problem solving to figure out at least one meaning for 45% of their total vocabulary. Not only did the number of words known increase dramatically through the school years but the total average estimated number of different word meanings known increased also from 28,797 word meanings in Grade 2 to 185,990 word meanings in Grade 11. Three types of meanings were identified according to their relation to their principal meaning (known by the most children): homonyms (share no semantic relationship); conversions (different grammatical part of speech); and metaphorical extensions (share some other semantic relationship). When children demonstrated knowledge of more than one meaning, they were asked to attempt to explain the relation between those two meanings. Even the youngest children in Grade 2 knew a large number of multiple meanings but the ability to express knowledge of a relation between those meanings was uncommon until the later school years. This developing ability can be explained in part by the children's increasing metalinguistic awareness and general linguistic expressiveness but also by an increasing ability to understand and express metaphorical similarities between lexical concepts, which are common to the metaphorically extended meanings.

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Dedication

To my parents.

I miss you both.

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A word is "a speech sound or series of speech sounds that symbolizes and communicates a meaning without being divisible into smaller units capable of independent use" (*Webster's Third New International Dictionary, Unabridged*. Merriam-Webster, 2002). Words are symbols that we use to communicate meanings. Spoken words are sound symbols and written words are visual symbols but both are used to communicate meaning. Words and phrases are symbols that stand for ideas. Humans use language to communicate ideas from one person to another. Humans also use language to organize and mentally manipulate ideas. L.S. Vygotsky called this inner speech (Vygotsky, 1962). Studying the ways in which children learn to use words to symbolize objects, actions, and ideas is one way to understand how children learn to know about the world. This has fueled vast quantities of research investigating the development of language and its intimate link to thought.

Vocabulary Research

The development of vocabulary in one's native language is one aspect of language development. It is important because words are the basic units of language with which speakers can transmit ideas to their listeners. Children's vocabulary growth allows them to become increasingly able to communicate their ideas through language but it also allows them to represent increasingly more concepts with linguistic symbols. In other words, vocabulary development is a part of communication development but it is also a part of cognitive development or the development of knowledge.

When investigating the ways that children learn vocabulary words, it is important to understand patterns of word learning. By examining what words or what kinds of words children know at different stages in development, these patterns can help to illuminate the

processes involved in word learning. With this aim, researchers have sampled child language to see what words they know how to use (e.g. Benedict, 1979; Nelson, 1973), had parents keep diaries of the words their young children use (e.g. Goldfield & Reznick, 1990), had parents record their child's word usage using a checklist of words (e.g. Reznick & Goldsmith, 1989) or tested children's vocabulary to see what words they understand (e.g. Anglin, 1993; Seashore & Eckerson, 1940; Smith, 1941; Templin, 1957). Tests of vocabulary, unlike language samples, often measure receptive vocabulary or the understanding of spoken words rather than the use of spoken words.

When children begin to use language, typically around their first birthday, their vocabularies are limited to a very few words. Over the next few months, their spoken vocabulary increases relatively slowly (Dromi, 1999). In this period, language researchers or parents can actually record in a diary or checklist all the words that a child uses (e.g. Benedict, 1979; Goldfield & Reznick, 1990; Nelson, 1973; Reznick & Goldsmith, 1989). However, as a child's vocabulary increases to several hundred words, it becomes more difficult to record all of the words in their vocabulary. Therefore, for older children, vocabulary is measured by estimating the number of words known by testing them on representative sample of words in their native language (e.g. Anglin, 1993; Seashore & Eckerson, 1940; Templin, 1957).

Vocabulary knowledge estimation typically uses a recognition test of a sample of words from a dictionary (Anglin, 1993; Seashore & Eckerson, 1940; Smith, 1941; Templin, 1957). A very large dictionary is used and is assumed to contain the entire population of words in the language. Then participants are tested for their knowledge of a large representative sample of words from the dictionary population. Typically the criteria for knowing a word are either being able to use it in a context that makes sense, by producing a definition of it or an

illustrative sentence indicating knowledge of its meaning, or being able to make sense of a context in which it is being used, by correctly answering a multiple choice question (for which scores are corrected for guessing). These criteria are employed in order not to underestimate comprehension vocabulary knowledge but to include all words that may be understood even if the participant cannot express a meaning in the form of a definition or an illustrative sentence. Results of this research have often highlighted the fact that there is a dramatic increase in vocabulary from the time children utter their first word to the time when they enter school. Templin (1957) found that a typical 6-year-old in Grade 1 has an estimated total recognition vocabulary of 13,000 words. From this, Carey (1978) estimated the rate of total vocabulary growth to be about nine words per day over the 4.5 years from the time the child was 18 months old (the average age, according to Carey, of a child's first words). Anglin, Alexander, and Johnson (1998) estimated that children in Grade 1 have an average total recognition vocabulary of just over 12,000 words. This translates to an average estimated growth of between six and seven words per day between 18 months and 6 years, 8 months (the average age of the Grade 1 children in this study). The addition of six to nine new words each day to the recognition vocabulary of the average preschool child is a remarkable accomplishment. However, vocabulary increases do not cease when children enter school. In fact, Anglin et al. (1998) found that the rate of total recognition vocabulary growth actually increases substantially between Grade 1 and Grade 5 resulting in an estimated average total recognition vocabulary of about 58,000 words by the time children reach the age of 10 years. This increase in vocabulary over the 4 years from Grade 1 to Grade 5 amounts to about 30 words per day. Word learning continues throughout childhood and into adulthood. Smith (1941) found that Grade 12 students in high school have a total estimated vocabulary of over 80,000

words. Seashore and Eckerson (1940) found that adult college undergraduates had an estimated recognition vocabulary of about 155,000 words. This astonishing growth rate, along with its implications for conceptual development, is a primary factor motivating research in the area of vocabulary development. The goal of much of this research is to understand the mechanisms that are involved in word learning.

Word Learning

Word learning comes from many different sources but most word learning is incidental in everyday experiences. Infants hear language used by adults and older children around them. It is not an easy task for infants to perceive words as separate entities in a speech stream, make a connection between the word and its referent, and ultimately comprehend the word meaning. This process involves linguistic, conceptual, and social skills (Bloom, 2000). However, there is some evidence that children can learn some aspects of a word's meaning very quickly and easily with limited incidental exposure to those words. Carey (1978) referred to this process as fast mapping. For example, Carey and Bartlett (1978) conducted an experiment in which they exposed 3- and 4-year-old children to a novel colour word, *chromium*, which was contrasted with a familiar colour word, *blue*. The word *chromium* was used as an adjective to describe a tray. When the children were tested one week later, more than half of the children remembered something about its meaning.

Fast mapping has often been used to explain the way toddlers begin to make large gains in vocabulary. Young children are hearing words used in context but also learn some words from direct instruction. An adult (or another experienced language user) may offer information about a word meaning by making a statement, such as, "*That's an emu*," while somehow indicating the referent. In addition, the child may directly request word information by saying,

"*What's that?"* This type of word learning happens most often for children learning the names for things, nouns. However, word learning continues throughout the school years and may also happen in a fast way with limited exposure to new words. This fast word learning can happen in many different ways as children encounter novel words. During the school years, some vocabulary instruction is prescribed by the curriculum. Typically, this consists of teaching dictionary definitions for less frequent words. However, direct vocabulary instruction cannot account for the large vocabulary growth rates found by Anglin et al. (1998) and others (Anglin, 1993; Seashore & Eckerson, 1940; Smith, 1941; Templin, 1957). Again, a large amount of vocabulary is learned in the context of everyday experiences. For example, Senechal & Cornell (1993) found that 4- and 5-year-olds could learn novel words from one exposure in a storybook reading context. They hypothesize that storybook reading is an effective medium through which young children can learn words because of the rich context surrounding the words, including pictures. After the skill of reading is mastered, books continue to be an important source of vocabulary growth. Measures of reading behavior in adults have been found to be related to vocabulary measures independent of age and education level (West, Stanovich, & Mitchell, 1993). There are many other potential sources of word learning in a child's world. Children can learn words from hearing them spoken in context by adults, by other children, and even on television. Anglin (2005) describes many of the processes which may be involved in later word learning. Anglin (2005) discusses how children learn groups of related words such as colour words or animal names. School-aged children also learn terminology related to a specific course of study such as number words and mathematical terms (Skwarchuk & Anglin, 2002). Finally, another major source of word knowledge comes from the child's growing ability to make inferences from morphological knowledge (Anglin,

1993; 2005). That is, increasingly with age, children are able to infer the meanings of complex words from their knowledge of the meanings of root words, affixes, and the rules for forming compound, inflected, and derived words.

Recognition vocabulary measures (Anglin, 1993; Anglin et al., 1998; Seashore & Eckerson, 1940; Smith, 1941; Templin, 1957) typically include many word forms, not just root words. Anglin (1993) decomposed the sample of words from *Webster's Third New International Dictionary of the English Language* (1981), which had been used to test participants' vocabulary, into five morphological word types: root words, inflected words, derived words, literal compounds, and lexical idioms. (See pp. 37-38 for brief definitions of these word types.) He estimated that 31% of a 6-year-old's vocabulary is made up of root words or lexical idioms. These words must be learned in order for children to know their meanings. The remaining 69% of their vocabulary is made up of words that can be broken down into parts. Inflected and derived words consist of a root word and an affix or affixes. Literal compounds consist of more than one root word (and may also contain an affix or affixes). From this, it is evident that a large portion of the words a child knows could be understood from knowing root words plus inflectional and derivational affixes, or the rules for forming compound words. It is this ability to infer word meaning from knowledge of the meanings of root words and morphological affixes that Anglin (1993; 1998) refers to as morphological problem solving.

In order to provide more insight into the processes that might be facilitating dramatic increases in vocabulary in the early school years, Anglin (1993) analyzed the growth rates of each of the five defined word types separately. He found that the knowledge of root words, inflected words, literal compounds, and idioms grew at a relatively steady rate from Grade 1 to

Grade 5. The most dramatic increase in word knowledge was found for the number of derived words known. This finding is compatible with the idea that a great deal of vocabulary development results from knowledge of the use of morphological affixes. Anglin hypothesized that only a portion of the words that children got credit for were actually learned. He investigated the possibility that many of the inflected and derived words, as well as literal compounds, could be figured out at the time of testing by morphological problem solving. That is, if the child knew a root word, some affixes, and word formation rules, then the child could figure out the meanings of unfamiliar words. Anglin looked for evidence of this kind of problem solving by examining the interview transcripts of the children's answers to the definition and sentence portions of the vocabulary test. Anglin et al. (1998) used the same methodology and found that in Grade 1 there was evidence of problem solving about 40%, in Grade 3, 53%, and in Grade 5, nearly 60% of the time. This means that of the average of 30 new words per day that children would have to gain knowledge of between Grade 1 and Grade 5 to reach a vocabulary of 58,000 words, less than half of them may be learned, or, as Anglin puts it, psychologically basic, and the rest may be potentially comprehended through morphological problem solving.

Knowledge of affix use and word formation rules is developing in parallel to the knowledge of basic root word vocabulary throughout early childhood and into the early school years. Children as young as 2 years of age can use and understand some inflectional morphemes and compound words (Brown, 1973; Clark, Gelman, & Lane, 1985; Clark, Hecht, & Mulford, 1986). Brown (1973) found that preschool children are gradually learning to use more complex word forms. He found in children's very early language, when they are only using one or two words at a time that they tend to use only root words without modification for

tense or number, etc. However, he found that children very quickly learn to use inflected words. They begin to use five regular inflections in an almost invariant order by the age of 4 years: present progressive (-*ing*), plural (-*s*), possessive (-*'s*), regular past tense (-*ed*), and third person singular (-*s*).

Eve Clark and her colleagues investigated children's use of compound words. Clark et al. (1985) studied preschool children's ability to understand novel noun-noun compound words (e.g., apple-knife) by having them identify a picture of the object described by the compound. They found that the ability to interpret these compounds correctly emerges between two and three years of age. Clark et al. (1986) found that simple noun-noun compounds such as these were both produced and understood by children up to 5 years old, but complex compounds containing one or more derived words such as *ball-kicker* were not produced until the early school years.

Knowledge of derivational affixes and the rules for their use follows a somewhat similar developmental trend to that of inflectional morphology. Children learn to use derivational affixes gradually, learning some affixes before others. However, derivational knowledge develops later in childhood. Derwing and Baker (1979) investigated the production of five derivational affixes, the agentive -*er*, the instrumental -*er*, the adverbial -*ly*, the adjectival -*y*, and the diminutive -*y,* using a test similar to the Berko (1958) *wugs* test. This test required children to produce derivations for nonsense words (such as *wug*). They found that some of these derivational affixes were learned earlier than others were learned (although none was used reliably in the preschool years). For example, the agentive -*er* was used by 63% of children in the early school years and 86% in the late school years, whereas the adverbial -*ly* was only used by 13% of children in the early school years and 79% in the late

school years. From this, they conclude that knowledge of derivational morphology develops gradually through the school years.

Vocabulary development requires two parallel processes to occur. New words are learned. This accounts for the growth of psychologically basic vocabulary, root words and lexical idioms (Anglin, 1993; Anglin et al. 1998). This word learning may take place through encounters with new words in various contexts such as hearing or reading words as described above. Equally important is the growth of knowledge of complex words, inflections, derivations, and literal compounds. These words are often learned by learning the root word(s) and having the knowledge to combine words or add affixes to words (Anglin, 1993; Anglin et al. 1998). Therefore, vocabulary growth is not simply a matter of learning the meanings of new words. It combines learning word meanings with learning the ways that words and affixes can be combined and altered for various uses.

Word Meaning

Even though learning new word meanings has been found to account for less than half of the growth of vocabulary knowledge in a typical vocabulary measure (Anglin et al., 1998), learning meanings is a very important part of vocabulary development. In fact, even though the vocabulary estimates cited above indicate that children are capable of learning vocabulary at an astonishing rate, the method of vocabulary estimation used by Seashore and Eckerson (1940), Smith (1941), Templin (1957), and Anglin and colleagues (1993; 1998) may seriously underestimate the knowledge of word meanings. Many words in the English language take on different meanings when used in different contexts. This is known as polysemy. For example, as Miller and Wakefield (1993) point out, the word *poker* can refer to *a type of card game* in one context or to *a tool used to stoke a fire* in another context. Vocabulary estimates reported

in past research have been based on participants' ability to understand any single meaning of each word tested. For example, according to Anglin's (1993) vocabulary testing procedure, the child who knows both uses of the word *poker* would only be credited as knowing one word. Anglin (1993 pp. 121, 141, 182-185 and elsewhere) acknowledges that this is a potential drawback to this measurement technique. It is likely that, as children develop an understanding of more individual words, they also develop an understanding of multiple meanings for some of those words and this has not been taken into account by vocabulary measurements that only give credit for knowledge of one meaning for a word.

It is difficult to estimate how much of an impact the knowledge of multiple word meanings might have on estimates of children's vocabulary. Britton (1978) estimated that 44% of words drawn randomly from *Funk and Wagnall's* dictionary have more than one meaning. It should also be noted that frequently occurring words are more likely to be polysemous. Britton (1978) also found that 93 of the 100 most frequently used words, as reported by Kucera and Francis' (1967) word frequency list, have multiple meanings in the dictionary. Since children's vocabulary is likely to contain many frequently occurring words, polysemy may increase vocabulary estimates by a large factor. It is probable that, just as Anglin (1993) found that the rate of growth of individual word knowledge increases with age in the early school years, children grow to understand more and more meanings for polysemous words as they get older and gain more experience with language. If multiple meanings are not considered, vocabulary estimates do not adequately reflect conceptual knowledge. Therefore, in order to measure total recognition vocabulary it is important to consider polysemy in the measurement.

Polysemy

In the English language, many words have more than one meaning. In our everyday encounters with words, whether through speaking, listening, reading, or writing, our comprehension of the meaning of each word is dependent on the context surrounding it. Adults, as well as children, are able to comprehend words in many different contexts. Much research has been conducted in order to determine what happens when adults encounter words with multiple meanings (Caramazza & Grober, 1976; Gernsbacher, 1984; Langacker, 1990; Millis & Button, 1989; Perfetti & Lindsey, 1974; Pustejovsky, 1995; Rubenstein, Garfield & Millikan, 1970). The focus of this line of research is to determine how adults disambiguate the intended meaning of polysemous words (usually homonyms). However, relatively little research has focused attention on the question of how individuals come to understand these multiple meanings in the first place. Although this ability is an important aspect of vocabulary knowledge, researchers have not extensively investigated it before now.

Homonyms are words for which there are two distinct and unrelated meanings. Upon inspection of Webster's (1981) dictionary entries for words that have multiple meanings listed within their definitions, it can be noted that not all of the different meanings of words are cases of homonymy. In other words, not all of the multiple meanings listed in the dictionary are unrelated meanings as in the example of the two meanings of *poker* used above. Word meanings can be classified into three different groups according to the following three types of polysemy: homonyms, conversions, and metaphorical extensions.

Homonymy may occur as a result of two unrelated words evolving during the history of a language and converging on the same phonology and orthography. This is not always the case. Some homonyms are historically related but their meanings have diverged to the point

where the relationship is totally obscured to virtually anyone other than a historical linguist. For example, the word *port* refers to both *a harbour* and *a sweet, dark-red wine*. These two words have a common Latin source, *portus* meaning *opening* or *harbour*. The meaning of port referring to *a sweet, dark-red wine* is a diminutive of the name *Oporto wine* because it was named for the chief Portuguese harbour or port where this type of wine originated (*Oxford Dictionary of English Etymology*, 1966). Despite this etymological relation, most people would consider these two meanings to be unrelated because they do not know the original relation between the two meanings.

Another kind of polysemy is conversion. These are words whose meanings have been converted from one part of speech to another. Typically, this happens in the evolution of language in order for a speaker, or community of speakers, to fill a gap where there is no other appropriate word. For example, the word *closet* was converted from the use of the word as a noun referring to *a small, room, cabinet, or recess* to the use of the word as a verb to describe *the act of shutting something up in a closet*.

Finally, the remainder of the instances of meanings of polysemous words that are not totally unrelated, as in the case of homonymy, and are not converted from one part of speech to another, can be referred to as metaphorical extensions.[1] Most of the multiple meanings of words listed in *Webster's* (1981) dictionary are related in some way or other. These meanings can be tied together by some semantic connection or metaphor. For example, the most common meaning of the word *cold* is the physical property of being low in temperature, as *ice*

[1] Many researchers make a distinction between homonyms and polysemous words (Anglin, 2005; Beretta, Fiorentino & Poeppel, 2005; Klepousniotou, 2002; Rodd, Gaskell & Marslen-Wilson, 2002). They refer to words with unrelated meanings or separate main entry dictionary headings as homonyms. They refer to words with multiple related senses listed under one dictionary heading as polysemous words. Some even distinguish among metaphorically related senses and metonymically related senses as two different types of polysemy (Klepousniotou, 2002).

is cold. This meaning has been metaphorically extended to describe the psychological property of being unresponsive or unfeeling, like *a murderer is cold*. Some of the different senses listed in *Webster's* (1981) dictionary for polysemous words are obvious metaphorical extensions like this one. Other senses seem to be so closely related that they appear to be describing the same meaning. For example, two of the senses listed for the word *take* are *to get into one's possession* and *to transfer into one's keeping*. Both of these meanings seem to be describing the same idea, that of *gaining possession*. These different senses of the words *cold* and *take* illustrate the varying degree of relatedness that is possible between metaphorically extended polysemous words.

The meanings of polysemous words can be described as falling on a continuum of semantic relatedness. The meanings of homonyms are semantically unrelated and are psychologically distinct (whether or not they are etymologically related). Conversions, on the other hand, are usually very close in meaning; they often only differ by a shift of grammatical category and their meanings are psychologically very similar. Metaphorical extensions may fall anywhere on this continuum beyond the unrelated homonyms. Some metaphorically extended meanings may be so closely related that they cannot really be distinguished as being different from each other, while other metaphorically extended meanings may be so different from each other that the connection between them is not very obvious. The degree to which the meanings of polysemous words are related may influence the ease with which children learn to understand these meanings.

The Adult Lexicon

Before attempting to understand or predict how children might learn multiple meanings for words, it is important to consider the ways that adults comprehend or respond to

polysemous words. Much of the research in this domain concerns the processing of lexically ambiguous phrases. In order to understand the speaker's or writer's intent, the intended sense of a polysemous word must be made explicit to the listener or reader. This process of disambiguating meaning may be somewhat different for each of the three types of polysemous words described in this paper.

Research in the domain of lexical processing attempts to describe the structure of the mental lexicon and the mechanisms underlying the retrieval of word meanings. An important question arises from this literature as to whether each meaning of a polysemous word is stored as a separate lexical item or whether each separate phonologic or orthographic instance is stored as a lexical item and multiple meanings are derived from that single source. The answer to this question has implications for the ease of processing or disambiguating polysemous words and for the processes involved in learning new meanings of polysemous words. If each word-meaning pair is stored as a separate lexical item, it may be more difficult or take longer to decide which meaning is intended by the context. It may also be more difficult to learn new meanings if they must be learned as new, separate word-meaning pairs rather than as additions to existing word-meaning associations. If word-meaning pairs are not stored as separate lexical items but instead are stored as one lexical item with links to multiple senses, then any meaning for a particular lexical item could be accessed by the connection to that one lexical item, and it therefore would take no longer to access any one meaning than any other meaning. If this were the case, learning new meanings would only involve learning additions to existing word-meaning associations.

One research paradigm used to study the structure of the mental lexicon is the measurement of lexical decision time. Participants are given a list of orthographic items

(strings of letters some of which are words and some of which are not words) and lexical decision time, the time it takes for each participant to indicate whether each item is a word or a non-word, is measured. Words that occur more frequently in the language and/or that are more familiar are responded to more quickly. This is said to reflect the relative ease of access to these highly frequent or familiar words in the mental lexicon. If each word-meaning pair for a polysemous word was stored separately, then one might expect a polysemous word would elicit a faster lexical decision time response. The reason for this effect is postulated to be that, since lexical entries are accessed at random, the probability of accessing one of a set of entries for a polysemous word is increased (Rubenstein et al., 1970).[2]

Results of lexical decision time studies have been mixed. Some find that lexical decision time is not influenced by the number of meanings a word is associated with, only by the familiarity of these words (Gernsbacher, 1984; Millis & Button, 1989). Others have found a decrease in lexical decision time (facilitation effect) based on the number of meanings the words have (Beretta et al., 2005; Hino & Lupker, 1996; Klepousniotou, 2002; Rodd et al., 2002). Gernsbacher (1984) assessed participants' familiarity with each of a set of 5-letter lexical items. Then she measured lexical decision time for sets of highly familiar words with single meanings listed in *Webster's* (1981), highly familiar words with more than 10 meanings listed in *Webster's* (1981), unfamiliar words with single meanings, and unfamiliar words with more than 10 meanings. She found that once the effect of familiarity was controlled, there was no difference in lexical decision times between polysemous or non-polysemous words. Gernsbacher's (1984) finding that polysemous words do not elicit a faster response than non-

[2] In order to understand this effect, one can use an analogy of drawing marbles from a bag. If you have one green marble, one pink marble (like words with one meaning each) and two blue marbles (like a homonym with two meanings), the probability of drawing a blue marble from the bag is greater than that of drawing a green marble.

polysemous words would seem to indicate that multiple word-meaning pairs might not be stored separately in the mental lexicon, at least according to Rubenstein et al.'s (1970) interpretation of response times.

Gernsbacher (1984) however, criticized the traditional method of measuring polysemy by counting the number of different numbered definitions listed for each word in the dictionary. She suggests that the mental lexicon of most well educated individuals does not contain as many definitions for words as the dictionary contains. For example, she conducted an informal survey, which revealed that only one meaning for the word *cadet* was known even though there are 15 dictionary definitions. Other researchers have looked for polysemy effects using more psychologically valid measures of polysemy. For example, Hino and Lupker (1996) defined words as polysemous if a group of participants rated those words as having more than one meaning. Using this criterion for distinguishing between polysemous and non-polysemous words and controlling for familiarity and frequency, they found that polysemous words are reacted to faster in a lexical decision task than non-polysemous words. The finding that polysemous words do elicit a faster response than non-polysemous words might indicate that multiple word-meaning pairs are stored separately in the mental lexicon according to Rubenstein et al.'s (1970) interpretation of response times.

More recently, some researchers have suggested a way to resolve this inconsistency in the findings of lexical decision tasks for polysemous words (Beretta et al., 2005; Klein & Murphy, 2001; Klepousniotou, 2002; Pexman, Lupker & Hino, 2002). Differences in patterns of results may be caused by differences in the types of polysemous words used. In many studies, the polysemous words are selected because participants have indicated that the words have more than one meaning (i.e., Hino & Lupker, 1996; Millis & Button, 1989). In most

cases, these polysemous words are not homonyms but instead have related meanings (Rodd et al., 2002). Rodd et al. (2002) suggest that the lexical decision time facilitation effects found by Hino and Lupker (1996) and others are due to the fact that the words used have many related senses. They also have an alternative hypothesis for the cause of the polysemy advantage. This opposes Rubenstein et al.'s (1970) hypothesis that facilitation effects are due to the increases in the probability of polysemous words with separate lexical entries being accessed. They suggest the possibility that polysemous words with related meanings have separate sense representations connected to a single lexical item in the mental lexicon. Words with more related meanings have more semantic information stored; they are semantically rich. When these words are encountered in a lexical decision task, they are accessed more quickly because they have a richer, more diverse lexical entry.[3]

Rodd et al. (2002) and others have found a difference between lexical decision times for homonyms and polysemous words with related meanings. Reaction time in the lexical decision task was faster for words with multiple senses than for words with only one sense listed in the *Online Wordsmyth English Dictionary-Thesaurus* (Parks, Ray, & Bland as cited in Rodd et al., 2002). This reaction time advantage was not found for words with two or more separate homonym entries listed in the *Wordsmyth* dictionary. Beretta et al. (2005) also found that words with related senses (i.e., *belt*) were accessed faster than words with homonym meanings (i.e., *bark*). They also measured brain wave activity using magnetoenchephalography while the participants performed the lexical decisions. They found

[3] This effect can also be illustrated with the analogy of drawing marbles from a bag. If you have one small green marble, one small pink marble (like words with one meaning each) and one large blue marble (like a polysemous word with many meanings inside it), the probability of drawing the blue marble from the bag is greater than that of drawing a green marble because the large blue marble is easier to grasp.

different patterns of brain wave activity for homonyms than for polysemous words with related meanings.

Another method used to investigate the structure of the mental lexicon is the word-priming paradigm. The perception of one word influences the speed of recognition in a lexical decision task of a subsequently perceived related word. For example, the word 'bread' primes the reader for any of the words *butter, roll, yeast, knife*, etc. The participant, therefore, will make a lexical decision response more quickly to those subsequently presented related words. Early priming experiments found no difference between polysemous and non-polysemous words in the degree of facilitation by priming of a related word (Perfetti & Lindsey, 1974). However, different effects have been found for words with related meanings when compared to words with unrelated meanings (Klein & Murphy, 2001; Klepousniotou, 2002). Klepousniotou (2002) distinguished between homonyms with unrelated meanings such as *pen* (*writing device* vs. *enclosure*) and polysemous words with related meanings. She further distinguished between two different types of polysemous words. The first type was words with meanings related by a metaphorical extension such as *eye* (*organ of the body* vs. *hole in a needle*). The second type was words with meanings related by a metonymic extension such as *turkey* (*the bird* vs. *the meat from the bird*). Participants were shown a sentence followed by a target word, a control word (matched for frequency or type of meanings) or a non-word. The sentences did not use the target word but would prime one meaning of the target word (i.e., the phrase *he goes to every football game* was used to prime the word *fan*). Priming effects were significantly greater for words with metonymical relations between multiple meanings than they were for words with metaphorically related meanings or homonyms. This supports the hypothesis that words that share more semantic information are more easily accessed.

Results of both lexical decision time experiments and priming experiments are consistent with the idea that each word is stored in the mental lexicon with a link to its meaning (in the case of single meaning words) or multiple links to their meanings (in the case of polysemous words). Homonyms have links to multiple unrelated meanings and other types of polysemous words have links to multiple meanings that have overlapping semantic information.

Assuming that multiple meanings are encoded in memory by connections to a single lexical entry, a mechanism must be available that can interpret the intended meaning in context. George Miller (1999) points out that polysemous words are potentially ambiguous in isolation but are often not ambiguous in context. Miller (1999) says that "associated with every distinct meaning of a polysemous word there must be some cognitive representation of the contexts in which that word form can be used to express that meaning" (p. 17). In a natural discourse or reading situation, context usually constrains word meaning. For example, as illustrated in Pustejovsky (1995), the sentence, "*The plane taxied to the terminal*," contains two homonyms. *Plane* could refer to an aircraft or a carpenter's tool and *terminal* could refer to a computer terminal or a building at an airport, train station, or bus station. If the passage or discourse context has not already primed the appropriate meaning of the word *plane* then the verb *taxied* would constrain it. *Taxi* is never used to describe the action of a carpenter's tool. Once the aircraft meaning of *plane* is active in processing, then the appropriate meaning of *terminal* is primed. This on-line priming and constraining of meaning allows the listener or reader to comprehend the intent of the proposition. However, when the possible meanings of a word are related, the process of priming and constraint is not so straightforward. In the sentences "*The window is broken*," and "*Mary crawled through the window*," the word *window*

shares a common meaning, that of a glass covered opening in a wall. Within each sentence, however, finer constraints are put on that meaning. In the first sentence *window* refers to the glass and in the second, it refers to the opening in the wall. Related meanings like these make the processing of polysemous words more complicated. However, the context of *breaking* or *crawling through* makes the intended meaning of even these closely related meanings clear.

Conversions are a special case of polysemy in that the meanings are highly constrained. Conversions are often used to talk about things for which the speaker lacks a conventional term. Adults use conversion to fill lexical gaps. E. Clark (1981) distinguishes between momentary gaps, where the speaker has forgotten the appropriate word, and chronic gaps, where there is no word in the lexicon to express that particular meaning. For example, the sentences, "*Are you finished garbaging?*" asked of a person who was sorting and bundling garbage and recyclables, and "*I'm going to bin my library books on the way home,*" said by a person leaving the office building with a stack of books in hand, both convert common nouns into verbs. The person who was sorting and bundling the garbage and recyclables knows that the speaker means to ask if he is finished with this task. The person who is seeing you leave the office building with a stack of library books in your hand understands that you intend to drop them in the book return bin. A listener can understand the speaker in the context of the conversation even though the typical meaning of the converted word does not strictly apply to the new usage. The original meaning is so close to the intended meaning that no ambiguity arises. The context makes the meaning transparent. Words that have entered the language more formally by this process of conversion, and are listed as separate entries in the dictionary, are also highly constrained by the meaning of the root word. For example, the verb *to closet* is

understood as an action pertaining to the common noun *closet*. Thus, converted words are a special case of polysemy where often little ambiguity of meaning is evident.

Langacker (1990) describes a cognitive grammar model for processing all types of polysemous lexical items. He suggests that each lexical item with more than one sense is stored together with all its meanings. Various meanings of a word are linked together to form a network that reflects the connections that speakers establish among them. Homonyms are only connected via common phonology and orthography and conversions are connected via a grammatical category shift.

Caramazza and Grober, in 1976, also described a model to account for polysemous meanings in the mental lexicon. They proposed that the mental lexicon contains a core entry for each word and differences in meaning are interpreted by deriving them from the core meaning. They used the different senses of the word *line* to illustrate this model. They asked participants to generate sentences to illustrate the meaning of the word *line*. They found that the meaning most frequently illustrated was that of unidimensional extension. They also had participants rate how typical each of the meanings was for this word. The results of the typicality ratings confirmed that unidimensional extension captured the core meaning and that other senses formed clusters of meaning that varied in semantic distance from this core meaning. They postulated that many different senses of the word could be generated through transformations from this core meaning that are made one step at a time. For example the sense illustrated in the phrase *draw a line* is a single step transformation, [visually perceptible] + [unidimensional extension], and the phrases *line your paper* and *line of wealthy noblemen* are two-step transformations, [verb concept] + [visually perceptible] + [unidimensional extension] and [unidimensional extension] + [through time] + [kinship], respectively. This

model reinforces the idea that the multiple meanings of a word (with the exception of homonyms) are connected to a greater or lesser degree by extension of a core meaning.

Lakoff (1987) illustrated a similar framework for dealing with polysemy. He proposed an idealized cognitive model (ICM) as the basis on which a collection of senses forms a radially structured category. Each sense of a polysemous word is linked in the structure by image-schema transformations and metaphors. Lakoff illustrated this with the example of the word *over*. One sense of the word *over* is captured by the image-schema *above*, as in the sentence, "*Hang the painting over the fireplace*." This *above* schema is connected to the *above-across* schema, as in the sentence, "*The plane flew over*." Another sense of the word *over* is captured by the *above-and-covering-the-surface* schema, as in the sentence, "*I walked all over the hill.*" All of these senses (and others) can be generated by modifying the original *above* schema. There are some senses of the word *over* that do not appear, at first glance, to fit into this image-schema transformation model. For example, the sense of *over* in the phrase "*look over the report*" illustrates the meaning *covering the surface with one's eyes*. Here the *above-and-covering-the-surface* schema applies but this schema is used in a metaphorical sense by connection to the *seeing is touching with the eyes* metaphor. Lakoff has illustrated how a word like *over*, with many related meanings, is captured in a structure of connected image-schemata and metaphors.

A study by Durkin and Manning (1989) confirms the idea that, within the human mind, polysemous words are each associated with some typical meaning and that this typical meaning is related to non-central meanings to a greater or lesser degree. Durkin and Manning (1989) asked participants to generate one meaning for each of a list of polysemous words. They tabulated the meanings generated by frequency to determine the dominant meaning (the

meaning most frequently produced) for each of the words. Then, they had another group of participants rate how related the non-dominant meanings each were to the dominant meanings on a 7-point scale. From this, they calculated semantic relatedness scores for each of the polysemous meanings. They found that meanings varied in relatedness across the scale. For example, the word *earth* meaning *planet* was dominant and the meaning *world* was judged to be very highly related. However, homonym meanings were judged to be semantically unrelated. For example, the word *date* meaning *time of year* was dominant and the meaning *a type of fruit* was judged to be completely unrelated. The data obtained in this study provide psychologically real examples for the models of the structure of the mental lexicon reviewed above and include unrelated meanings in this model of varying degrees of semantic relatedness.

Children's Understanding of Polysemous Words

How does the structure of the adult lexicon develop? Do children learn the core meaning first and then learn other meanings of polysemous words? Do they learn one meaning at a time or learn to generate meanings on-line when necessity arises? Children probably do learn the most frequently used meaning of a word first but how they learn multiple meanings and when they learn about semantic relationships between those meanings is yet to be determined.

Homonym meanings are different from other polysemous word meanings. Clearly, it is sensible to assume that homonym meanings must be learned separately since they are separate, unrelated meanings for a word. Some theorists claimed that the ability to understand that one word can have two unrelated meanings would be difficult for pre-school children since they would have to hold two separate representations for a single lexical entry and there is a bias in

language learning to assume that each word refers to exactly one category (Slobin, 1985). Backscheider and Gelman (1995) investigated pre-school children's ability to understand homonyms. They tested 3-year-old children's ability to identify noun homonym pairs from pictures. The children were shown a picture of an object referred to by its label and asked to choose which one of three other pictures was referred to by the same label. The 3-year-old children chose the correct homonym match 75% of the time. This was significantly better than chance responding (33%). Next, they presented the children with pictures of two objects (homonyms or non-homonyms, which were objects from a single category that had different labels such as *rose* and *daisy*) and asked them to choose whether they were called by the same name or not. The children said that the homonym objects had the same name 86% of the time. This was significantly better than chance responding (50%). They only replied that the non-homonym pairs had the same name 19% of the time (significantly less often than chance). Finally, they presented the children with one picture of an object and had the children choose which one of a pair of pictures was a homonym (name) match and which one was a semantically related (category) match. They found that the 3-year-olds chose the homonym object correctly as the name match 81% of the time. This was significantly better than chance responding (50%). These findings indicate that even pre-schoolers have the cognitive ability to represent two different objects with the same name.

Most of the nouns used in Backscheider and Gelman's (1995) study were highly familiar objects (i.e., *glasses – eyeglasses* and *drinking glasses*). Thus, even 3-year-old children would have heard both members of the homonym pair labeled with the same word. The mechanisms for word learning that are available to the child pertain to both homonyms and words with single meanings. Children learn words from hearing them in the context of

everyday listening experiences, from storybook reading (Senechal & Cornell, 1993), from direct vocabulary instruction (Beck, Perfetti, & McKeown, 1982), and from their knowledge of word formation rules (Anglin, 1993). The most frequently used or dominant meaning of a homonym is likely to be learned first because the child has more opportunity to experience instances of the use of that meaning. Other homonymous meanings are likely to be learned separately since there is no logical connection between meanings, and no way to generate a second unrelated meaning from knowledge of the first meaning. Homonymy is, however, a special case. The learning of meanings of other types of polysemous words is probably influenced by the relationships between those meanings.

Words with multiple meanings that are converted from one part of speech to another share a special relationship between meanings. They are often highly related meanings differing only in part of speech. Eve Clark (1981) found that children as young as two years old use innovative conversions to fill their lexical gaps. For example, if a child has the word *broom* in his/her lexical repertoire but not the word *sweep*, then he/she may use the word *broom* to describe the action associated with the object, "*I broom the floor*." One possible way that children could learn to convert words from one part of speech to another is by analogy. There are words in the language that children may hear that are similar to their own denominalized verbs, for example, *hammer* and *to hammer* or *iron* and *to iron*. E. Clark (1982), however, showed that analogy is not always capable of explaining children's lexical innovations. She found that the most common type of innovative denominalized verb in young children's speech applied to instrument verbs (those for which the noun is the instrument used in the activity given by the verb) such as the verb *broom* for *sweep* or *needle* for *sew.* However, legitimate instrument verbs occur frequently in adult language (i.e., *to hammer, to*

iron, or *to skate*). The next most frequently produced category of children's innovative denominalized verbs was that of characteristic activity of an object. Examples of denominalized verbs used for characteristic activities are "*The buzzer is buzzering,*" or "*It flagged,"* used to describe a drooping flag that suddenly spread out in a gust of wind (examples from p. 410). E. Clark (1982) claimed that this type of conversion does not appear at all in adult speech, with the exception of the weather terms *to rain* and *to snow.* In adult speech (and in dictionaries), it is more common to find denominalized verbs used for actions produced by an object, such as *hammering, drumming, or fiddling*. Therefore, children could not learn these forms by analogy from examples in adult speech. E. Clark (1982) suggested that instead children are using a rule, "any noun denoting a concrete entity can be used as a verb for talking about a state, process, or activity associated with that entity" (p. 424), in order to learn to create words by conversion. Whatever the process underlying this ability to create new words from well known words, these instances of lexical innovation indicate that children are able to use lexical conversions at a very young age and that children learn the dominant meaning of a word before they convert the use of that word to another part of speech. This implies that the child's lexicon is developing around a core or dominant meaning for each word, with multiple converted senses linked via the necessary grammatical category shift.

Words that have multiple meanings that are related but not converted from one part of speech to another may also be learned by young children. Some research has been conducted to investigate children's understanding of related multiple meanings of words. Colin Clark (1982) investigated 4-, 8-, and 12-year-old children and adults' ability to produce multiple meanings for 10 common polysemous nouns. The words he chose do not have homonym meanings but each has three related meanings. He found that 4-year-olds almost all produced

one meaning for each word. A second meaning was produced only 4% of the time by 4-year-olds and never a third meaning. Eight-year-olds only produced a second meaning 16% of the time and only one 8-year-old produced a third meaning for only one of the 10 words. Twelve-year-olds produced a second meaning 44% of the time and a third meaning 7% of the time. Adults produced a second meaning 50% of the time and a third meaning 32% of the time. Overall, C. Clark also found a consistent order of acquisition for the meanings of the 10 words he tested. When only one meaning for a word was produced, the children were producing the same meaning 96% of the time. This clearly indicates a developmental trend in the knowledge of multiple meanings of words. This trend was not completely straightforward. C. Clark noticed that the number of meanings known by children of various ages was different for different words. Children seemed to know some multiple meanings before others. C. Clark suggested that this might be due to familiarity since some of the words are more frequently occurring words than other words and some of the meanings are also more frequently occurring than other meanings. These results led Wilma Reckers (1984) to speculate about what processes may be involved in the learning of multiple meanings of words. She was interested to know whether degree of abstraction, functional relevance, or relation to a core meaning might influence the order in which children learn these multiple meanings. She also tested 4-, 8-, and 12-year-olds and adults for their knowledge of three meanings of a group of ten polysemous nouns. The words she chose all had three meanings that were ranked according to how abstract they were, how functionally relevant they were, and how related they were to a core meaning. Again, she found differences in the number of meanings known by children of various ages for different words. However, she found that none of these dimensions was any better than any other dimension at predicting the order of acquisition of

the word meanings. It may be that the developmental progression of the learning of multiple meanings is a complex process influenced by several factors. This process may be different for different types of relations between multiple meanings of words and different levels of word frequency in the language.

The multiple meanings of words that are metaphorically extended from a core meaning may be learned by means of that relationship between meanings. Durkin, Crowther, and Shire (1986) found that children's understanding of the meanings for spatial terms such as *up* and *down* are biased in favour of the dominant sense. Children have difficulty with these spatial terms in relation to music and math. In order for most children to learn the use of the word *up* to refer to increasing musical pitch, the relationship between the spatial meaning and the musical meaning had to be explicitly illustrated (i.e., notes going up a staircase). Children do eventually learn relationships between word meanings such as these without intervention. However, the age at which and ease with which children learn related meanings of words may depend to some extent on the explicitness of the relationship between the meanings.

Frank and Hall (1991) thought that knowledge of multiple meanings progressed from concrete meanings to abstract meanings. They investigated children's use of different senses of the internal state words *think* and *know*. They found that the word *know* was used most often in a very concrete sense, that of perception ("*I know his shirt is red*."). They found a definite pattern of decreasing usage of more abstract meanings of *know*, from perception, to memory, understanding, evaluation, metacognition, and finally planning. This analysis supported the idea that multiple meanings develop from concrete to abstract. However, the word *think* did not fit this pattern. *Think* was used most often in the context of evaluation ("*I think this idea is better than the first*."). The other five senses of think, perception, memory,

understanding, metacognition, and planning, are all used equally infrequently by children. Frank and Hall (1991) suggest that these differential patterns of use may reflect the fact that knowledge of words develops around a core or dominant meaning. It is possible that the dominant meaning of *know* pertains to perception and the dominant meaning of *think* pertains to evaluation. If this is the case, then the degree to which other meanings are related to these dominant senses, rather than the concreteness of the meaning itself, may determine the ease with which they are learned.

Asch and Nerlove (1960) investigated words that described both physical and psychological properties, like the word *cold*. They found that 4- and 5-year-olds understood the physical meanings of these words quite thoroughly but it was not until they were 7 or 8 years old that they accepted that these words could be used to describe people using the psychological meaning. For all the words in this study, the physical or more concrete meanings were learned first and the more abstract psychological meanings were learned later. However, the fact that the 7- and 8-year-olds began to understand the more abstract meaning, does not necessarily mean that they had learned the second meaning because of its connection to the physical meaning. In fact, when the experimenters asked the 7- and 8-year-olds what the relationship was between the two meanings, most of them suggested that there was no similarity (e.g., "ice cubes and people are a lot different," p. 53). They appeared to interpret the two meanings as a case of homonymy. It was not until most of the children were at least 9 years old that they could make a connection between the two meanings. This suggests that the children learned these different meanings from separate contexts, not from figuring out a metaphorical connection between them. The physical and psychological meanings of words like *cold* appear to be learned as if they are homonyms. It is possible that children learn all

metaphorically extended meanings separately like homonyms. However, it is more likely that the words and meanings that Asch and Nerlove (1960) used are cases of rather distant metaphorical extension and that this is why they were treated more like homonyms by the children. The psychological meanings of these words seem to be quite distantly related to the physical meanings. In fact, Durkin and Manning (1989) had the word *cold* in their meaning generation test but only the meanings *not hot* (dominant) and *illness* were generated by participants. These meanings were not very closely related (2.52 on a 7-point scale where 1 is completely unrelated). The psychological meaning of the word *cold* was not even generated by participants, so one might predict that that meaning would be judged to be even more unrelated to the physical meaning. If the ability of children to make connections between word meanings as they learn them is a function of the closeness of the relation between the meanings or the explicitness of that relationship, then the findings of Asch and Nerlove (1960) are not incongruent with the hypothesis that meaning relationships facilitate the learning of different senses of a given word.

Broderick (1991) found that 3-, 4-, and 5-year-olds could, in fact, comprehend physical/psychological metaphors. He used a task that was easier for young children to respond to in an effort to rule out the possibility that the younger children in Asch and Nerlove's (1960) study failed to articulate relationships between word meanings simply because they lacked the metalinguistic skills to do so and not because they lacked the knowledge of the relationship between the meanings. For example, after a story was told to the child that described a silly character and a serious character, the child was asked to tell which one of two objects was silly and which serious. The silly object was purple with orange polka dots and the serious object was brown. Even the youngest children were able to complete this

task correctly with an above chance probability (75% at age 3 years). However, the author discussed the possibility that children may be making some associative connection between the objects and the personality words and that this is not quite the same as understanding the metaphorical connection. For example, clowns are silly and they often wear costumes with polka dots on them.

Other researchers have found that the difficulty or explicitness of the metaphor affects the age at which the child might be able to comprehend the metaphor (Epstein & Gamlin, 1994; Siltanen, 1990). For example, Epstein & Gamlin (1994) tested 3-, 4-, and 5-year-olds on explicit (e.g., *eye – button, rain – tears*) or implicit (e.g., *sun – fire, zipping up a zipper – sealing an envelope*) metaphorical relationships. They asked the children to choose one of two objects that was most like a third object. Then they asked the children to state the reason for their choice. Older children performed better than younger children at both choosing the correct object and giving the correct reason for their choice but all three age groups performed better when the relationship was explicit than when it was implicit.

Children learn word meanings from their experiences with language in the rich social-linguistic context of everyday life. Since a large proportion of the words that they encounter have multiple senses, children are likely equipped with the ability to extract the appropriate word meaning in the language setting. The fact that many polysemous words have meanings that are related by some grammatical or metaphorical transformation may facilitate learning of related meanings.

Present Research

This study was designed to investigate vocabulary acquisition by extending previous research in two ways. First, a wide age range of children was tested. The vocabulary of

children and adolescents from Grades 2, 5, 8 and 11 (7-, 10-, 13-, and 16-year-olds) was tested. Anglin and his colleagues have tested the vocabulary of school-aged children ranging from the first through the fifth grades (Anglin, 1993; Anglin et al., 1998; Malloy, 1994). Others have tested vocabulary of grade school and high school students (Smith, 1941) and adult college students (Seashore & Eckerson, 1940). However, Smith's (1941) study of elementary through high school students' vocabulary did not analyze the different morphological word types that participants knew as Anglin (1993; 1998) did. This study replicated and extended Anglin's previous studies of vocabulary by using the same dictionary sample of words from *Webster's Third New International Dictionary of the English Language* (1981) as Anglin (1993) had used while adding to that sample sub-entries (bold faced words within the dictionary definition of words), similar to the sample used by Anglin et al. (1998). Recognition vocabulary estimates were calculated and the results for children in Grades 2 and 5 were compared to those found by Anglin (1993) and Anglin et al. (1998) for children in Grades 1, 3 and 5. However, children in Grades 8 and 11 were also tested using the same methodology, extending our knowledge of vocabulary development to adolescent participants.

This study also replicated Anglin's method of analyzing the morphological classifications of the words children knew. The sample of words was broken down into root words, inflected words, derived words, literal compounds, and lexical idioms. Vocabulary estimates for each of these word types were compared to those found in Anglin (1993) and Anglin et al. (1998). This study also replicated Anglin's method of investigating participants' use of morphological problem solving to figure out the meanings of complex words for which they may not have had any previous knowledge. The transcripts of the vocabulary test were

analyzed for evidence of morphological problem solving. The amount of morphological problem solving that is evident at each grade level was compared.

It was hypothesized that, as previous vocabulary research has shown, children would demonstrate knowledge of more words as they get older and that they would show a larger increase in knowledge of morphologically complex words than root words as they get older (Anglin, 1993; Anglin et al., 1998; Seashore & Eckerson, 1940; Smith, 1941; Templin, 1957). It was also hypothesized that participants' definitions of words would show an increase in the amount of morphological problem solving expressed as they get older as Anglin's (1993; 1998) research has shown.

The second way that this research extended previous vocabulary studies was by testing children for their knowledge of multiple meanings of words in the sample. This may illuminate the mechanisms involved in learning to understand multiple meanings. This test included all the multiple meanings of those words that were: 1) sufficiently different from one another that could be considered different senses; and, 2) likely to be known by participants in this age range. When all of the dictionary senses for the sample of words were inspected, it was evident that some preliminary investigation was necessary to create the list of meanings on which students were tested and to determine which meanings were homonyms and which were converted or metaphorically extended meanings. This was achieved through preliminary studies one and two of this investigation as described below. In preliminary study one, adults were asked to rate the degree to which pairs of meanings are related to each other on a 7-point scale similar to the method used by Durkin and Manning (1989). From this, semantic relatedness scores were calculated for each pair of polysemous meanings. This information was used to determine which meanings are so closely related that they can be combined to

form one meaning that is more general as well as to classify meanings as homonyms (not semantically related). In preliminary study two, adults were asked to produce multiple meanings for this same sample of words or to recognize the use of those meanings in a matching paradigm. This information was used to determine which meanings were not known by any adult participants and were therefore not likely to be known by younger participants. In addition, the frequency of production or recognition of each of the multiple meanings of words was used as a guide for determining the order that the multiple meanings of words were presented to the students in the vocabulary test. Meanings that were better known by adult participants may be more likely to be known by younger participants on the vocabulary test and so were listed before less well-known meanings. Finally, in order to investigate the means by which children may develop this knowledge of multiple meanings of words, the semantic relatedness ratings from preliminary study one were used as a variable in analyses of participants' performance on the vocabulary test. This was done to see whether more highly related meanings were more likely to be known by the participants.

It was hypothesized that participants would demonstrate knowledge of more meanings of polysemous words as they get older, just as previous vocabulary research has shown that children know more individual words as they get older (Anglin, 1993; Anglin et al., 1998; Seashore & Eckerson, 1940; Smith, 1941; Templin, 1957). It was also expected that the degree of relatedness between meanings of each word would play a role in children's developing knowledge of multiple meanings. More specifically, the youngest children tested in this study (7-year-olds) would know or be able to recognize meanings that are converted from one part of speech to another as long as the relation between those meanings is fairly transparent (rated as highly related). This hypothesis is based on the fact that children as

young as two years old have been found to produce and recognize simple conversions from one part of speech to another (E. Clark, 1981; 1982). These very young children may also know or be able to recognize metaphorically extended meanings as long as they are highly related meanings. As the age of the child tested increases, it was expected that the number of meanings produced increases and the average degree of relatedness between those meanings decreases. Older children were expected to be able to recognize meanings that were more opaque transformations of the main meanings.

Children in this study were also asked about their knowledge of relations between the multiple meanings of words. It was expected that as children get older, they would be able to discuss the relations between converted or metaphorically extended words. Asch and Nerlove (1960) found that children under 9 years old could not discuss the relations between two meanings of the same word even though children who were 7 or 8 years old had knowledge of more than one meaning for the words tested. Therefore, it was hypothesized that students would be increasingly able to discuss the relations between the multiple meanings of words with age.

Sample of Words

This study used a sample of 434 main entry words selected by Anglin (1993) from *Webster's Third New International Dictionary of the English Language* (1981). This sample was compiled by selecting every seventh bold faced word, flush to the left margin (hereafter called main entries) on every sixth page of *Webster's* (1981). Sets of homographs were counted as one word. All non-words (abbreviations, affixes, and combining forms) were eliminated. In addition to this sample of main entry words, 125 sub-entries (bold face type) found within the main entry definitions were also included in this study.

The main entry word list was tested by Anglin (1993) to ensure that it was not biased in favour of, or against, frequently occurring words. To be considered unbiased the proportion of frequently occurring words in the sample should be similar to the proportion of frequently occurring words in the dictionary (Lorge and Chall, 1963). Four different frequency of occurrence norms (Carroll, Davies, & Richman, 1971; Kucera & Francis, 1967; Rinsland, 1945; Thorndike & Lorge, 1944) were used to test the sample bias. For each of these four frequency norms, chi square tests were used to compare the proportion of frequently occurring words that appear as main entry words in this sample with the proportion of frequently occurring words estimated to appear in *Webster's* (1981). All of these tests yielded non-significant results.[4]

The main entry words were ranked in order of difficulty by Anglin (1993). In that study, the words were ordered from the simplest to the most difficult according to ratings of relative difficulty made by 10 adult judges. Pilot testing of 20 children was then conducted and results of this testing was used to determine the final ordering of the words from the

[4] See Anglin, 1993 for a more detailed description of word selection and sample bias testing.

simplest to the most difficult. For the present study, the results of Anglin's (1993) complete study were analyzed. Words were ranked according to the number of children who received credit for knowing the word.[5] Since the purpose of ranking according to difficulty is to make the test easier for younger children, the first 55 words were ranked according to the number of first grade children who received credit for knowing them. No first grade children in Anglin's (1993) study attempted to define or answer multiple-choice questions for words beyond word 55. Words 56 through 181 were ranked according to the number of children in Grades 3 and 5 combined who received credit for knowing the words. No children in Anglin's (1993) study attempted to define or answer a multiple-choice question for words beyond 181 except for *drammatico* which was repositioned to word number 134 in the current study, and therefore, these words (except for *drammatico*) remain in the same order as they were in Anglin's (1993) study. Anglin (1993) tested Grade 5 children on only the first 196 main entry words because adult judges thought that 10 year old children would have no chance of knowing more difficult words, which was confirmed in pilot testing with Grade 5 children (p.59). Words 197 through 241 were ranked in order of difficulty by Anglin and Poulin (1994). Sub-entry words used in this study were listed immediately following their corresponding main entries except for synonyms, which were placed at the end of the word list. (See Appendix A for a list of the first 241 main entry words and the 68 corresponding sub-entry words on which participants were tested in this study.)

Morphological Classification

Each main entry word was classified according to five morphological word types by Anglin (1993). These word types are root (R), inflected (IW), derived (D), literal compound

[5] A correction for the possibility of guessing was made to the number of children who received credit in the multiple-choice phase of testing.

(C), and lexical idiom (I). A root word is defined as a single free morpheme (e.g., *plenty*). An inflected word is made up of one free morpheme and an inflectional suffix indicating tense, number, gender, person, or case. Inflected words remain the same part of speech as their root (e.g., *serviced*). Derived words consist of one root morpheme and one or more derivational affixes. Derived words are semantically related to their root morpheme but are often a different part of speech (e.g., *stillness*). Literal compounds are made up of two or more words, which may or may not have inflectional or derivational affixes. The meaning of a literal compound can be determined from knowledge of the meanings of its morphological components (e.g., *live-born; western saddle*). A lexical idiom is also comprised of two or more words (with or without derivational or inflectional affixes) but its meaning is not a literal combination of its constituent root words (e.g., *softheaded; red herring; eleventh hour*). The morphological classifications as reported by Anglin (1993) for the main entries from this word list were made by two independent raters with 94% agreement for the entire sample of 434 main entries. The sub-entry words were classified in the same manner. Two independent raters reached 96.8% agreement for the sample of 125 sub-entry words. All disagreements were resolved through discussion between the two raters. (See Appendix A for the morphological classifications of the first 241 main entries and their corresponding sub-entries.) The numbers and percentages of each of the five morphological word types in the sample are shown in Table 1.

Sample Word Meanings

Dictionary definitions for the first 241 main entry words and the 68 corresponding sub-entry words were compiled.[6] Definitions were either direct quotes or simple paraphrases of

[6] Words beyond the first 241 were determined to be too difficult for students in Grade 11 to know. Therefore, the definitions of words 242 to 434 were not compiled for the vocabulary test.

Table 1

The Number of Each Word Type in the Dictionary Sample

Word Type	Main Entries	Sub-Entries	Total Entries
Root Words	124 (28.57%)	21 (16.80%)	145 (25.94%)
Idioms	82 (18.89%)	9 (7.20%)	91 (16.28%)
Inflected Words	20 (4.61%)	42 (33.60%)	62 (11.09%)
Derived Words	140 (32.26%)	38 (30.40%)	178 (31.84%)
Literal Compounds	68 (15.67%)	15 (12.00%)	83 (14.85%)
Total	434 (100%)	125 (100%)	559 (100%)

those listed in Webster's (1981). Anglin (1993) had compiled a list of the most common meanings of each of the 241 main entries including homographs for some words (e.g., *flop*). However, all meanings for the words were considered in compiling the current list, not just the most common meanings. Meanings for each of a set of homographs (e.g., 1 *flop*, 2 *flop*, 3 *flop*) were all included.[7] Each sense of a word (indicated by bold faced Arabic numerals) listed in Webster's (1981) was included. Occasionally more than one sub-sense of a numbered sense (indicated by boldface lowercase letters) were also included if these sub-senses were judged by the author to be sufficiently different from one another (e.g., *disburden 1a: to rid something or someone of a load, b: to relieve of something oppressive to the mind*). Meanings that were listed in Webster's (1981) as obsolete or archaic were not included.

This compilation resulted in a list of 127 main entry words that each had a single meaning and 114 main entry words that had multiple meanings. There were a total of 446

[7] Anglin (1993) counted homograph entries as one main entry. However, a child could receive credit for knowing a word if the child could express knowledge of any meaning or homograph of the word.

meanings associated with those 114 polysemous words. Two of the polysemous main entry words had sub-entries with more than one additional meaning associated with it (not just an inflection, derivation, or synonym for the main entry). One was an idiom sub-entry, *behind the scenes*, of the word *scene*, which had two meanings. The other was a synonym, *Edwardian*, of the main entry word *Edwardean*, which had two additional meanings not listed under the main entry. In addition, two of the non-polysemous main entry words had sub-entries with more than one meaning, *Devon* (three meanings) and *Somerset* (seven meanings). They were synonyms of the main entry words, *Devonshire* and *Somersetshire*. This resulted in a total of 118 polysemous main or sub-entry words with 460 associated meanings. (See Appendix B for a list of the polysemous words and their meanings.)

Grammatical Classification

Each of the 460 meanings for the 118 polysemous words identified in this study was classified according to part of speech. Five grammatical classifications were identified in this sample: nouns, verbs, adjectives, adverbs, and one interjection. This type of classification was done in order to determine which pairs of meanings might have been converted from one part of speech to another. The grammatical classifications were made by consulting the *Webster's* (1981) dictionary. In most cases, the grammatical classification was clearly indicated in the dictionary. Thus, two independent raters reached 99% agreement for the entire sample of 460 meanings. Disagreements between the raters were resolved though discussion. (See Appendix B for a list of polysemous words and their meanings with grammatical classifications.)

Preliminary Study One

The purpose of study one was to determine how semantically related each polysemous meaning of a word was to each other meaning of that word. This information was used to classify meanings as homonyms (not semantically related). It was also used to determine which meanings were so closely related that they could be combined to form one meaning that is more general. Finally, the semantic relatedness ratings were used as a variable in analyses of participants' performance on the vocabulary test described below in the main study.

Method

Participants

Ninety-six undergraduate students at the University of Waterloo participated as part of the requirements of an introductory psychology course. Equal numbers of male and female undergraduates participated in this study. Participants' ages ranged from 18 to 69 years old ($M = 21.92$, $SD = 6.70$). All participants spoke English as their first language.

Materials

The 118 polysemous words identified from the original dictionary sample as described above and their corresponding meanings were used to construct test booklets for this study.

Test booklets. The first page of each booklet consisted of a page of written instructions, which included three examples. On the top of each subsequent page was a 7-point rating scale ranging from 1 (completely unrelated) through 4 (somewhat related) to 7 (highly related). On each of these pages, polysemous words were printed 8 to 10 per page. Below each word, two meanings for that word were printed followed by a blank space where participants could indicate their rating for each pair of meanings. Combining every possible pair of meanings for each of the 118 polysemous words generated a total of 933 different pairs of meanings. These

were divided into four separate test booklets, three containing 233 pairs of meanings and one containing 234 pairs. The pages within each test booklet were shuffled to create a pseudo-random ordering of words for each participant. (See Appendix C for a sample of the test booklet instruction page and a sample of a rating page used in study one.)

Procedure

Participants were tested in small groups in a classroom in the psychology department. Each of the 96 participants was randomly assigned to one of four groups with the restriction that there would be 24 participants in each group, 12 male and 12 female. Each group was given a different one of the four test booklets. The instructions were read aloud to the participants. They were instructed to work at their own pace and turn in their test booklet when completed.

Results

For each pair of meanings an average semantic relatedness score was calculated from the 24 participants' scores. If any pair of meanings had an average semantic relatedness rating of 2.0 or less, those two meanings were classified as homonyms. In any further analyses, they are considered psychologically unrelated homonyms whether or not they are linguistically related since participants have rated them as being completely unrelated on this scale. If any pair of meanings had an average semantic relatedness rating of 6.0 or greater, those two meanings were considered to be basically the same. Therefore, one more general meaning, encompassing the ideas expressed in both meanings, was constructed. For example, according to *Webster's* (1981) the word *changed* means both *that something has been made different* and *that something has turned into something markedly different.* These two meanings had an average semantic relatedness rating of 6.08. Therefore, they were combined into one more

general meaning, *that something has been made or turned into something different.* There were 23 pairs of meanings that had an average semantic relatedness score of 6.0 or greater. These 23 meaning pairs were all combined into new meanings that are more general. (See Appendix D for a list of the 23 meaning pairs that were combined.) As a result of these combined meanings, four of the original 114 polysemous main entry words were no longer considered polysemous for this study. They no longer had multiple meanings but had one more general meaning to be used in the vocabulary test. Therefore, preliminary study two included a total of 110 polysemous main entry and four polysemous sub-entry words with 435 associated meanings.

Preliminary Study Two

The purpose of study two was to determine which meaning for each polysemous word was the most well known by adults and to eliminate any of the polysemous meanings that were not likely to be known by any adults. This study was also designed to be a guide for determining the order that the multiple meanings of words were to be presented to the students in the vocabulary test below. The vocabulary test was designed so that participants would be asked to define words ordered from the simplest to the most difficult. For words with multiple meanings, the meanings were also ranked according to difficulty. It was assumed that the larger the number of adult participants who knew a particular meaning of a word, the more likely that meaning was to be known by younger participants on the vocabulary test (less difficult). Therefore, the results of adults' performance on preliminary study two were used to determine the final list of words and meanings and the ordering of presentation of multiple meanings for the vocabulary test below.

Method

Participants

Eighty undergraduate students at the University of Waterloo participated as part of the requirements of an introductory psychology course. Equal numbers of male and female students participated. Participants' ages ranged from 18 to 23 years old (M = 19.15, SD = 0.99). All participants spoke English as their first language.

Materials

The 114 polysemous words remaining after preliminary study one and their 435 corresponding meanings were used to construct test booklets for this study.

Test booklets. The polysemous word list was divided into four separate lists of 28 or 29 words each, which were used in four versions of the test booklet. Each test booklet consisted of three sections. The same 28 or 29 words were used in each of the three sections of the test booklet. The first page of each section of the test booklets was a page of written instructions, which included three examples. In section one, each of the following pages had polysemous words printed approximately six per page. Below each word were two blank lines labeled definition and sentence where participants could write one definition or defining sentence for each word. In section two, each of the pages had two of the polysemous words printed followed by 10 blank lines each where participants could write as many definitions or defining sentences as they could think of for each word. Section three was subdivided into four subsections, each containing seven or eight polysemous words. On the top of each page of section three, seven or eight polysemous words were printed. Below these words was a list that consisted of a random ordering of all the meanings for those seven or eight words plus one meaning for each word that did not define any of these words (distracters). Since the words varied greatly in the number of multiple meanings they had, some words having only two meanings and some as many as 10, the words were selected to be combined into groups such that each grouping had approximately 40 meanings including the 7 or 8 distracters. Each meaning in the list was preceded by a short blank line where participants could indicate which word was defined by each meaning or indicate with an *X* if they did not recognize that meaning as defining any of the given words. The pages of each section of the test booklets (not including the instruction page) were shuffled to create a pseudo-random ordering of words within each test booklet for each participant. (See Appendix E for samples of the instruction

pages for the test booklets and samples of questions from each section of the test booklets used in study two.)

Procedure

Participants were tested in small groups in a classroom in the psychology department. Each person was randomly given the first section of one of the four test booklets with the restriction that each of the four booklets was completed by 20 participants, 10 male and 10 female. The instructions were read aloud to the participants. They were instructed to work at their own pace and indicate to the investigator when they had completed each section of the test booklet. Each participant was given section two of their test booklet when they had completed section one. When each participant had completed sections one and two, the investigator took those sections from him or her and gave him or her section three of the test booklet.

Results

For each word, a frequency score based on the performance of the twenty participants was calculated. For each meaning, a score of one was given for each participant who produced a definition or an illustrative sentence for that meaning in either section one or two of the test. Participants did not have to produce an exact dictionary definition but could give a definition that contained the gist of a particular meaning or could use the word in a sentence that represented that meaning in context. A second rater coded six out of every twenty participants (30% of the data) for each questionnaire version in order to establish inter-rater reliability. Mean inter-rater reliability for coding the meanings was examined by two different methods. First, inter-rater reliability was established based on both raters agreeing that a provided definition or sentence meaning should be credited as an acceptable meaning that would match

one of the available meanings on the polysemous word list. The mean inter-rater reliability in relation to the agreement to code a response for section one was 90.7% and for section two was 88.1%. Secondly, inter-rater reliability was established based on both raters coding a provided meaning with the same corresponding numbered meaning from the polysemous word list. The mean inter-rater reliability for an exact coding match for section one was found to be 79.4% and for section two was 85.0%. Examination of the coding between the two raters revealed that mismatches were frequently the result of two or more meanings for a particular word being very similar such that they were difficult to differentiate. Instances of disagreement were resolved through discussion of the mismatches and resulted in 100.0% agreement for the final coding of meanings. For section three, a score of one was given for each participant who correctly matched that meaning to the correct word. This resulted in a maximum possible score of 40 for each meaning for all three sections combined (20 for section one and two and 20 for section three), given that 20 participants were tested on each set of polysemous meanings. Any meaning that had a score of zero in section one or two of the test and a score of one or zero in section three of the test was eliminated since it is highly unlikely that participants in the oral vocabulary test, described below, would know it. A score of one was used as the cutoff point for section three rather than zero since it is possible for participants to have guessed when matching the correct words and meanings in section three. This resulted in 27 meanings being eliminated from the vocabulary test. (See Appendix F for a list of the meanings eliminated from the vocabulary test.) In addition, since four main entry words had all but one meaning eliminated by this method, those four main entry words no longer were considered polysemous for the purpose of the vocabulary test described below. Therefore, the

vocabulary test included a total of 106 polysemous main entry and four polysemous sub-entry words with 404 associated meanings.

The resulting frequency scores for the meanings of the polysemous words tested in preliminary study two were used to determine the order in which those meanings were presented to participants in the final vocabulary test. Meanings with higher frequency scores were presented to participants before meanings with lower frequency scores. (See Appendix B for the list of polysemous words and meanings with the resulting frequency scores from this study.)

Vocabulary Test

Method

Participants

Twenty students in each of Grades 2, 5, 8, and 11 participated in this study. All participants spoke English as their first language and had no speech impediments or language disabilities (as reported by their parents). The average age was 7 years, 8 months and 27 days for students in Grade 2 (range 7;2;8 to 8;4;4), 10 years, 8 months and 19 days for students in Grade 5 (range 10;0;18 to 11;1;24), 13 years, 9 months and 6 days for students in Grade 8 (range 13;2;27 to 14;3;29), and 16 years, 9 months and 12 days for students in Grade 11 (range 16;2;25 to 17;3;12). There were equal numbers of males and females and equal numbers of students from high and low socioeconomic status (SES) selected such that there were five male upper SES, five male lower SES, five female upper SES, and five female lower SES within each age group. Socioeconomic status was determined by parental occupational information reported in demographic questionnaires, which were distributed to parents along with consent forms, and scored using the 1981 Socioeconomic Index for Occupations (Blishen, Carroll, & Moore, 1987). Blishen et al. (1987) report a mean SES score of 42.74 over the 514 Canadian Census occupations in their index. Therefore, a score of 42.74 was considered the dividing line between upper and lower SES ratings for this study. Students whose parents' occupation ratings scored below 42.74 were considered lower SES (LSES) and students whose parents' occupation ratings scored above were considered upper SES (USES). Across the four grade levels, the mean SES rating was 32.12 for the LSES group and 53.38 for the USES group. In Grades 2, 5, 8, and 11, the means were 26.21, 34.21, 35.22 and 32.85, respectively, for the LSES groups and 54.27, 56.29, 51.47 and 51.48, respectively, for the USES groups.

Materials

The list of words used in this study consisted of the first 241 main entry words from Anglin (1993) as well as their 68 corresponding sub-entry words.

Multiple-choice questions. Multiple-choice questions for the most common meanings of the first 241 main entry words in the sample were taken from *J. M. Anglin's Revised Test of Absolute Vocabulary Knowledge* (Anglin & Poulin, 1994). These questions were designed to be used when a student did not explicitly define a word or use it in a defining sentence (see procedure below). Each question consists of four alternative responses of which only one was correct. The alternatives were short phrases and the correct alternative was a simple paraphrase of the meaning of the word. For example:

The word *closet* means:

a) a small room in which clothes are kept,

b) a trunk on a car,

c) a room in which there is a stove or oven, or

d) a book, which can be locked.

Anglin and Poulin's (1994) multiple choice questions were used for the 135 non-polysemous main entry words and one meaning of the 106 polysemous main entries. Additional multiple-choice questions were constructed for all of the other main entry meanings (those that were determined to be different from one another and likely to be known by Grade 11 students based on studies one and two). These multiple choice questions were constructed according to the nine guidelines generated by Anglin (1993) as follows:

"1. All alternatives should be expressed simply and clearly.
2. There should be only one correct answer; the remaining alternatives should be clearly incorrect in view of all possible meanings for the word.

3. Although clearly incorrect, the wrong alternatives (distracters) should be plausible. They should be of the same part of speech as the right answer and of roughly the same length and complexity. In general, avoid irrelevant clues to the correct choice and avoid farfetched alternatives…
4. The correct choice should be a simple paraphrase, or in some cases a synonym, of the most common meaning…
5. Choices should be phrased in words that occur more frequently than the test word. Frequency of occurrence norms should be consulted for this purpose…
6. Never use a test word, or a component morpheme of the test word, in the alternatives.
7. Do not use "none of the above," "all of the above," or "some of the above" as choices.
8. The correct alternative for inflected words, derived words, and literal compounds should capture the entire meaning of the word. In constructing the distracters as well as the right answers for such words, each component part of the word should therefore be varied…
9. The final set of four choices should be randomly assigned to the first, second, third, and fourth position, with the restriction that the correct answer never occurs in the same position for more than two consecutive words." (Pp. 55-56)

Two exceptions to these guidelines were made in constructing multiple-choice questions for the multiple meanings of polysemous words. The first exception was that guideline number four does not apply in this case since multiple choice questions were constructed for all meanings to be tested not just the most common meaning. The second exception is that guideline number five was relaxed in cases of very infrequent (according to the results of study two) meanings for a word. In some cases, the frequency of the test word is slightly higher than one of the words in the multiple choice answers. In constructing the multiple choice questions *The Educator's Word Frequency Guide* (Zeno, Ivens, Millard, & Duvvuri, 1995) was consulted. This book is based on a larger sample of words (over 17 million tokens) than the frequency of occurrence norms consulted by Anglin (1993) (Carroll et al., 1971; Kucera & Francis, 1967; Rinsland, 1945; Thorndike & Lorge, 1944). This means that more of the words in the sample are included in this frequency of occurrence norm. Zeno et al. (1995) is based on samples of text from students' reading material for several grade

levels. Therefore, it is quite appropriate to choose this as the basis of determining the frequency of words in the multiple-choice alternatives. However, the fact that more words from the sample are included in Zeno et al. (1995) means that more of the multiple choice questions must take into account the frequency of the words used in the alternatives. In most cases, this is not a difficult task. However, there are a few cases where the words used in the correct meaning of the word are less frequent than the test word and more frequent alternative words cannot be found. For example, the word *changed* has a frequency of occurrence score of 168 in Zeno et al. (1995). The word *clothes* has a frequency score of 126. The word *clothes* is less frequent than *changed* but the meaning of the word *changed, that someone has put on different clothes,* cannot be expressed in any other more frequently occurring words. (See Appendix G for a list of less frequent words used in multiple-choice alternatives.)

Multiple-choice questions were also constructed for the 68 sub-entry words. Multiple-choice questions for sub-entries that are root words, literal compounds, or idioms were constructed in the same way as the main entries. However, of the 68 sub-entry words to be tested, 40 are either derived or inflected words. The multiple-choice questions for these words were constructed to test grammatical usage (Malloy, 1992). The rationale for testing grammatical usage stems from the fact that the meanings for these words differ from the main entry primarily in terms of grammatical usage. Therefore, if the student being tested has already received credit for one or more meanings of the main entry word, he/she can then receive credit in the multiple-choice test for recognizing the correct grammatical usage of the word. For example, after a student had displayed knowledge of the main entry word *enjoyable*, the following question would be used to test knowledge of the sub-entry word *enjoyably*:

The word *enjoyably* is used correctly in the sentence:

a) The enjoyably children were playing in the sandbox;
b) The children were playing in the enjoyably sandbox;
c) The children enjoyably in the sandbox; or
d) The children were playing enjoyably in the sandbox.

(See Appendix H for a sample of multiple-choice questions and answers.)

Procedure

Vocabulary testing was conducted by means of individual private interviews with each student. Each student was tested over a number of sessions. No student was tested more than once on the same day or more than twice in the same week. The average time taken to complete the interview was 1 hour, 41 min, for second grade students (session length M = 27 min), 3 hours, 20 min, for fifth grade students (session length M = 36 min), 5 hours, 14 min, for eighth grade students (session length M = 48 min) and 5 hours, 31 min, for eleventh grade students (session length M = 55 min). All sessions were audio-recorded for later transcription.

The vocabulary test procedure was adopted from Anglin (1993). The initial testing session began by explaining the testing procedure to the student, assuring him or her of the confidentiality of results, and explaining that no one is expected to know all the words. Three simple practice words were used to ensure that the student understood the task. The word *lunchroom* was used to demonstrate a multiple choice question and the word *bat* was used to demonstrate possible multiple meanings (both unrelated meanings; *bat* - a flying animal and *bat* - a wooden stick used to hit a baseball; and related meanings; *to bat* - the action of hitting a baseball with a wooden stick). Then the students were tested on the words on the list from the simplest to the most difficult. For each word, the participant was first asked the definition question, "What does the word _____ mean?" Further probe questions, such as, "Can you tell

me anything more about what the word _____ means?" were used at the interviewer's discretion to elicit a more detailed response. If the participant demonstrated sufficient knowledge of the word, the interviewer moved on to the next word. If the meaning was unclear or the definition incomplete, then the interviewer asked the student to demonstrate knowledge of the word by using it in a sentence. The interviewer asked, "Can you use the word _____ in a sentence to show me what it means?" If the student's sentence demonstrated knowledge of the word's meaning, the testing moved on to the next word. If not, the interview proceeded to the multiple-choice question. The multiple-choice question corresponding to the most common meaning (as determined in preliminary study two above) was read first. The participant was instructed to say "yes", "no", or "maybe" to each of the four alternatives as they were being read. If the participant responded "yes" or "maybe" to more than one alternative or responded "maybe" to only one alternative, the interviewer re-read those alternatives until the participant said "yes" to one alternative that he or she thought to be the most correct or said "no" to all of the alternatives. Multiple meanings and sub-entries were tested only if the student successfully demonstrated knowledge of any one meaning for the main entry word (as previous research indicates that if students do not know a given main entry word, they do not know corresponding sub-entries). Sub-entries were tested in the same manner as main entries. Polysemous words were tested according to the following procedure. If a participant successfully gave a definition for a polysemous word, he or she was then asked, "Do you know anything else that the word _____ means?" The interviewer continued to ask this question until the participant had given all of the definitions for that word or until the participant indicated that he/she did not know any more meanings for that word. If the participant had not given any correct definitions of the word, he or she was then asked the

standard sentence question (as above). If the participant had not given all the definitions for the word or had only demonstrated knowledge of one meaning for the word after the standard sentence question, he or she was then asked, "Can you use the word _____ in a sentence to show me that it means something else?" The interviewer continued to ask this question until the participant used that word in sentences that demonstrated all of the remaining meanings for that word or until the participant indicated that they could not use it in any more sentences. If the participant had still not demonstrated knowledge of all the multiple meanings for that word, the interviewer proceeded to the multiple-choice questions and asked all of the multiple choice questions for meanings that the participant had not already demonstrated knowledge.

This method, called Method 1, was used until the student failed to correctly define, or use in a defining sentence, any meaning of seven words in a row and of those seven words he or she had correctly answered multiple choice questions for no more than two words. From this point on, the interviewer used a briefer method of evaluation, Method 2. The student was asked to tell the interviewer if he or she knew a word's meaning by responding "yes", "no", or "maybe" to each of the remaining words as they were read aloud. If the student answered "yes" or "maybe", then the interviewer asked the definition, sentence, and multiple choice questions for that word.

The testing was terminated at main entry word 103 for Grade 2 students, 196 for Grade 5 students, and 241 for Grades 8 and 11 students. As described above (see pp. 36-37) the words were ordered according to the results of Anglin (1993) and Anglin and Poulin (1994). No first grade children in Anglin's (1993) study attempted to define or answer multiple-choice questions for words beyond word 55. No third grade children attempted to define or answer multiple-choice questions for words beyond word 115. Anglin (1993) used a cut-off point of

word 103 for first grade children and word 160 for third grade children. In order to determine an appropriate cut-off point for second grade children, the first five second grade children tested were pilot tested. It was found that no children attempted to define or answer multiple-choice questions for words beyond word 63. Therefore, to be conservative, word 103 was used as the cut-off point for second grade children. No fifth grade children attempted to define or answer multiple-choice questions for words beyond word 181 in Anglin's (1993) study (except for word 188, *drammatico*, which was repositioned to word 134 in the current study) and he used a cut-off point of word 196 for fifth grade children. Therefore, word 196 was also used as a cut-off point for fifth grade children in this study. Anglin and Poulin (1994) using this same word list, concluded that adult participants never knew words beyond word 241. Therefore, word 241 was used as a cut-off point for both eighth and eleventh grade students.

After testing of all of the words was completed, the students were asked about their knowledge about the relationship between the multiple meanings that they had correctly defined, used in a defining sentence, or identified in the multiple-choice questions. The procedure for this additional questioning was explained and three examples were used to demonstrate some possible ways that two meanings for a word might be related. The words *bat, green*, and *table* were used to explain different kinds of conversion relationships, semantically related meanings, and completely unrelated meanings (*bat* – a wooden stick used to hit a ball in baseball; the act of hitting a ball; a flying animal with a mouse-like body; *green* – the colour of grass; unripe; the place on a golf course where you putt the ball into a cup; *table* – a piece of furniture with four legs and a flat surface; an arrangement of information in a written document often presented in a box; the act of presenting a document or matter for discussion). For each pair of meanings that the student demonstrated knowledge of,

he or she was asked, "Why does the word _____ mean both _____ and _____?"

Coding

Word knowledge. The taped interviews were transcribed. Each student's responses were coded to indicate whether they received credit for knowledge of the word meanings and to indicate if that credit was obtained in the definition, sentence, or multiple-choice phase of the test. Incorrect multiple-choice answers were also coded so that they could be counted in the multiple choice correction factors. If a student did not respond "yes" to any of the four multiple-choice alternatives for a particular question, his/her response was not considered an incorrect multiple-choice answer.

The criteria used to determine when credit was given for knowledge of a word are those developed by Anglin (1993). Students were not expected to give exact dictionary definitions but were required to paraphrase the meaning in general terms using different words and morphemes than those making up the test word. For example, if a student defined the word *milk cow* as "*a cow that gives milk*", then the interviewer probed the student for the meanings of the words *cow* and *milk*. Credit was given if the student expressed knowledge of any of the meanings of a particular word listed in *Webster's* (1981). For example, the word *elastic* could be defined as any of "*a rubber band*", "*flexible*", "*adaptable to new ideas*", or "*a fabric woven of yarns containing rubber*". Credit was given for multiple meanings whenever more than one meaning was expressed. For morphologically complex words, the student was given credit only if he or she expressed knowledge of the root morpheme and any affixes. For example, "*including all of mankind*" is a sufficient definition of *universal* but, in order to receive credit for the word *universalness*, the student must also define or indicate knowledge of the affix -

ness along with the word *universal* (e.g., "*the quality of including all of mankind*"). Finally, for idioms, the student was required to express knowledge of the idiomatic meaning found in *Webster's* (1981). For example, a definition of *doubting Thomas* must demonstrate the idea of "*a person who does not believe unless they experience something with their own senses*" rather than "*a man called by the name of Thomas who does not believe*".

Twenty percent of the transcripts were coded by a second person for reliability. The two independent raters reached 97% agreement as to whether or not a participant would receive credit for knowing a word or meaning, and 94% agreement as to which type of credit was given, definition, sentence or multiple-choice and 99% agreement as to which meaning the participant received credit for knowing. All disagreements were resolved through discussion between the two raters.

Correction factors. Multiple-choice questions were corrected for guessing by subtracting one third of the number of incorrect answers from the number of correct responses. A "zero minimum rule" was employed to ensure that no student received a negative score. For example, if a student answered 3 multiple choice questions correctly and 10 incorrectly, he or she received a score of 0.00 and not -0.33 (3 - 10/3 = -0.33).

Polysemous meanings with sub-entries. If a student received credit for more than one meaning of a main entry word and then went on to receive credit for a sub-entry of that word, the student would receive credit for as many meanings of the sub-entry as correspond to the main entry. For example, if the student received credit for 4 of the meanings of the word *flop*, 3 verb meanings and 1 noun meaning, and then received credit for the words *flopped, flops, and flopping* used as a verb, he/she should get credit for 3 meanings of each of *flopped, flops, and flopping* because he/she could potentially understand these inflected forms of the word

flop as applied to any of the 3 known verb root meanings for *flop*. However, he/she would not get credit for a fourth meaning of these inflected sub-entries since these inflected forms are not inflected forms of the noun meaning. This same logic would apply to derived sub-entries, literal compound sub-entries, inflected forms of lexical idiom sub-entries, and sub-entries that are synonyms of main entries. Only in the case of sub-entries that are lexical idioms (of a non-lexical idiom main entry) would a student be required to know those particular meanings of the sub-entry and only get credit for that meaning.

Sub-entry words that are synonyms of the main entry word (or another sub-entry) and are also homophones (differing only in spelling) were not tested separately. A student received credit for these words (e.g., *driveling* and *drivelling*) if they received credit for the corresponding main entry (or sub-entry) to which it is synonymous and they indicated that they recognized the spelling of that synonym as being correct when asked "How would you spell the word _____, like this (indicating one spelling by pointing to the word on a page) or like that (indicating the other spelling) or both ways?.

Morphological problem solving. The students' responses were also coded for evidence of morphological problem solving. Only those words for which they received credit were coded for problem solving. These responses were examined only to the point in testing where credit was given. Therefore, if the student received credit in the definition phase of testing but the sentence phase had also been administered, that sentence phase would not be examined for evidence of problem solving. A main entry word was coded as "PS" for problem solving if any of the following criteria were met:

1. The child mentioned and defined each component morpheme of the word separately in deriving the meaning of the whole word (e.g., if for *firesafe* the child defined *fire* as "flames"

> and *safe* as "protected" and then deduced that *firesafe* means "protected from flames").
>
> 2. The child mentioned and defined first a morphological component of a word, then two parts together, then three parts together, etc., until he or she had come up with the meaning of the whole word (e.g., if for *waspishly* the child defined *wasp* as "a flying insect that looks like a bee and can sting," then *waspish* as "like a wasp," then *waspishly* as "in a waspish way").
>
> 3. The child used a morphemic component of the word by itself before or during the phase of the interview in which credit for knowing the word was given (e.g., if for *soaking* the child mentioned *soak* by itself before or during the phase of the interview in which credit was given).
>
> 4. The child defined a morphological component of the word by itself en route to getting credit for knowing the word (e.g., if the child said, "When you wish for something a lot" which was her definition of hope, and later got credit for hopelessness).
>
> 5. The child produced a different inflected or derived form of the word en route to getting credit for the word (e.g., *soaked* or *soaks* for *soaking, forgot* for *forgotten, hopeful* for *hopelessness,* etc.).
>
> 6. The child defined or used one part of a literal compound separately from the others (see 3 and 4 above) or reordered the words in the literal compound in attempting to define it, it was coded as PS (e.g., if for *firesafe* the child said "safe from fire," or if for *milk cow* the child said "a cow that gives milk," etc.).
>
> 7. The child used or defined a component of a word with more than two morphemes that was itself made up of more than one morpheme en route to getting credit for the whole word, it was coded as PS (e.g., if for *hopelessness* the child used or defined *hopeless* and then got credit for *hopelessness*) (Anglin, 1993 p. 81).

If none of these seven criteria was met, the word was coded as "NE" for no evidence of problem solving.

Sub-entries were coded for evidence of morphological problem solving in a slightly different manner. Sub-entries that were associated with a correctly defined main entry root word were automatically coded as PS, since the root component morpheme had already been defined separately on the way to getting credit for the more complex sub-entry word. For sub-

entries that were associated with more complex main entries, both the main entry response and the sub-entry response were examined for evidence of problem solving. If the student's response to the main entry word showed evidence of problem solving, then the sub-entry response was also coded as PS. If the student received credit for a main entry word in the multiple choice phase of testing, then the sub-entry response alone was considered in coding for problem solving based on the seven criteria outlined above.

A second, independent judge coded 20% of the transcripts to assess reliability. The two independent raters reached 97% agreement and all disagreements were resolved through discussion.

Correction factor. The problem solving analysis also employed a correction factor for multiple-choice responses. Each student's PS and NE scores for each word type were adjusted so that their sum remained consistent with the overall scores for each word type. For this analysis, the overall correction factor for each word type was partitioned according to the proportions of correct multiple-choice questions (mc) that were scored as PS or NE. This was done using the following formula:

$$CF(PS) = [PSmc/(PSmc + NEmc)] \times CF(overall)$$

$$CF(NE) = [NEmc/(PSmc + NEmc)] \times CF(overall)$$

For example, if the overall correction factor for derived words for a particular child was 3.00, and if one third of the correct multiple-choice questions for derived words were coded as PS, and the other two thirds were coded as NE, then the correction factor of 3.00 would have been partitioned into 1.00 for derived words coded as PS and 2.00 for derived words coded as NE.

Relations between multiple meanings. If a student demonstrated knowledge of more than one meaning of a polysemous word in the definition, sentence or multiple-choice phase of

testing, he/she would be asked about the relations between those meanings. Every possible combination of pairs of meanings (for which the participant had received credit) was tested. For each of these pairs of meanings, he or she was asked, "Why does the word _____ mean both _____ and _____?" Responses to these questions were coded as R when students gave a response that explained any reasonable relation between the two meanings and NR when no relation was known or could be explained. A second, independent judge coded 20% of the transcripts to assess reliability. The two independent raters reached 84% agreement and all disagreements were resolved through discussion.

Results

Vocabulary data were compiled separately for main entries, sub-entries, and multiple meanings. Results are presented separately for main entries, total entries (main entries and sub-entries combined), and total meanings (total entries and multiple meanings combined).

Vocabulary Estimation

Mean numbers of main and sub-entry meanings for which students at each grade level received credit (raw scores) were used to estimate overall vocabulary size and vocabulary size for each morphological word type. Estimates of the overall recognition vocabulary and estimates of vocabulary size for each morphological word type for students at each grade level were calculated by multiplying each main entry raw score by a factor of 595.85 and each sub-entry raw score by 530.97. Total recognition vocabulary estimates were calculated for both overall total vocabulary and each morphological word type by summing the main entry and sub-entry estimates together. These factors were used since the 434 main entry words which make up the sample on which students were tested represent 434/258,601 or 1/595.85 of all the main entries in the dictionary and the 125 sub-entry words represent 125/66,371 or 1/530.97 of

all the sub-entries in the dictionary (see Anglin, 1993 for a more detailed explanation of the calculation of the main entry estimation factor and Anglin et al., 1998 for the sub-entry estimation factor).

Vocabulary Results

Main entries. A grade (4) by gender (2) by SES (2) Analysis of Variance (ANOVA) conducted on the number of main entries known (raw scores) showed a significant increase in vocabulary from Grade 2 to Grade 11 ($F(3,64) = 72.744$, $p < .001$) (see Figure 1). The mean numbers of main entry words known at each grade level are presented in Table 2 along with their corresponding vocabulary estimates. Tukey's HSD posthoc tests revealed that the number of main entry words known increased significantly between each grade. There were no other significant effects found from this ANOVA.

Table 2

Mean Number of Main Entry Words Known at Each Grade Level

	Sample Main Entries Known	*SD*	Estimated Main Entries Known	*SD*
Grade 2	24.08	8.85	14,350	5,273
Grade 5	54.73	13.45	32,613	8,014
Grade 8	93.37	21.20	55,633	12,632
Grade 11	111.78	30.91	66,606	18,421

A trend analysis on the number of main entries known as a function of grade revealed a significant linear effect ($F(1,76) = 218.806$, $p < .001$). Children's estimated main entry vocabulary increased by 18,263 words between Grades 2 and 5, 23,020 words between Grades 5 and 8, and 10,973 words between Grades 8 and 11. Even though the rate of increase in

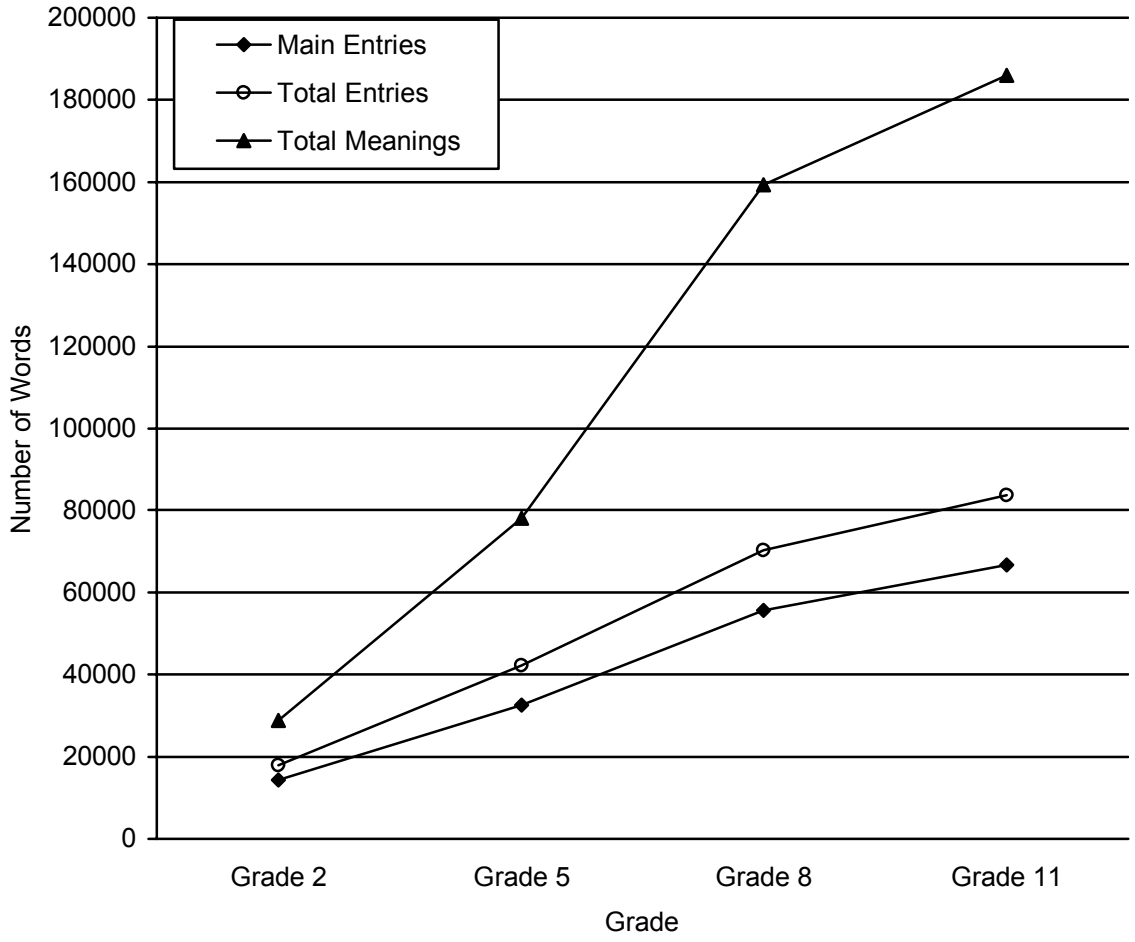

Figure 1. Mean estimated number of main entry words, total entry words, and total word meanings known at each grade.

vocabulary appears to decrease between Grades 8 and 11, no significant quadratic or cubic effects were found.

Children's responses were also examined to see what proportion of the total main entry words known for which credit was earned in the definition, sentence, or multiple-choice phase of testing to see if their type of responses changed with age. For main entries, the mean percentage of credit earned for definitions in Grades 2, 5, 8 and 11 was 36%, 41%, 46%, and 46%, respectively. The mean percentage of credit earned for sentences was 13%, 15%, 13% and 11%, respectively. The mean percentage of credit earned for multiple-choice questions was 51%, 44%, 41%, and 43%, respectively. Three ANOVAs with grade as the independent variable and the proportions of each type of response as the dependent variables failed to find any significant effects for grade. On average participants tended to earn credit for expressing their knowledge of a word in a definition or sentence about 55% of the time and recognized the word in a multiple-choice question about 45% of the time.

Total entries. A grade (4) by gender (2) by SES (2) Analysis of Variance (ANOVA) conducted on the estimated number of total entries known showed a significant increase in vocabulary from Grade 2 to Grade 11 ($F(3,64) = 75.491$, $p < .001$) (see Figure 1). The mean numbers of total entry words known at each grade level are presented in Table 3. Tukey's HSD posthoc tests revealed that the number of total entry words known increased significantly between each grade. There were no other significant effects found from this ANOVA.

A trend analysis on the estimated number of total entries known as a function of grade revealed a significant linear effect ($F(1,76) = 226.421$, $p < .001$). Children's estimated total entry vocabulary increased by 24,174 words between Grades 2 and 5, 28,064 words between Grades 5 and 8, and 13,663 words between Grades 8 and 11. Even though the rate of increase

in vocabulary appears to decrease between Grades 8 and 11, no significant quadratic or cubic effects were found.

Table 3

Mean Estimated Number of Total Entry Words Known at Each Grade Level

	Estimated Total Entries Known	*SD*
Grade 2	17,970	6,825
Grade 5	42,144	10,531
Grade 8	70,208	15,643
Grade 11	83,871	22,322

Again, children's responses were also examined to see what proportion of the total words known for which credit was earned in the definition, sentence, or multiple-choice phase of testing to see if their type of responses changed with age. For total entries, the mean percentage of credit earned for definitions in Grades 2, 5, 8 and 11 was 32%, 37%, 44%, and 44%, respectively. The mean percentage of credit earned for sentences was 13%, 16%, 15% and 12%, respectively. The mean percentage of credit earned for multiple-choice questions was 55%, 47%, 41%, and 44%, respectively. Again, ANOVAs with grade as the independent variable and the proportions of each type of response as the dependent variables were conducted. The ANOVA for the proportion of sentence responses did not find any significant effect of grade. However the definition and multiple-choice ANOVAs did reveal significant effects ($F(3,76) = 5.430$, $p < .003$ and $F(3,76) = 5.724$, $p < .002$, respectively). Tukey's HSD posthoc tests found that Grade 2 students produced a significantly smaller proportion of definitions than Grade 8 or Grade 11 students did and a significantly larger proportion of correct multiple-choice responses than Grade 8 or Grade 11 students. Grade 5 students did not

differ significantly from any other students in either their proportions of definitions or multiple-choice responses. There were no significant differences between Grade 8's and Grade 11's in their response styles.

Total meanings. A grade (4) by gender (2) by SES (2) Analysis of Variance (ANOVA) conducted on the estimated number of total meanings known showed a significant increase in vocabulary from Grade 2 to Grade 11 ($F(3,64) = 76.145$, $p < .001$) (see Figure 1). The mean estimated numbers of total meanings known at each grade level are presented in Table 4. Tukey's HSD posthoc tests revealed that the number of total meanings known increased significantly between Grade 2 and Grade 5 as well as between Grades 5 and 8. The increase in the number of total meanings known between Grades 8 and 11 was not significant. There were no other significant effects found from this ANOVA.

Table 4

Mean Estimated Number of Total Meanings Known at Each Grade Level

	Estimated Meanings Known	*SD*
Grade 2	28,797	13,405
Grade 5	78,078	22,505
Grade 8	159,373	42,303
Grade 11	185,990	51,673

A trend analysis on the estimated number of total meanings known as a function of grade revealed a significant cubic effect ($F(1,76) = 5.842$, $p < .019$). The total estimated number of meanings in children's vocabulary increased by 49,281 meanings between Grades 2 and 5. The greatest rate of increase in meanings known was found between Grades 5 and 8, an

increase of 81,295 meanings. Then the rate of increase in meanings of words decreased to a gain of 26,617 meanings between Grades 8 and 11.

Once more, children's responses were also examined to see what proportion of the total meanings known for which credit was earned in the definition, sentence, or multiple-choice phase of testing to see if their type of responses changed with age. For total meanings, the mean percentage of credit earned for definitions in Grades 2, 5, 8 and 11 was 24%, 25%, 27%, and 27%, respectively. The mean percentage of credit earned for sentences was 11%, 12%, 10% and 8%, respectively. The mean percentage of credit earned for multiple-choice questions was 65%, 63%, 63%, and 65%. Again, three ANOVAs with grade as the independent variable and the proportions of each type of response as the dependent variables failed to find any significant effects for grade. On average participants tended to earn credit for expressing their knowledge of a particular meaning in a definition or sentence about 36% of the time and recognized the meaning in a multiple-choice question about 64% of the time.

Morphological Word Types

In order to ascertain whether children were changing the proportions of each morphological type of words as their vocabularies grew, morphological word type analyses were conducted. Therefore, each child was given five scores for each of root words, inflected words, lexical idioms, derived words, and literal compounds known. These five scores were compiled for each of main entries, total entries, and multiple meanings. Each of these scores was the sum of the credit received by the child for definitions, sentences, and multiple-choice scores (corrected for guessing).

Main entries. A repeated measures analysis of variance with grade, gender, and SES as the between-subject factors and word type as the within-subject factor was conducted on the

main entry raw scores for each of the five word types. Significant between-subject effects were found for grade ($F(3,64) = 72.744$, $p < .001$). This analysis also revealed a significant within-subject effect of word type ($F(4,256) = 368.950$, $p < .001$), and a grade by word type interaction ($F(12, 256) = 55.722$, $p < .001$). [It should be noted that all reported F values for the within-subjects portions of repeated measures ANOVAs were also found to be significant using the Greenhouse and Geisser epsilon, which corrects for possible violations of the assumption of compound symmetry of the covariance matrix (Howell, 2007).] No other significant interactions were found. Mean estimated numbers of main entry words of each morphological word type are reported in Table 5.

Table 5

Estimated Mean Number of Main Entry Words Known for Each Morphologically Defined Word Type

	Grade 2		Grade 5		Grade 8		Grade 11	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Root Words	3,704	1,053	6,703	1,037	8,839	1,749	10,447	2,530
Idioms	447	550	1,907	1,022	3,605	2,126	5,472	2,520
Inflected Words	3,257	1,213	5,204	937	6,564	906	7,329	1,205
Derived Words	3,208	2,322	12,284	4,944	24,837	6,847	30,279	9,237
Literal Compounds	3,734	1,430	6,515	1,463	11,788	2,922	13,079	4,195
Main Entry Total	14,350	5,273	32,613	8,014	55,633	12,632	66,606	18,421

The word type effect was a result of the fact that there were significant differences in the estimates of each word type known collapsed across grades. Lexical idioms had the lowest

mean estimate (M = 2,858) followed by inflected words (M = 5,589), root words (M = 7,423), literal compounds (M = 8,779), and derived words (M = 17,652).

The significant grade by word type interaction is illustrated by Figure 2. The estimated number of each type of main entry word known increased with age. However, the rate of this increase differed for the five word types. The estimated numbers of idioms, inflected words, and root words showed a steady rate of increase with age. The mean estimates for compounds showed a more accelerated growth rate between Grades 5 and 8. However, the number of derived words known showed the most dramatic increase between Grade 2 and Grade 11 surpassing that of all other word types.

Tukey HSD posthoc tests showed that Grade 2 students knew significantly fewer root words than students in all other grades did. Grade 5 students knew significantly fewer root words than Grade 11 students did. Grade 2 students knew significantly fewer idioms than Grade 8 and 11 students. Grade 5 students knew significantly fewer idioms than Grade 11 students did. For inflected words, only Grade 2 students differed from Grade 8 and 11 students. Grades 2 and 5 students differed from every other grade in the number of literal compounds known. All grades differed significantly from every other grade in the number of derived words known.

For the within grade comparisons, in Grade 2 the only significant difference between the numbers of each word type known was for lexical idioms. Grade 2 students knew fewer lexical idioms than any other word type. By Grade 5, children knew significantly more derived words than any other word type and significantly fewer idioms. There were no differences between the numbers of root words, inflected words and literal compounds known in Grade 5. In Grade 8, the only non-significant difference was for the number of root words

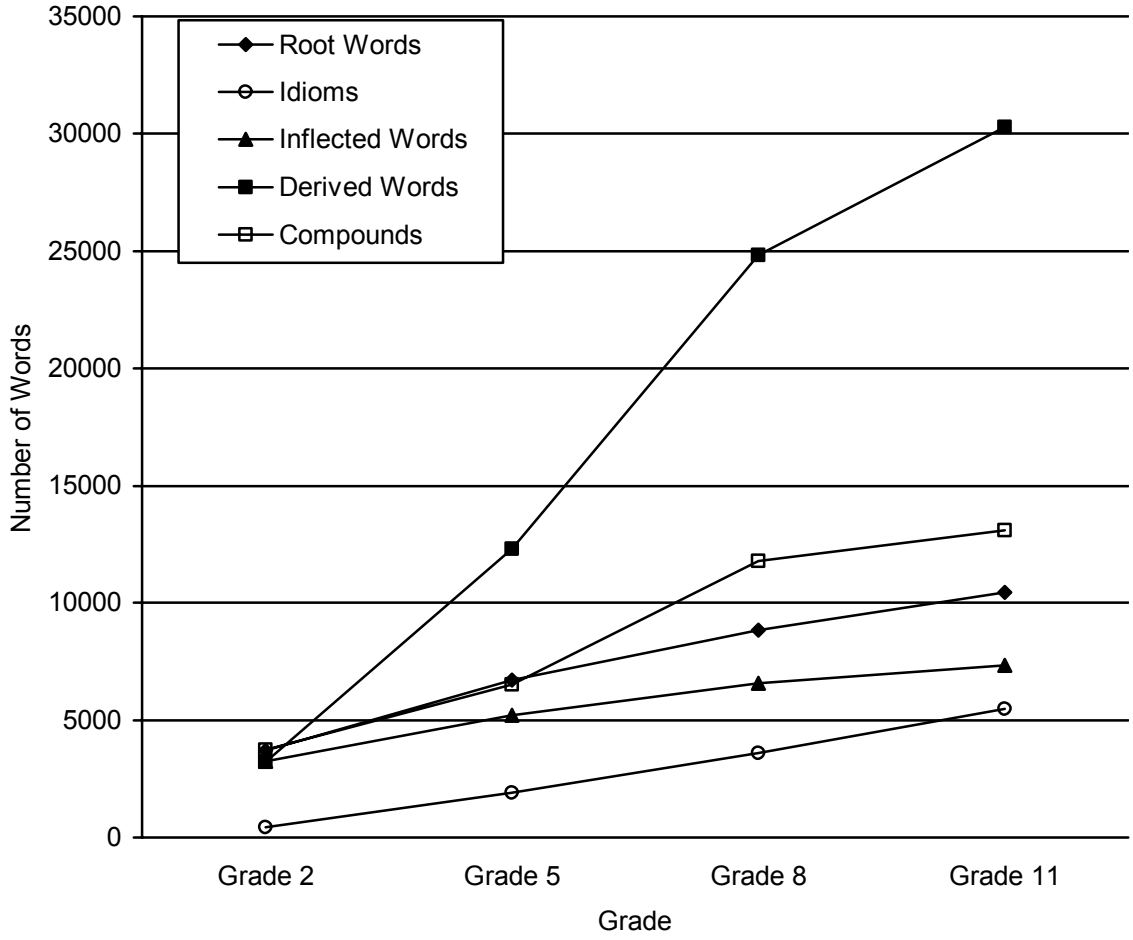

Figure 2. Mean estimated number of main entry words known at each grade for each morphologically defined word type.

and inflected words known. All other word types differed significantly from each other. In Grade 11, there were significantly fewer idioms and inflected words known than root words, derived words or compounds. There were significantly more derived words know than root words or compounds. Therefore, the grade by word type interaction can be understood, at least in part, by the children's dramatically increasing competence with derived words at each age and the accelerated rate of increase in the number of compound words known between Grades 5 and 8.

Trend analyses were also conducted on the main entry estimates for each word type as a function of grade. These analyses found significant linear components for all five word types with values ranging from $F(1, 76) = 92.116$, $p < .001$ to $F(1, 76) = 217.055$, $p < .001$. A significant quadratic component was revealed for inflected words ($F(1, 76) = 6.042$, $p < .017$). This was a decelerating quadratic trend. The greatest increase in the estimated number of inflected words known was between Grades 2 and 5, an increase of 1947 words. The size of the increase in estimated number of inflected words known decreased across ages to 756 words between Grades 8 and 11. A significant cubic component was revealed for compound words ($F(1, 76) = 5.531$, $p < .022$). There was a large increase in the estimated number of literal compound words known between Grades 5 and 8 of 5273 words. The difference between the estimated number of compounds known in Grade 8 and Grade 11 was much smaller, 1291 words.

Total entries. A repeated measures analysis of variance with grade, gender, and SES as the between-subject factors and word type as the within-subject factor was conducted on the estimated total entry scores for each of the five word types. A significant between-subject effect was found for grade ($F(3,64) = 75.491$, $p < .001$). This analysis also revealed a

significant within-subject effect of word type ($F(4,256) = 369.917$, $p < .001$), and a grade by word type interaction ($F(12, 256) = 55.516$, $p < .001$). No other significant interactions were found. Mean estimated numbers of total entry words of each morphological word type are reported in Table 6.

Table 6

Estimated Mean Number of Total Entry Words Known for Each Morphologically Defined Word Type

	Grade 2		Grade 5		Grade 8		Grade 11	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Root Words	3,704	1,053	6,703	1,037	8,892	1,831	10,660	2,869
Idioms	642	772	2,845	1,378	4,879	2,451	7,118	2,948
Inflected Words	5,319	2,020	9,434	1,913	11,697	1,906	12,957	2,158
Derived Words	3,942	2,761	15,090	5,919	30,058	8,204	36,429	10,855
Literal Compounds	4,363	1,693	8,072	2,037	14,682	3,483	16,707	5,029
Total Entry Total	17,970	6,825	42,144	10,531	70,208	15,643	83,871	22,322

The word type effect was a result of the fact that there were significant differences in the estimates of each word type known collapsed across grades. Lexical idioms had the lowest mean estimate ($M = 3,871$) followed by root words ($M = 7,490$), inflected words ($M = 9,852$), literal compounds ($M = 10,956$), and derived words ($M = 21,380$).

The significant grade by word type interaction is illustrated by Figure 3. Tukey HSD posthoc tests showed that Grade 2 students knew significantly fewer root words and idioms than students in Grades 8 and 11. Grade 5 students knew significantly fewer root words and idioms than Grade 11 students did. For inflected words, Grade 2 students differed from

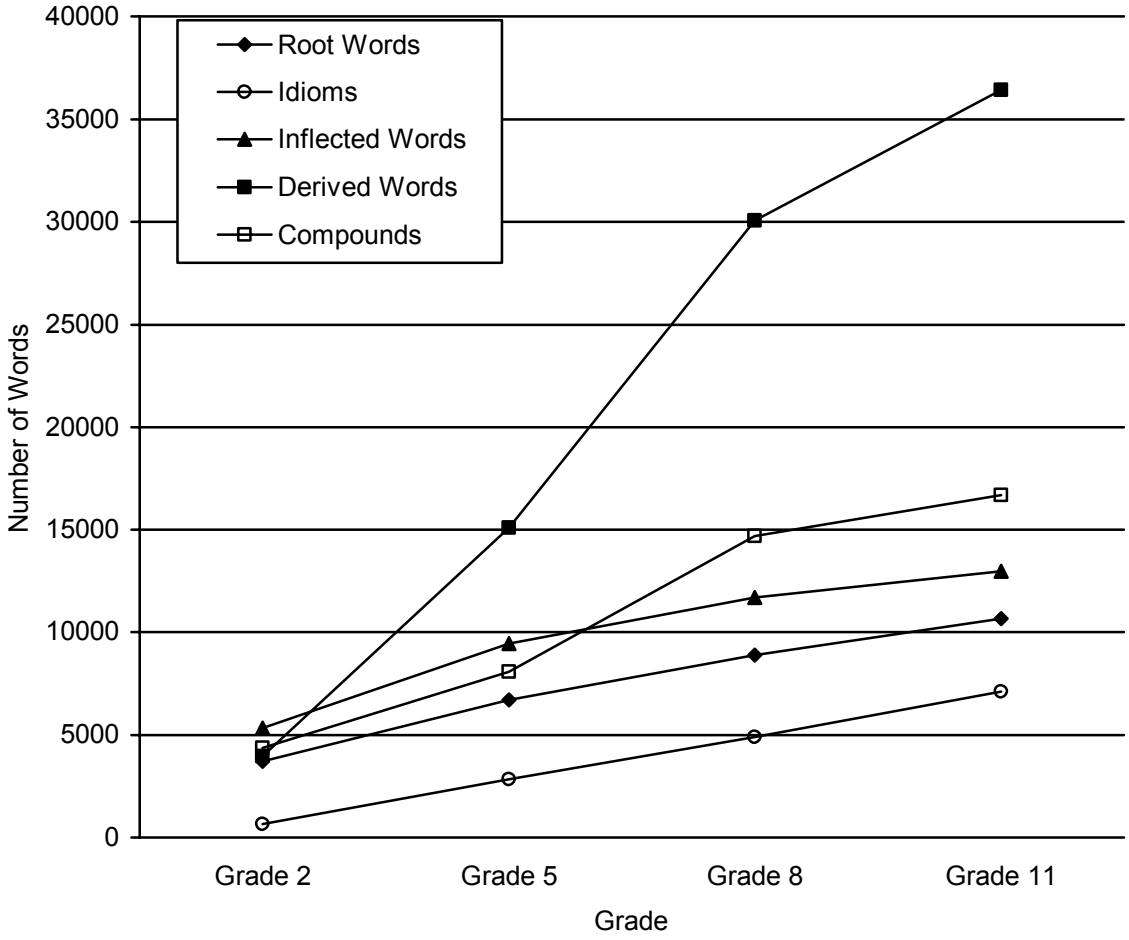

Figure 3. Mean estimated number of total entry words known at each grade for each morphologically defined word type.

students in all other grades and Grade 5 students differed from students in Grade 11. Grades 2 and 5 students differed from every other grade in the number of literal compounds known. All grades differed significantly from every other in the number of derived words known.

For the within grade comparisons, in Grade 2 the only significant difference between the numbers of each word type known was for lexical idioms. Grade 2 students knew fewer lexical idioms than inflected words, derived words and literal compounds. By Grade 5, children knew significantly more derived words than any other word type and significantly fewer idioms. There were no differences between the numbers of root words, inflected words and literal compounds known in Grade 5. In Grade 8, students knew significantly more derived words than any other word type, significantly fewer idioms than all other word types, and knew more literal compounds than root words. In Grade 11, the only non-significant difference was for the number of root words and inflected words known. All other word types differed significantly from each other. Similar to the pattern of knowledge of main entry word types, the grade by word type interaction for total entries can be understood, at least in part, by the children's dramatically increasing competence with derived words at each age and the accelerated rate of increase in the number of compound words known between Grades 5 and 8.

Trend analyses were also conducted on the total entry estimates for each word type as a function of grade. These analyses found significant linear components for all five word types with values ranging from $F(1, 76) = 107.198$, $p < .001$ to $F(1, 76) = 221.959$, $p < .001$. A significant quadratic component was revealed for inflected words ($F(1, 76) = 10.166$, $p < .003$). A significant cubic component was revealed for compound words ($F(1, 76) = 5.042$, $p < .029$).

Total meanings. A repeated measures analysis of variance with grade, gender, and SES as the between-subject factors and word type as the within-subject factor was conducted on the estimated total meaning scores for each of the five word types. A significant between-subject effect was found for grade ($F(3,64) = 76.145$, $p < .001$). This analysis also revealed a significant within-subject effect of word type ($F(4,256) = 287.448$, $p < .001$), and a grade by word type interaction ($F(12, 256) = 46.767$, $p < .001$). No other significant interactions were found. Mean estimated numbers of total meanings known for each morphological word type are reported in Table 7.

Table 7

Estimated Mean Number of Total Meanings Known for Each Morphologically Defined Word Type

	Grade 2		Grade 5		Grade 8		Grade 11	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Root Words	8,272	4,269	18,541	4,724	30,253	6,837	34,976	8,074
Idioms	695	781	3,193	1,530	6,488	3,194	9,309	4,099
Inflected Words	9,931	5,330	22,636	5,498	36,670	9,395	40,232	7,921
Derived Words	5,386	4,512	23,443	10,126	63,663	21,917	75,703	26,469
Literal Compounds	4,513	1,801	10,265	3,469	22,299	5,434	25,770	7,939
Meaning Total	28,797	13,405	78,078	22,505	159,373	42,303	185,990	51,673

The word type effect was a result of the fact that there were significant differences in the estimates of the number of meanings for each word type known collapsed across grades. Lexical idioms had the lowest mean estimate ($M = 4,921$) followed by compound words

(M = 15,712), root words (M = 23,010), inflected words (M = 27,368), and derived words (M = 42,049).

The significant grade by word type interaction is illustrated by Figure 4. Tukey HSD posthoc tests showed that Grades 2 and 5 students knew significantly fewer root word meanings and inflected word meanings than students in all other grades did. For idioms and their meanings, Grade 2 estimates were significantly lower than Grade 11 estimates. Grades 2 and 5 did not differ from each other in the number of literal compounds and their meanings known but they did differ from Grades 8 and 11. All grades differed significantly from every other in the number of meanings for derived words known.

For the within grade comparisons, in Grade 2 the only significant difference between the word types was for lexical idioms. Grade 2 students knew fewer meanings of lexical idioms than meanings of root and inflected words. By Grade 5, children knew significantly more root, inflected, and derived word meanings than either literal compounds or lexical idioms. In both Grade 8 and Grade 11, the only non-significant difference was for the number of root word meanings and inflected word meanings known. All other word types differed significantly from each other. Therefore, the grade by word type interaction can be understood, at least in part, by the children's dramatically increasing competence with derived words at each age.

Trend analyses were also conducted on the estimates of total meanings known for each word type as a function of grade. These analyses found significant linear components for all five word types with values ranging from $F(1, 76) = 113.378$, $p < .001$ to $F(1, 76) = 221.178$, $p < .001$. Significant quadratic components were revealed for root and inflected word meanings ($F(1, 76) = 4.033$, $p < .049$ and $F(1, 76) = 8.019$, $p < .007$). Significant cubic

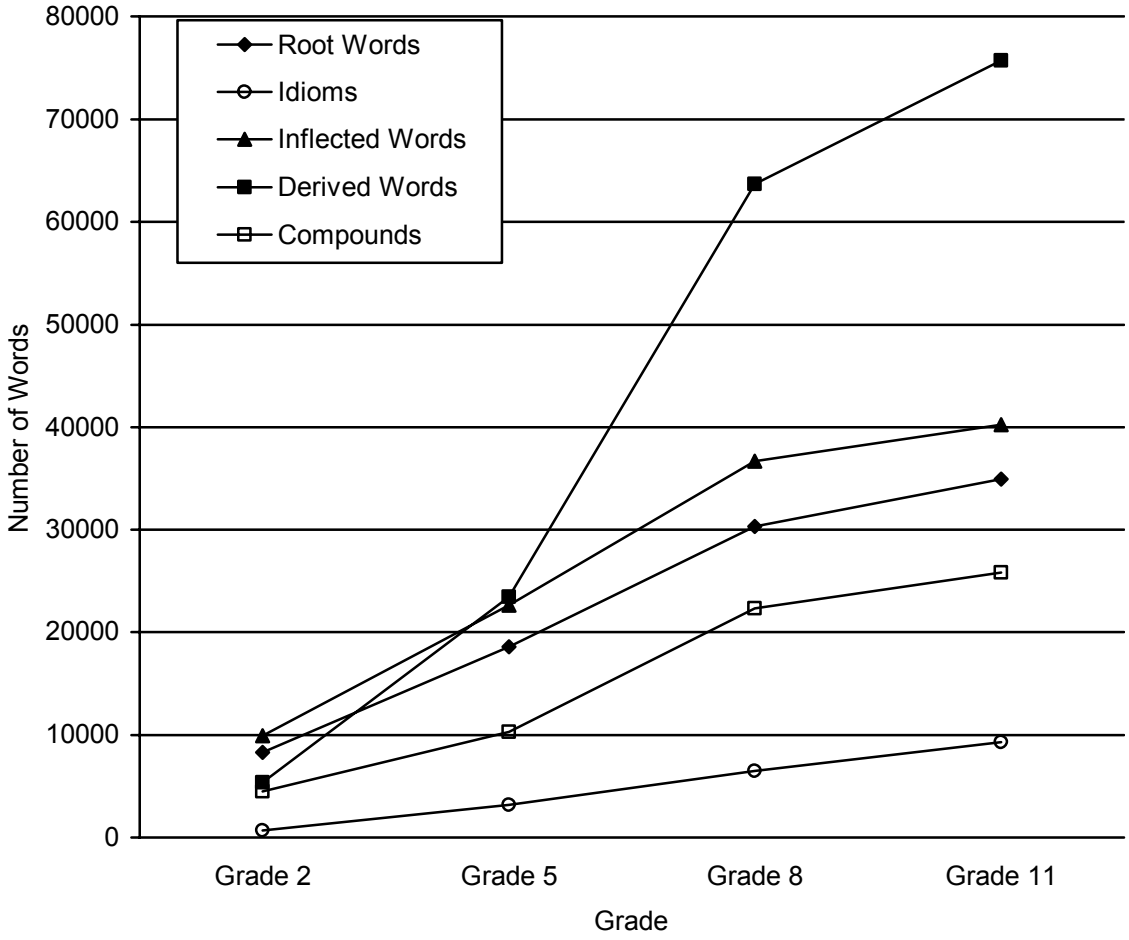

Figure 4. Mean estimated number of total meanings known at each grade for each morphologically defined word type.

components were revealed for derived and compound word meanings ($F(1, 76) = 7.775$, $p < .008$ and $F(1, 76) = 8.176$, $p < .006$).

Word Learning and Morphological Problem Solving

Main entries. The mean estimated number of main entry words at each grade level for which the children's responses would have shown evidence of morphological problem solving (PS), had it been feasible to test them on the entire dictionary population, and the number for which there would have been no evidence of problem solving (NE) are shown in Table 8 . A multivariate analysis of variance was conducted with grade, gender, and SES as the independent variables and the estimates of the number of main entry PS words and the estimates of the number of NE words as the dependent measures. This analysis resulted in a significant multivariate grade effect, $F(6, 128) = 15.066$, $p < .001$. Univariate F-tests revealed significant grade effects for both PS and NE words, $F(3, 64) = 16.061$, $p < .001$ and $F(3, 64) = 65.880$, $p < .001$, respectively. Tukey HSD posthoc tests indicated that Grades 8 and 11 had significantly more PS words than Grades 2 and 5 while all grades differed from every other in the number of words for which there was no evidence of problem solving. (See Figure 5.)

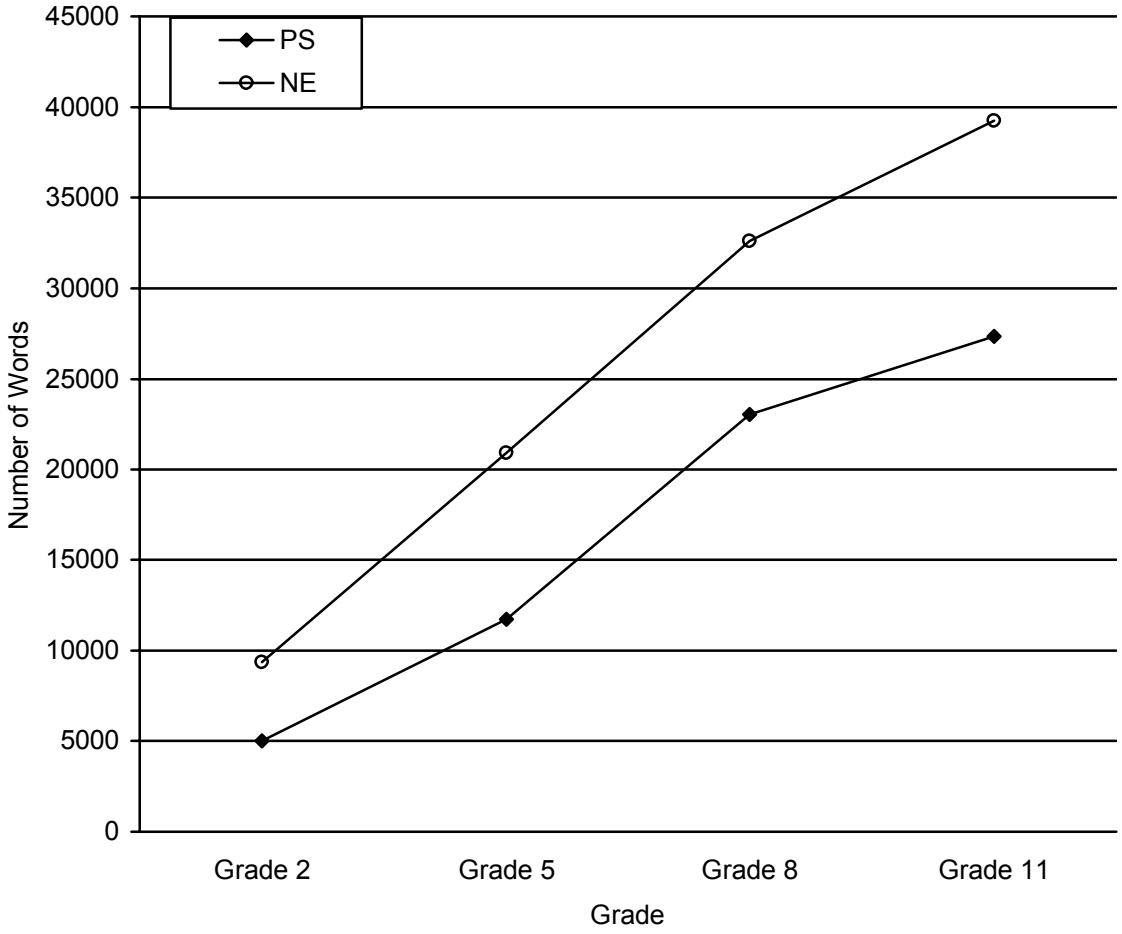

Figure 5. Mean estimated number of main entry meanings for which there was evidence or no evidence of problem solving at each grade level.

Table 8

Mean Estimated Number of Known Main Entry PS and NE Words

	Main PS		Main NE	
	M	*SD*	*M*	*SD*
Grade 2	5,011	3,902	9,339	2,193
Grade 5	11,701	7,660	20,912	6,297
Grade 8	23,038	12,203	32,595	9,398
Grade 11	27,357	17,137	39,249	9,892

The multivariate analysis also revealed a significant interaction between grade and SES, $F(6, 128) = 2.426$, $p < .031$. Univariate *F*-tests found that this interaction was only significant for NE words, $F(3, 64) = 4.713$, $p < .006$. The significant grade by SES interaction is illustrated in Figure 6. Tukey HSD posthoc tests revealed that there were no significant differences between upper and lower SES participants in the number of words for which there was no evidence of problem solving in their definitions for all grades except Grade 11. In Grade 11, the lower SES participants had a greater number of main entry words for which there was no evidence of problem solving in their definitions than the upper SES participants.

Trend analyses were also conducted for both sub-estimates of main entries, PS and NE, as a function of grade (collapsed across gender and SES). This analysis found that both the estimated number of main entry PS and NE words increased in a linear fashion between Grade 2 and Grade 11, $F(1, 76) = 47.573$, $p < .001$ and $F(1, 76) = 178.378$, $p < .001$, respectively. There were no significant quadratic or cubic effects.

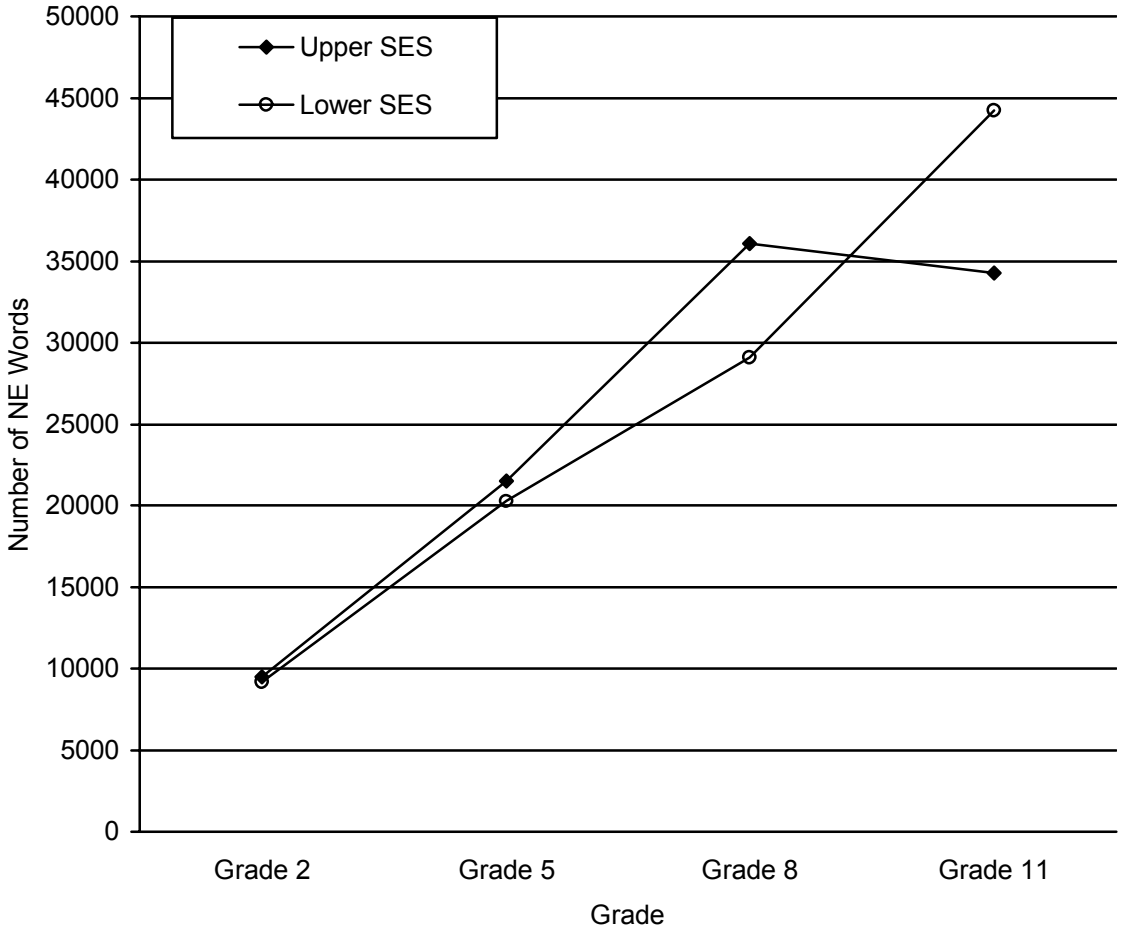

Figure 6. Mean estimated number of main entry meanings for which there was no evidence of problem solving at each grade for each level of SES.

Total entries. The mean estimated number of total entry words at each grade level for which the children's responses would have shown evidence of morphological problem solving (PS), had it been feasible to test them on the entire dictionary population, and the number for which there would have been no evidence of problem solving (NE), are shown in Table 9 . A multivariate analysis of variance was conducted with grade, gender, and SES as the independent variables and the estimates of the number of total entry PS words and the estimates of the number of NE words as the dependent measures. This analysis resulted in a significant multivariate grade effect, $F(6, 128) = 15.077$, $p < .001$. Univariate *F*-tests revealed significant grade effects for both PS and NE words, $F(3, 64) = 21.867$, $p < .001$ and $F(3, 64) = 64.495$, $p < .001$, respectively. Tukey HSD posthoc tests indicated that Grades 8 and 11 participants had significantly more PS words than Grades 2 and 5 while all grades differed from every other in the number of words for which there was no evidence of problem solving. See Figure 7.

Table 9

Mean Estimated Number of Known Total Entry PS and NE Words

	Total PS		Total NE	
	M	*SD*	*M*	*SD*
Grade 2	7,971	5,180	9,999	2,438
Grade 5	19,289	10,517	22,855	6,972
Grade 8	34,518	14,842	35,690	10,708
Grade 11	40,207	20,565	43,664	11,392

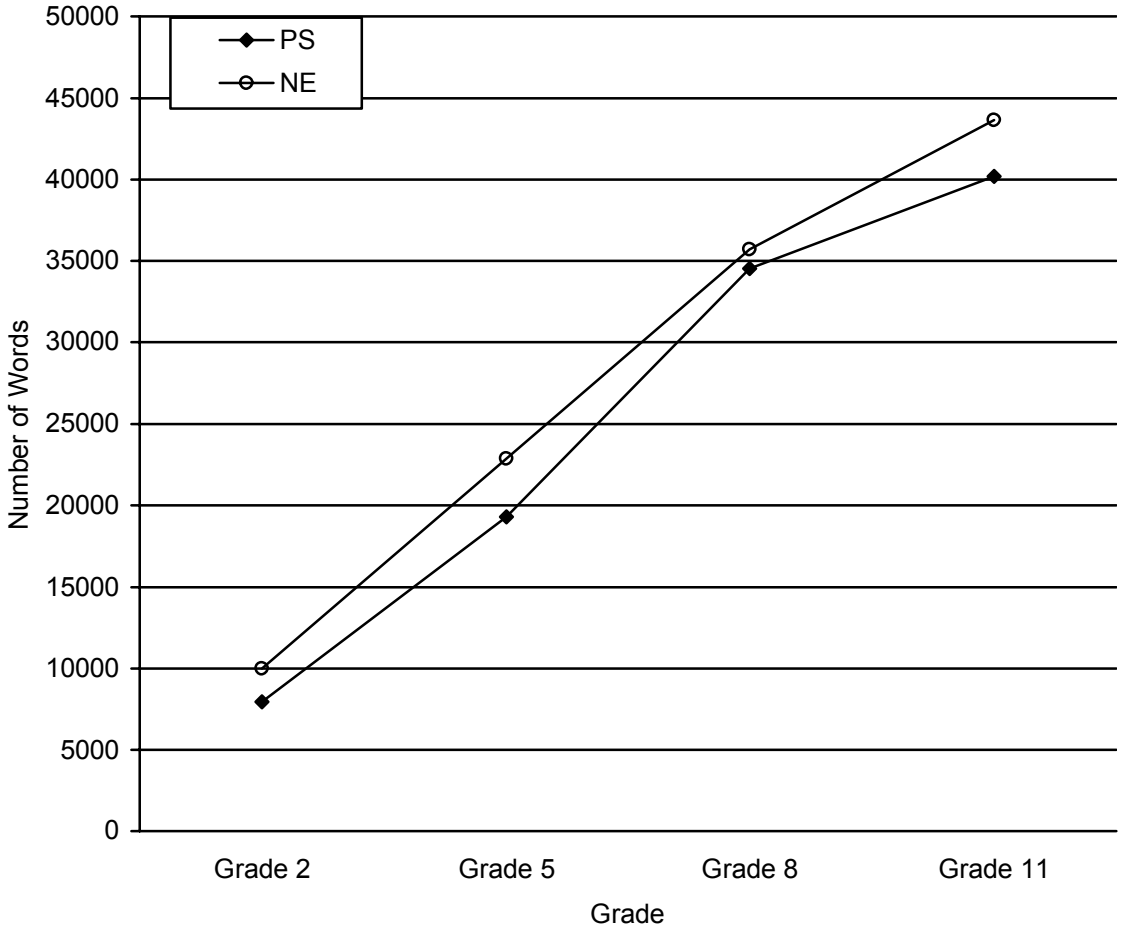

Figure 7. Mean estimated number of total entry meanings for which there was evidence or no evidence of problem solving at each grade level.

The multivariate analysis also revealed a significant interaction between grade and SES, $F(6, 128) = 2.475$, $p < .028$. Univariate F-tests found that this interaction was only significant for NE words, $F(3, 64) = 5.040$, $p < .004$. The significant grade by SES interaction is illustrated by Figure 8. Tukey HSD posthoc tests revealed that there were no significant differences between upper and lower SES participants in the number of words for which there was no evidence of problem solving in their definitions for all grades except Grade 11. In Grade 11, the lower SES participants had a greater number of total entry words for which there was no evidence of problem solving in their definitions than the upper SES participants.

Trend analyses were also conducted for both sub-estimates of total entries, PS and NE, as a function of grade (collapsed across gender and SES). This analysis found that both the estimated number of total entry PS and NE words increased in a linear fashion between Grade 2 and Grade 11, $F(1, 76) = 64.204$, $p < .001$ and $F(1, 76) = 173.349$, $p < .001$, respectively. There were no significant quadratic or cubic effects.

Proportional analysis of main entry problem solving. It is not surprising that the number of words for which participants showed evidence of problem solving increased across grades since the overall number of words known increased with age. In order to look for changes in participants' ability to engage in morphological problem solving, the proportion of each participant's main entries that were coded as PS was calculated. A grade by gender by SES ANOVA was conducted with the proportion of main entries coded as PS as the dependent variable. This ANOVA did not find any significant main effects of grade, gender or SES. On average 36% of the students' main entry answers were coded as showing evidence of problem solving. The grade by gender by SES interaction was significant, $F(3, 64) = 3.510$, $p < .021$. This interaction is shown in Table 10. Simple effects t-tests indicated that in Grade 2 lower

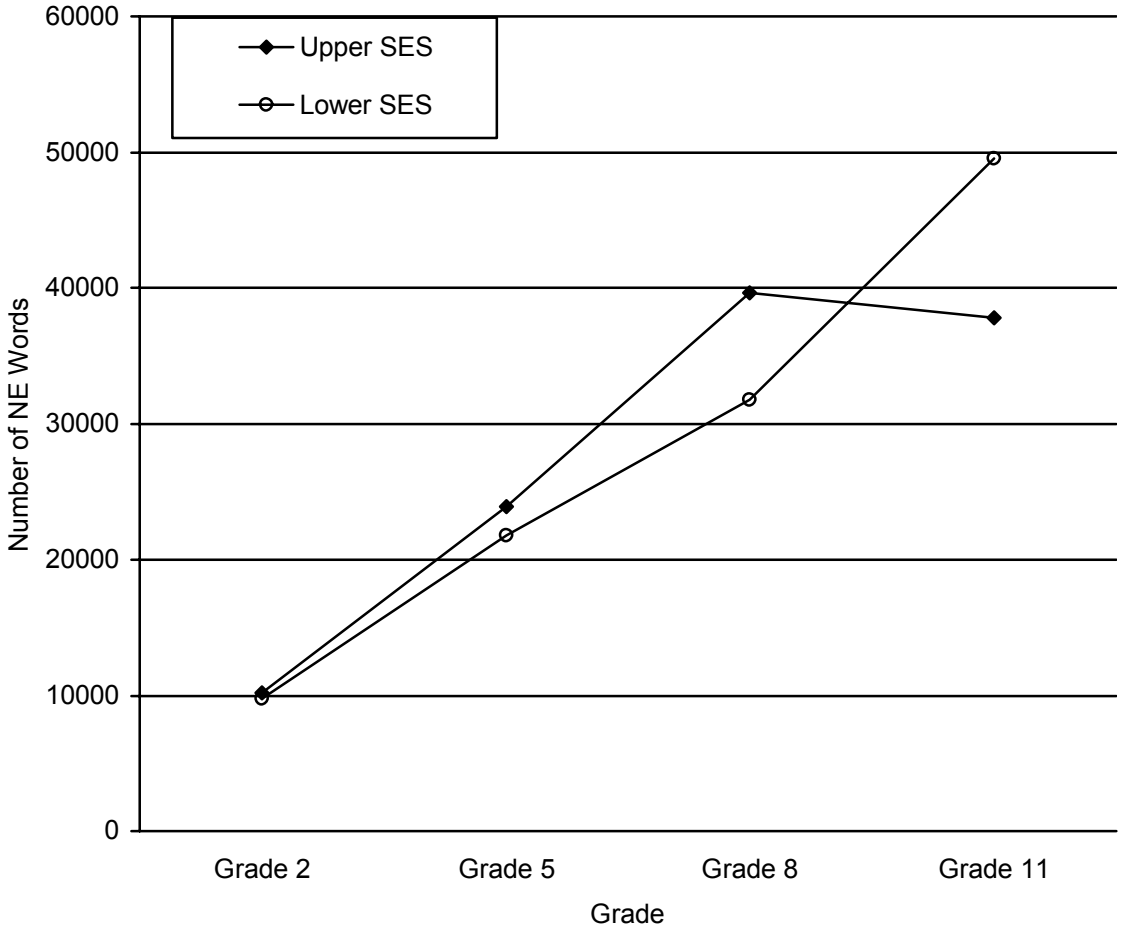

Figure 8. Mean estimated number of total entry meanings for which there was no evidence of problem solving at each grade for each level of SES.

SES females had a significantly smaller proportion of their answers coded as PS than lower SES males ($t(8) = 2.442$, $p < .041$). In Grade 5, both upper SES females and lower SES males had a significantly smaller proportion of their answers coded as PS than upper SES males ($t(8) = 2.607$, $p < .032$ and $t(8) = 3.136$, $p < .015$ respectively).

Table 10

Grade by Gender by SES Interaction for the Mean Proportion of Known Main Entry PS Words

	Upper SES		Lower SES	
	Female	Male	Female	Male
Grade 2	.254	.324	.247	.430
Grade 5	.212	.502	.386	.266
Grade 8	.367	.435	.410	.393
Grade 11	.483	.426	.257	.365

A grade by gender by SES ANOVA was conducted with the proportion of complex main entries (inflected words, derived words, and literal compounds) coded as PS as the dependent variable. Again, no main effects were found between grades or levels of SES. For complex main entries, on average 45% of the students' answers were coded as showing evidence of problem solving. There was a significant main effect of gender, $F(1, 64) = 5.633$, $p < .022$. Only 40% of the females' answers were coded as showing evidence of problem solving whereas 47% of the males' answers were coded as PS. There was also a significant grade by gender by SES interaction, $F(3, 64) = 3.769$, $p < .016$. This interaction is shown in Table 11. Simple effects t-tests analyses indicate a similar pattern to the previous analysis. In Grade 2, lower SES females had a significantly smaller proportion of their answers coded as PS than lower SES males ($t(8) = 3.363$, $p < .011$). In Grade 5, both upper SES females and

lower SES males had a significantly smaller proportion of their answers coded as PS than upper SES males ($t(8) = 2.491$, $p < .038$ and $t(8) = 2.806$, $p < .024$ respectively).

Table 11

Grade by Gender by SES Interaction for the Mean Proportion of Known Complex Main Entry PS Words

	Upper SES		Lower SES	
	Female	Male	Female	Male
Grade 2	.313	.472	.320	.604
Grade 5	.269	.611	.501	.339
Grade 8	.413	.533	.481	.460
Grade 11	.577	.502	.312	.453

Proportional analysis of total entry problem solving. A grade by gender by SES ANOVA was conducted with the proportion of total entries coded as PS as the dependent variable. This ANOVA did not find any significant main effects of grade, gender or SES. On average 45% of the student's total entry answers were coded as showing evidence of problem solving. The grade by gender by SES interaction was significant, $F(3, 64) = 3.504$, $p < .021$. This interaction is shown in Table 12. Simple effects *t*-tests indicated that in Grade 2 lower SES females had a significantly smaller proportion of their answers coded as PS than lower SES males ($t(8) = 2.690$, $p < .028$). In Grade 5, both upper SES females and lower SES males had a significantly smaller proportion of their answers coded as PS than upper SES males ($t(8) = 2.362$, $p < .047$ and $t(8) = 2.581$, $p < .034$ respectively).

Table 12

Grade by Gender by SES Interaction for the Mean Proportion of Known Total Entry PS Words

	Upper SES		Lower SES	
	Female	Male	Female	Male
Grade 2	.389	.425	.303	.503
Grade 5	.325	.568	.481	.375
Grade 8	.437	.519	.494	.477
Grade 11	.547	.502	.341	.442

A grade by gender by SES ANOVA was conducted with the proportion of complex total entries (inflected words, derived words, and literal compounds) coded as PS as the dependent variable. Again, no main effects were found between grades or levels of SES. For complex total entries, on average 54% of the student's answers were coded as showing evidence of problem solving. There was a significant main effect of gender, $F(1, 64) = 5.559$, $p < .022$. Only 49% of the females' answers were coded as showing evidence of problem solving whereas 58% of the males' answers were coded as PS. There was also a significant grade by gender by SES interaction, $F(3, 64) = 3.567$, $p < .020$. This interaction is shown in Table 13. Simple effects *t*-tests indicated that in Grade 2 lower SES females had a significantly smaller proportion of their answers coded as PS than lower SES males ($t(8) = 3.649$, $p < .008$). In Grade 5, lower SES males had a significantly smaller proportion of their answers coded as PS than upper SES males ($t(8) = 2.368$, $p < .046$).

Table 13

Grade by Gender by SES Interaction for the Mean Proportion of Known Complex Total Entry PS Words

	Upper SES		Lower SES	
	Female	Male	Female	Male
Grade 2	.472	.569	.392	.675
Grade 5	.402	.661	.583	.457
Grade 8	.485	.613	.562	.541
Grade 11	.635	.579	.402	.535

Learning the Multiple Meanings of Words

Multiple meaning relation type. Each of the multiple meanings for a word that students received credit for knowing had an associated semantic relation score (from preliminary study one). This semantic relation score was the average score for that meaning paired with the main meaning (the first meaning that the student received credit for knowing). These semantic relations were also used to help categorize type of relation. Homonyms, by definition, had semantic relation scores of 2.0 or less. Converted relations were more closely related meanings that were two different parts of speech. Metaphoric relations were more closely related meanings that were the same part of speech.

For each student, the estimated number of multiple meanings that they knew was broken down into three scores; the number of homonym meanings, the number of converted meanings, and the number of metaphorically extended meanings. A repeated measures analysis of variance with grade, gender, and SES as the between-subject factors and relation type as the within-subject factor was conducted on the estimated multiple meaning scores for

each of the three relation types. Significant between-subject effects were found for grade ($F(3,64) = 67.385$, $p < .001$). This analysis also revealed a significant within-subject effect of relation type ($F(2,128) = 481.503$, $p < .001$), and a grade by relation type interaction ($F(6, 128) = 65.432$, $p < .001$). No other significant interactions were found. Mean estimated number of multiple meanings of each type are reported in Table 14.

The relation type effect was a result of the fact that there were significant differences in the estimates of each relation type known collapsed across grades. Homonyms had the lowest mean estimate ($M = 4,191$) followed by converted meanings ($M = 9,086$), and metaphorically extended meanings ($M = 46,235$).

Table 14

Estimated Mean Number of Multiple Meanings Known for Each Relation Type

	Grade 2		Grade 5		Grade 8		Grade 11	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Metaphorical Extension	7,945	5,926	27,835	10,788	69,570	23,202	79,589	23,353
Conversion	2,641	1,880	6,461	2,536	12,399	3,315	14,842	3,929
Homonym	241	338	1,638	1,625	7,196	3,626	7,688	4,348
Multiple Meaning Total	10,827	7,528	35,934	13,675	89,165	28,721	102,119	30,845

The significant grade by relation type interaction is illustrated by Figure 9. This interaction is a result of the large difference in growth rate of knowledge of metaphorically extended meanings compared to converted meanings or homonyms. Tukey HSD posthoc tests showed that there were no significant differences between grades in the number of homonym meanings that children knew. There was a significant difference between Grade 2 students and Grades 8 and 11 students in the number of converted meanings known. There was also a

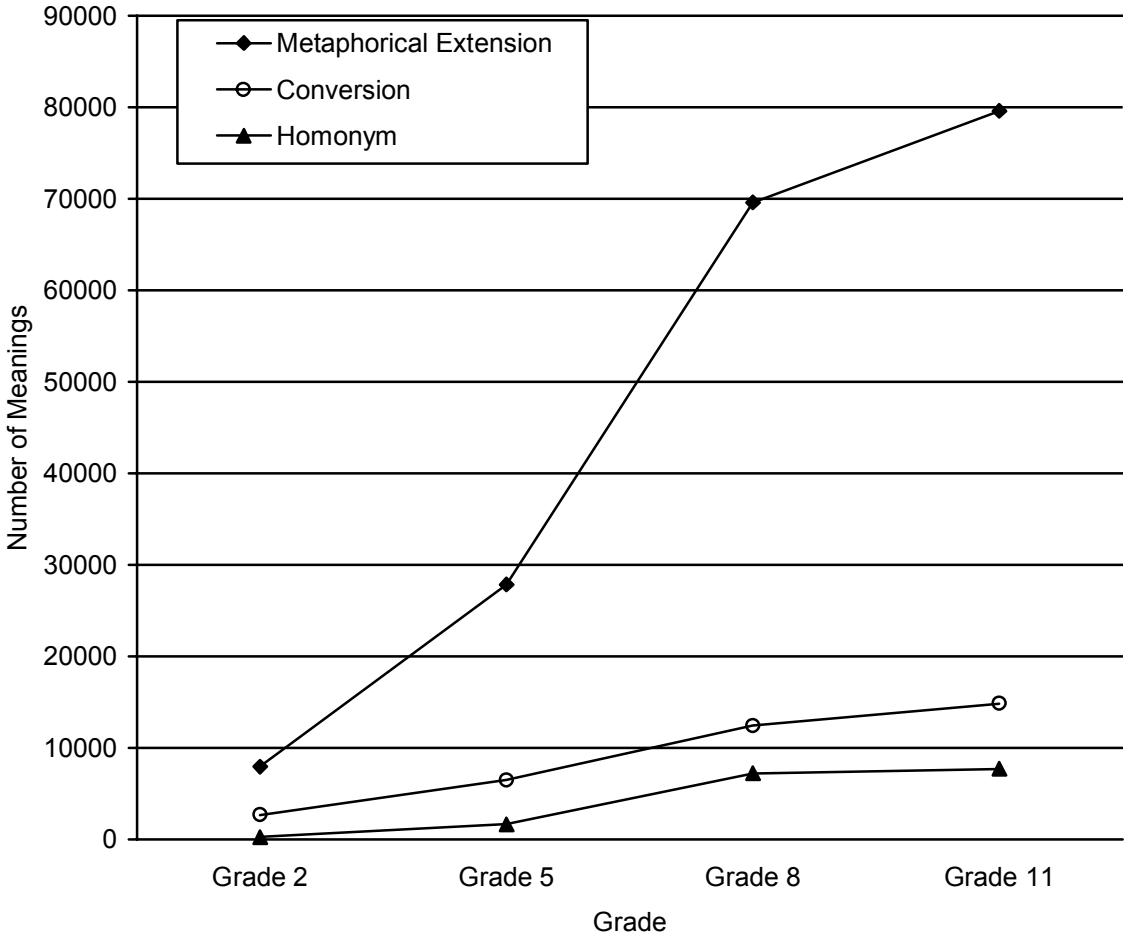

Figure 9. Mean estimated number of multiple meanings known at each grade for each meaning type.

significant difference between all grades in the number of metaphorically extended meanings known.

For the within grade comparisons, in Grade 2 there were no significant differences between the numbers of each meaning type known. By Grade 5, children knew significantly more metaphorically extended meanings than homonyms or converted meanings. This same pattern was true for students in Grades 8 and 11. Therefore, the grade by relation type interaction can be understood, at least in part, by the children's dramatically increasing competence with metaphorically extended meanings at each successive age.

Trend analyses were also conducted on the estimates of multiple meanings known for each relation type as a function of grade. These analyses found significant linear components for all three word types; $F(1, 76) = 213.334$, $p < .001$ for metaphorical extensions, $F(1, 76) = 198.876$, $p < .001$ for conversions, and $F(1, 76) = 89.441$, $p < .001$ for homonyms. Significant cubic components were revealed for metaphorical extensions and homonyms ($F(1, 76) = 9.291$, $p < .004$ and $F(1, 76) = 9.782$, $p < .003$ respectively). The cubic component approached significance for conversions also ($F(1, 76) = 3.461$, $p < .068$).

Proportion one: Proportions of multiple meanings known for each relation type. The increases in the total number of each relation type across grades are confounded by the increases in total vocabulary across grades. In order to investigate changes in participants' ability to understand different types of multiple meanings across grades, two different proportion scores for each multiple meaning relation type were calculated for each participant. The first proportion was calculated by dividing each of their 3 individual relation type scores (metaphorical extensions, conversions, and homonyms) by their individual total multiple meaning score. A repeated measures analysis of variance with grade, gender, and SES as the

between-subject factors and proportions of relation types as the within-subject factor was conducted on these proportion scores for each of the three relation types. Again, a significant within-subject effect of relation type ($F(2,128) = 1232.118$, $p < .001$), and a grade by relation type interaction ($F(6, 128) = 6.670$, $p < .001$) was found. No other significant interactions were found. Mean proportions of each relation type are reported in Table 15.

Table 15

Proportion One: Mean Proportions of Multiple Meanings Known for Each Relation Type

	Grade 2	Grade 5	Grade 8	Grade 11
Metaphorical Extension	.702	.777	.776	.782
Conversion	.278	.183	.143	.148
Homonym	.020	.040	.081	.070

The relation type effect was a result of the fact that there were significant differences in the proportions of each relation type known collapsed across grades. Homonyms had the lowest proportion (.053) followed by converted meanings (.188), and metaphorically extended meanings (.759).

The significant grade by relation type interaction is illustrated by Figure 10. Tukey HSD posthoc tests showed that there were no significant differences between grades in the proportion of homonyms or metaphorically extended meanings that children knew. There was a significant difference between Grade 2 students and all other grades in the proportion of converted meanings known. For Grade 2 students, a significantly larger proportion of the multiple meanings that they knew were meanings that were converted from one part of speech to another.

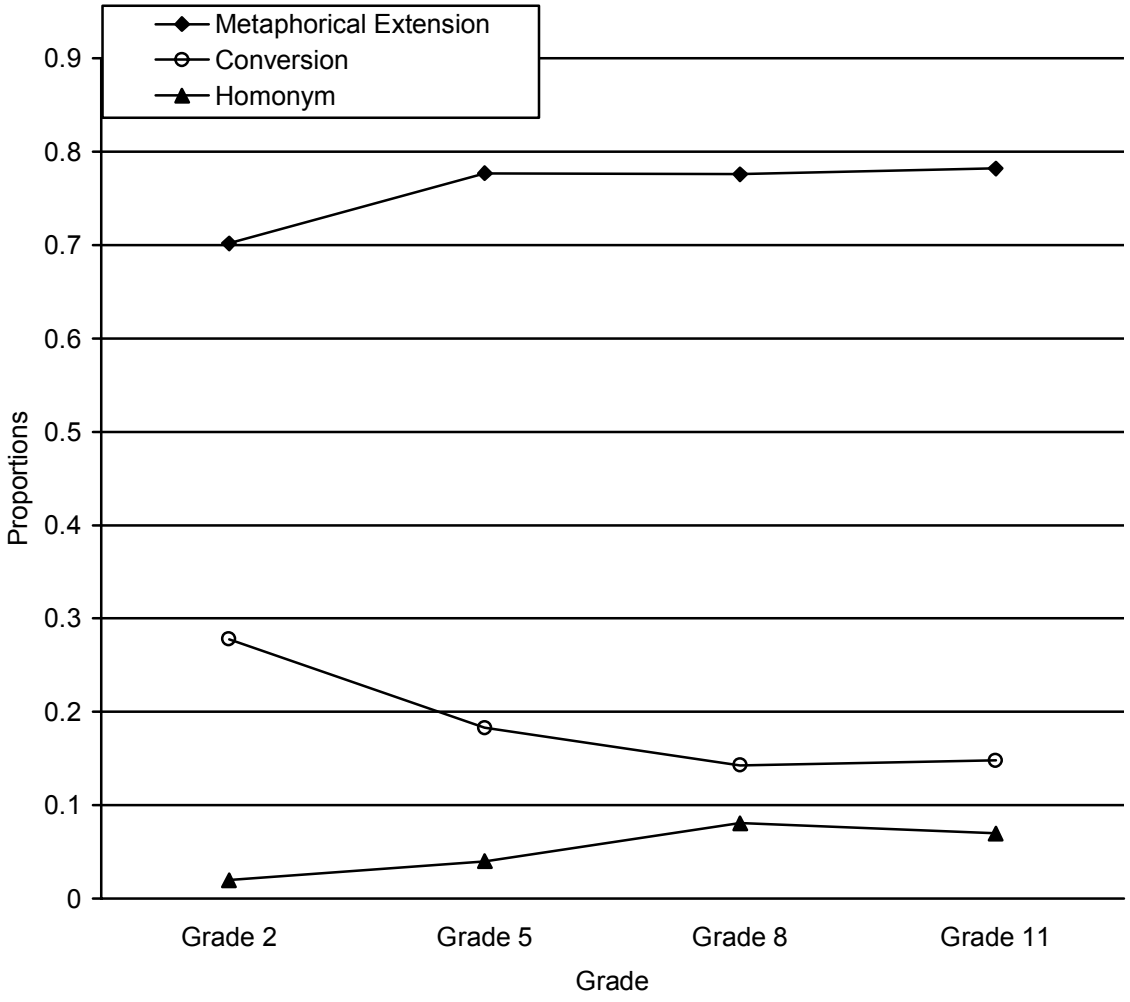

Figure 10. Proportion one: Proportions of each type of multiple meanings known at each grade.

For the within grade comparisons, in Grade 2 and Grade 5 there were significant differences between the proportions of each relation type known. In Grades 8 and 11, the students knew a significantly larger proportion of metaphorically extended meanings but there were no differences between the proportions of converted meanings or homonyms known. Therefore, the grade by relation type interaction can be understood by the Grade 2 and Grade 5 children's relatively greater competence with converted meanings than homonyms.

Proportion two: Proportions of the total multiple meanings in the test that were known for each relation type. The proportional analysis computed above, divides participants' scores into three separate proportions for homonyms, conversions and metaphorical extensions. This gives information about what proportion of each participant's multiple meaning score can be accounted for by each relation type. However, some children knew relatively few of the total multiple meanings in the test and other children knew more. The proportional analysis computed above, does not reflect these differences. A second type of proportion score was calculated for each participant by dividing the number of each type of meaning known (the number of metaphorical extensions, conversions, and homonyms) by the total number of each of those meaning types in the sample of words. A repeated measures analysis of variance with grade, gender, and SES as the between-subject factors and proportions of relation types as the within-subject factor was conducted on these proportion scores for each of the three relation types. A significant within-subject effect of relation type ($F(2,128) = 317.219$, $p < .001$), and a grade by relation type interaction ($F(6, 128) = 34.369$, $p < .001$) were found. No other significant interactions were found. Mean proportions of each relation type are reported in Table 16.

Table 16

Proportion Two: Proportions of the Total Multiple Meanings in the Test that were Known for Each Relation Type.

	Grade 2	Grade 5	Grade 8	Grade 11
Metaphorical Extension	.0192	.0698	.1816	.2106
Conversion	.0286	.0707	.1346	.1610
Homonym	.0023	.0121	.0658	.0712

The relation type effect was a result of the fact that there were significant differences in the proportions of each relation type known collapsed across grades. Homonyms had the lowest proportion (M = .0378) followed by converted meanings (M = .0987), and metaphorically extended meanings (M = .1203).

The significant grade by relation type interaction is illustrated by Figure 11. Tukey HSD posthoc tests showed that there were significant differences between all grades in the proportion of converted or metaphorically extended meanings that children knew. There was a significant difference between both Grade 2 and Grade 5 students on one hand and Grade 8 and Grade 11 students on the other hand in the proportion of homonyms known. Grade 2 students knew a significantly smaller proportion of homonyms than converted meanings. For Grade 5 students, a significantly smaller proportion of the multiple meanings that they knew were homonyms than either converted or metaphorically extended meanings. In Grades 8 and 11, the proportions of all meaning types were significantly different from each other. Therefore, the grade by relation type interaction can be understood at least in part by the Grade 2 children's relatively greater competence with converted meanings than homonyms and an overall increase in competence in all word types in Grades 8 and 11.

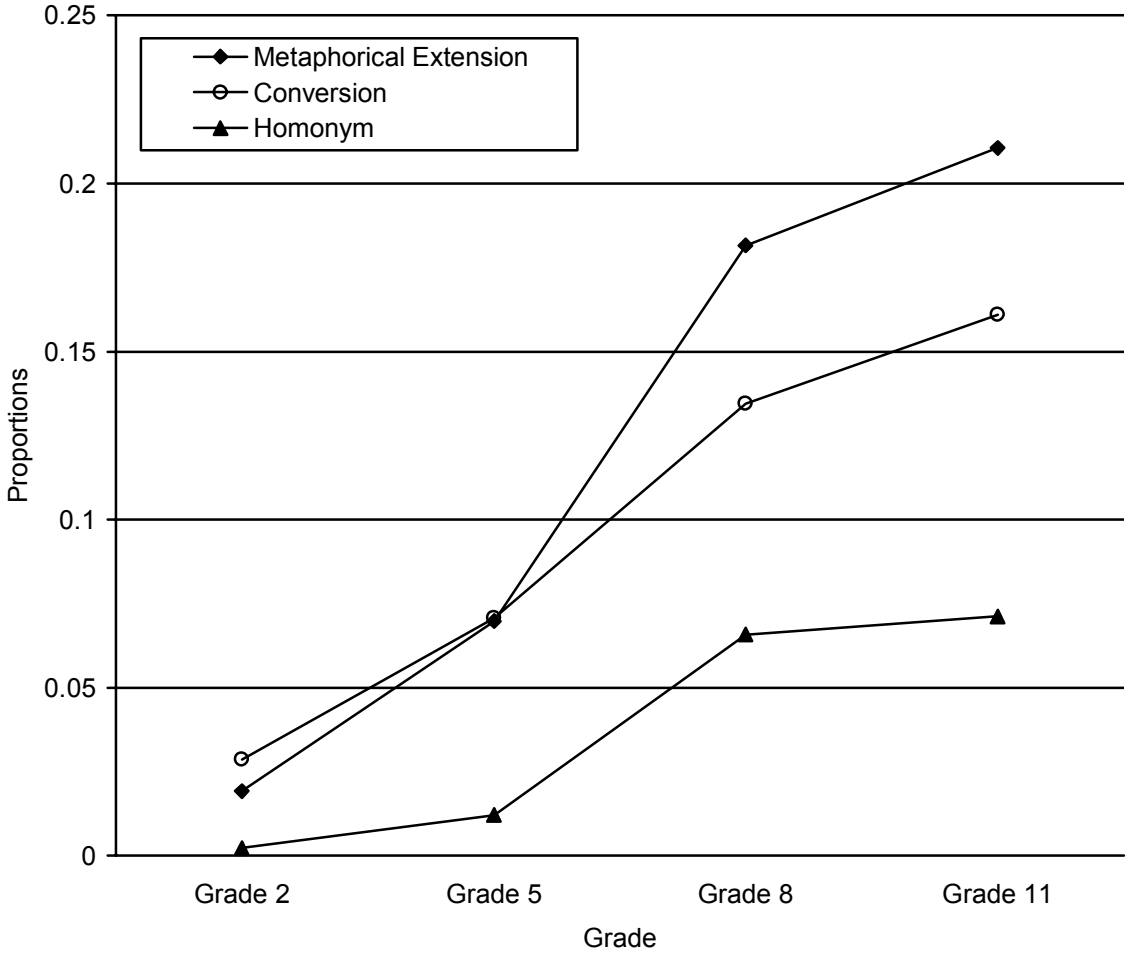

Figure 11. Proportion two: Proportions of the total multiple meanings in the test that were known for each relation type.

Semantic relations between multiple meanings. Each multiple meaning that a participant received credit for knowing had an associated semantic relation (SR) score (from preliminary study one) for that meaning's relation to the main meaning of that word (the first meaning a participant received credit for knowing). It was hypothesized that older participants would receive credit for more distantly related meanings (lower SR score) than younger children. This increasing competence with distantly related meanings should be evident in the SR scores for converted and metaphorically extended meanings. Homonyms by definition are more distantly related. Each participant's mean SR score for the multiple meanings he/she received credit for knowing was calculated for both converted meanings and metaphorically extended meanings. A repeated measures analysis of variance with grade, gender, and SES as the between-subject factors and relation type as the within-subject factor was conducted on these mean SR scores for these two relation types (metaphorically related or converted). A significant within-subject effect of relation type ($F(1,63) = 29.631$, $p < .001$), and a grade by relation type by SES interaction ($F(3, 63) = 4.081$, $p < .011$) was found. No other significant interactions were found.

The relation type effect was a result of the fact that there were significant differences in the SR score for each relation type collapsed across grades. Converted meanings for which participants had received credit were more closely related ($M = 4.277$) than metaphorically extended meanings ($M = 4.078$).

The significant grade by relation type by SES interaction is shown in Table 17. Tukey HSD posthoc tests showed that there was a significant difference between upper SES Grade 2 and Grade 5 participants' SR scores for converted meanings known. The converted meanings

known by Grade 2 upper SES participants were more closely related than those known by Grade 5 upper SES participants.

Table 17

Mean Semantic Relation Scores for Each Relation Type

	Metaphorical Extensions		Conversions	
	Upper SES	Lower SES	Upper SES	Lower SES
Grade 2	3.869	4.325	4.476	4.422
Grade 5	4.072	4.113	4.063	4.300
Grade 8	4.060	4.037	4.290	4.132
Grade 11	4.059	4.067	4.228	4.324

For the within grade comparisons, in Grade 2, upper SES participants' SR scores for converted meanings were significantly greater than the SR scores for metaphorically extended meanings. There was also a significant difference between Grade 2 upper SES participants and Grade 2 lower SES participants in their SR scores for metaphorically extended meanings. Therefore, the grade by relation type x SES interaction can be understood at least in part by the Grade 2 upper SES children's higher SR scores for converted meanings as compared to metaphorical extensions.

Understanding Relations between Multiple Meanings

The extent to which children understood a possible relation between two meanings for a word was investigated. For each pair of meanings that the student demonstrated knowledge, he or she was asked, "Why does the word _____ mean both _____ and _____?" Responses to these questions were coded as R when students gave a response that explained a relation between the two meanings and NR when no relation was known or

could be explained. Each participant was given three scores for the number of answers scored as R; one for metaphorically related meanings, one for converted meanings, and one for homonym pairs. For the pairs of meanings that were considered homonyms participants were not expected to be able to describe a relation between these unrelated meanings. For the pairs of meanings that were either converted from one part of speech to another or metaphorically extended from one meaning to another, students were more likely to be able to describe a relation.

A repeated measures analysis of variance with grade, gender, and SES as the between-subject factors and meaning type as the within-subject factor was conducted on the relation question scores (raw scores) for each of the three meaning types. Significant between-subject effects were found for grade ($F(3,64) = 32.158$, $p < .001$). This analysis also revealed a significant within-subject effect of meaning type ($F(2,128) = 130.114$, $p < .001$), and a grade by meaning type interaction ($F(6, 128) = 30.312$, $p < .001$). No other significant interactions were found. Mean numbers of meaning pairs of each type for which a relation was expressed are reported in Table 18.

The meaning type effect was a result of the fact that there were significant differences in the number of relations known for each meaning type collapsed across grades. Homonyms had the lowest number ($M = 3.49$) followed by converted meanings ($M = 21.99$), and metaphorically extended meanings ($M = 61.61$).

Table 18

Mean Number of Meaning Pairs for which a Relation was Expressed for Each of the Three Meaning Types

	Metaphorical Relation		Conversion		Homonym	
	M	*SD*	*M*	*SD*	*M*	*SD*
Grade 2	1.25	1.860	1.05	1.276	0	0
Grade 5	21.75	11.760	10.40	6.219	0.15	0.489
Grade 8	98.70	62.855	34.45	18.277	6.50	7.612
Grade 11	124.75	65.867	42.05	18.121	7.30	8.621

The significant grade by meaning type interaction is illustrated by Figure 12. Tukey HSD posthoc tests showed that there were no significant differences between grades in the number of relations between meanings that were known for homonyms. All participants expressed very few relations between homonym meanings as was expected given that homonyms are by nature unrelated meanings. There was a difference between Grade 2 and Grade 5 students and Grade 8 and 11 students in the number of relations expressed for both converted and metaphorically extended meanings. There was also a difference between Grade 8 and Grade 11 students in the number of relations expressed for metaphorically extended meanings.

For the within grade comparisons, in Grade 2 and Grade 5 there were no significant differences between the number of relations expressed for any of the meaning types. In Grades 8 and 11, there were significant differences in the number of relations expressed for all meaning types. Therefore, the grade by meaning type interaction can be understood by the

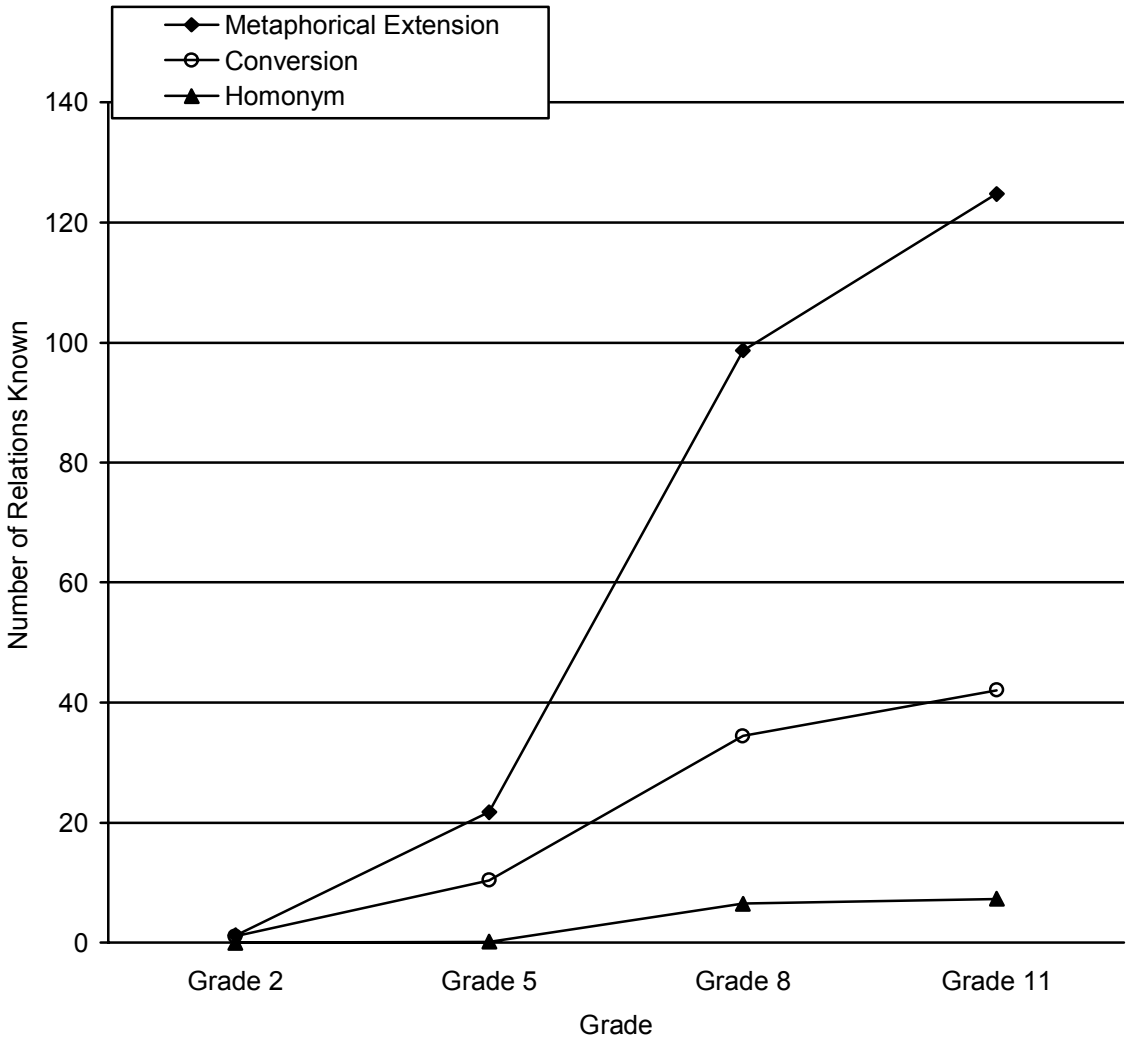

Figure 12. Number of relations expressed for each type of multiple meanings pair at each grade.

Grade 8 and Grade 11 students' increasing ability to express relations between both converted and especially metaphorically extended meanings.

Semantic relations. It was hypothesized that the degree of semantic relatedness between two meanings for a word would play some part in whether or not children could express an understanding of that relation. In order to test this hypothesis, the SR score for each pair of meanings obtained in preliminary study one was used. The SR score was recorded for each meaning pair that a student received credit for knowing, R, and for each meaning pair that received no credit, NR, for the metaphorically extended or converted meaning pairs. Homonym pairs were not included in this analysis since their semantic relation scores were, by definition, 2 or less. For each participant, the mean SR score for the metaphorically extended and converted relations known was recorded and the mean SR score for the metaphorically extended and converted relations not known was recorded. A repeated measures analysis of variance with grade, gender, and SES as the between-subject factors and relation status (known or not known) as the within-subject factor was conducted on the mean SR scores for the metaphorically extended or converted meaning pairs. Significant between-subject effects were found for grade and SES ($F(3,56) = 11.052$, $p < .001$ and $F(3,56) = 9.675$, $p < .004$ respectively). This analysis also revealed a significant within-subject effect of relation status ($F(1,56) = 196.225$, $p < .001$), and a grade by relation status interaction ($F(3, 56) = 7.505$, $p < .001$). No other significant interactions were found. Mean SR scores are reported in Table 19.

Table 19

Mean SR Scores for Relations Known and Not Known

	Relation Known		Relation not Known	
	M	*SD*	*M*	*SD*
Grade 2	4.402	0.444	4.162	0.299
Grade 5	4.324	0.136	3.888	0.180
Grade 8	4.268	0.152	3.641	0.213
Grade 11	4.299	0.172	3.614	0.177

The relation status effect was a result of the fact that there was a significant difference in the SR scores collapsed across grades. When a relation was known the mean SR score was higher (more closely related) ($M = 4.315$) than when a relation was not known ($M = 3.789$).

The significant grade by relation status interaction is illustrated by Figure 13. Tukey HSD posthoc tests showed that the mean SR scores for meaning pairs for which participants expressed a relation were significantly greater than the SR scores for meaning pairs for which participants did not express a relation at all grade levels. There were no differences between the grades for the mean SR scores for meaning pairs for which participants expressed a relation. However, Grade 2 and Grade 5 students mean SR scores for meaning pairs for which they did not express a relation were significantly different from those of every other grade.

Trend analyses were also conducted on the SR scores for each relation status as a function of grade. No significant trends were found for SR scores for meaning pairs for which participants expressed a relation. Significant linear and quadratic components were revealed for SR scores for meaning pairs for which participants did not express a relation ($F(1, 75) = 69.488$, $p < .001$ and $F(1, 75) = 6.175$, $p < .016$ respectively).

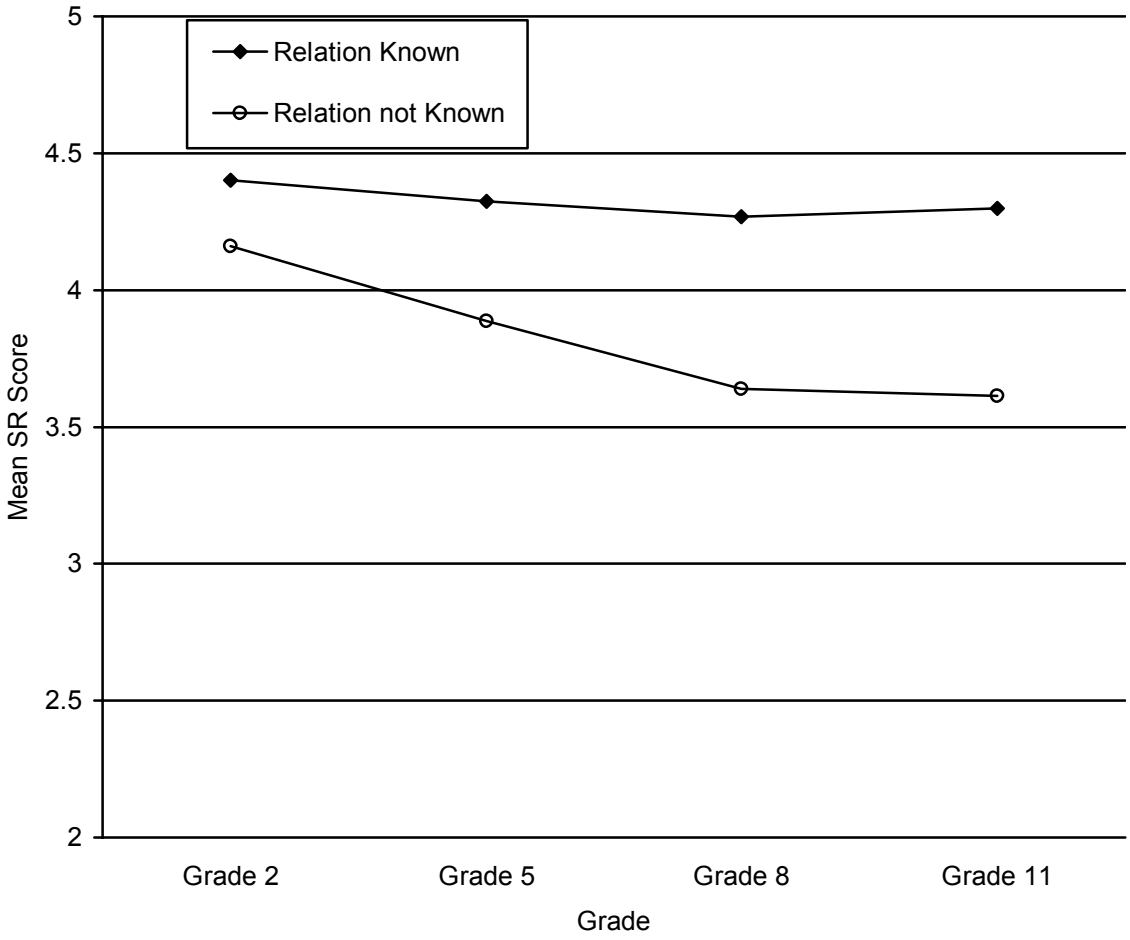

Figure 13. Mean SR score at each grade for each relation status.

Discussion

This research was conducted with two primary goals in mind. The first goal was to replicate Anglin's (1993; 1998) previous vocabulary findings and extend those findings to older children. Vocabulary size was estimated for children in the early school years through to adolescents in high school. The vocabulary measured was analyzed to see what morphological word types were known and to see the extent to which participants showed evidence of morphological problem solving in their test results. The second goal was to extend previous vocabulary studies by testing children for their knowledge of multiple meanings of words. Estimates of the total number of meanings known were calculated. The number of meanings known was also broken down by morphological word type. In addition, the meanings known were analyzed according to the type of relation between multiple meanings. Participants were also asked about their knowledge of the relations between multiple meanings of words.

Vocabulary Estimation

The results of the present study clearly show that the vocabulary of children and adolescents increases dramatically during the school years. Estimated main entry vocabulary was found to increase linearly from 14,350 words in Grade 2 to 66,606 words in Grade 11. These results are relatively consistent with previous vocabulary measures. Anglin (1993) estimates main entry vocabulary to be approximately 10,000 words in Grade 1, 19,000 words in Grade 3, and 40,000 words in Grade 5. The Grade 2 students' estimated main entry vocabulary falls in between Anglin's (1993) estimates for Grade 1 and Grade 3 students. The Grade 2 estimated main entry vocabulary is slightly larger than Templin's (1957) estimate of 12,400 basic words and slightly smaller than Smith's (1941) estimate of 18,500 basic words. The estimated main entry vocabulary found in this study for Grade 5 students of 32,613 words

is somewhat smaller than that found by Anglin in 1993. However, since the variability of these estimates is quite large (SD = 12,638 in Anglin, 1993 and SD = 8,014 in the present study), this could be due to variability in the samples of students. This estimate is slightly larger than Smith's (1941) estimate of 28,000 words.

The present study extends Anglin's findings to include vocabulary estimates for Grade 8 and Grade 11 students. Smith (1941) measured vocabulary for Grade 8 and Grade 11 students also. The results of the present study exceed Smith's basic vocabulary estimates. In Grade 8, Smith (1941) reports a basic vocabulary of 37,000 words. The present study found Grade 8 students had an estimated main entry vocabulary of 55,633 words. In Grade 11, Smith (1941) reports a basic vocabulary of 44,000 words. The present study found Grade 11 students had an estimated main entry vocabulary of 66,606 words. Again, these differences may be due to variability in the participants. However, it is more likely that these differences are due to the fact that Smith (1941) used a different dictionary for the population of words that she was sampling. Smith (1941) followed Seashore and Eckerson's (1940) methods and used the same 331 main entries sampled by them from *Funk and Wagnall's New Standard Dictionary* (1937). As Anglin (1993) points out, Seashore and Eckerson's (1940) main entry sample contained fewer derived words than Anglin's (1993) sample. Since this study found that the largest portions of words known in Grades 5, 8, and 11 were for derived words, the relatively smaller number of derived words in Smith's (1941) sample may partially explain her smaller basic vocabulary estimates for each of these grade levels.

Estimated total entry vocabulary was found to increase in a linear fashion from 17,970 words in Grade 2 to 83,871 words in Grade 11. These results are also relatively consistent with previous vocabulary measures. Anglin et al. (1998) estimate total entry vocabulary to be

approximately 12,000 words in Grade 1, 34,000 words in Grade 3, and 58,000 words in Grade 5. The Grade 2 students' estimated total entry vocabulary falls in between Anglin et al.'s (1998) estimates for Grade 1 and Grade 3 students. The Grade 2 estimated total entry vocabulary is slightly smaller than Smith's (1941) estimate of 26,000 total words. The estimated total entry vocabulary found in this study for Grade 5 students of 42,144 words is smaller than that found by Anglin et al. (1998). Again, this could be due to variability in the samples of students. The students in Anglin et al.'s (1998) study came from a different community than those in the present study. Anglin et al.'s (1998) participants came from a large city. Participants in the present study came from a mainly rural community. The average socioeconomic level was lower in the present study (M = 42.75 compared to M = 48.18). However, it is difficult to say if the socioeconomic status of the two groups of participants was equivalent or not since the present study used a revised version of Blishen's socioeconomic index to obtain the socioeconomic status scores.

The estimated total vocabulary for Grade 5 participants is almost identical to Smith's (1941) estimate of 42,000 total words. The results of the present study exceed Smith's total vocabulary estimates for participants in Grade 8 and Grade 11. In Grade 8, Smith (1941) reports a total vocabulary of 55,000 words. The present study found Grade 8 students had an estimated total entry vocabulary of 70,208 words. In Grade 11, Smith (1941) reports a total vocabulary of 73,000 words. The present study found Grade 11 students had an estimated total entry vocabulary of 83,871 words. Again, these differences may be due to variability in the participants. The results of the present study are similar to previous vocabulary measures considering the fact that different populations of children were measured in some cases in very different circumstances. Anglin's studies (1993; 1998) report results for children in a different

type of community separated by about 10 years time. Smith (1941) used a similar testing procedure with a sample of words taken from *Funk and Wagnall's* (1937) dictionary. These results are from children separated by more than 60 years time from the present study using a different sample of words from a different dictionary. Given these differences, it is perhaps surprising the similarities in the results are as great as they are.

Morphological Word Types

This study also replicated Anglin's method of analyzing the morphological classifications of the words children knew. The sample of words was broken down into root words, inflected words, derived words, literal compounds, and lexical idioms. Results of the present study support the hypothesis that children demonstrate knowledge of more increasingly morphologically complex words than root words as they get older. The estimated numbers of each of the five word types known increased with age. However, the highly significant grade by word type interactions indicated that increases in vocabulary knowledge are not uniform for each of the five word types. The largest increase in vocabulary was for derived words (for both main entry estimates and total entry estimates). Trend analysis of the rate of growth of each of the five total entry word types revealed that knowledge of lexical idioms increased at a relatively steady (linear) rate, root words and inflected words increased at a slightly decelerating (quadratic) rate between Grades 2 and 11, while the derived and compound words increased at an accelerated rate between Grades 5 and 8 (cubic effect).

This finding of differential rates of growth of morphological word types was expected. The learning of morphology is an important way that vocabulary develops. According to Brown (1973) there is a very early stage in language development when mainly root, or uninflected words, are used. Then, inflectional suffixes are learned and most are mastered

before children reach school age. Therefore, it is not surprising that inflected words would be well known by children in the second grade. From this, one would expect the number of inflected words known to increase primarily as a function of the number of new root words learned as opposed to the addition of new inflectional suffixes to lexical knowledge.

The learning of derivational morphology accounts for a substantial portion of continued vocabulary growth in later childhood. Research has consistently found that knowledge of derivational morphology is developing during the school years (Berko, 1958; Derwing and Baker, 1979; Windsor, 1994; Wysocki & Jenkins, 1987). Wysocki and Jenkins (1987) found that children in the sixth and eighth grades were more skilled than children in the fourth grade are at using morphological clues to figure out the meanings of unfamiliar derived words. Windsor (1994) similarly found that children in the fifth through eighth grades were significantly better than third and fourth grade children are at both producing and comprehending derivational suffixes attached to nonsense words. The current research illustrates a similar developmental trend. Second grade children knew very few derived words. The number of derived words known in Grade 2 did not differ significantly from the number of root, inflected or compound words known. However, by Grade 5, children knew significantly more derived words than any other word types for both main and total entry vocabulary. This difference becomes even more pronounced in Grades 8 and 11. These results provide additional evidence that knowledge of derivational morphology exerts a powerful influence on vocabulary development in the school years.

Morphological Problem Solving

So far, the present research findings are consistent with the idea that vocabulary growth can be accounted for by learning of words, and by learning of word formation rules such as

inflectional and derivational morphology as well as compounding rules. Another way to investigate the development of children's ability to use word formation rules is to look for evidence that children are dissecting the words on the vocabulary test into their morphological units and figuring out the meanings of those words through morphological problem solving. This study replicated Anglin's method of investigating participants' use of morphological problem solving. The transcripts of the vocabulary test were analyzed for evidence of morphological problem solving. Anglin (1993; 1998) has found that evidence of children's morphological problem solving increases with age. Anglin (1993) found evidence of morphological problem solving in main entry words increased from 41% of the time in Grade 1 to 50 % of the time in Grade 5. Anglin et al. (1998) found evidence of morphological problem solving in total entry words increased from 38% of the time in Grade 1 to 58 % of the time in Grade 5. Anglin et al. (1998) also found evidence of morphological problem solving in complex total entry words (inflected, derived, and compound words) increased from 50% of the time in Grade 1 to 71 % of the time in Grade 5. This study did not replicate those findings. There were significant increases across age in the estimated number of words (both main and total entry) for which the children's responses would have shown evidence of morphological problem solving (PS), had it been feasible to test them on the entire dictionary population. The main entry problem solving estimates increased linearly from 5,011 words in Grade 2 to 27,357 words in Grade 11. The total entry problem solving estimates increased linearly from 7,971 words in Grade 2 to 40,207 words in Grade 11. However, there were no significant increases in the proportion of answers coded as showing evidence of morphological problem solving across age. On average 36% of the student's main entry answers and 45% of their complex main entry answers were coded as showing evidence of problem solving. On average

45% of the student's total entry answers and 54% of their complex total entry answers were coded as showing evidence of problem solving.

Given the consistency of previous findings of increasing competence with morphological problem solving in the early school years (Anglin, 1993; Anglin et al., 1998; Malloy, 1992), it is surprising that no significant increases in the proportions of morphological problem solving were found in this study. The coding of morphological problem solving involves inspecting the transcripts to see if the participant "mentioned and defined each component morpheme of the word separately in deriving the meaning of the whole word." (Anglin, 1993, p. 81) (See additional coding criteria on pp. 59-61 in this thesis.) When coding the data from the present study for morphological problem solving, it was noted that many Grade 8 and Grade 11 participants were particularly careful not to use the component morphemes for complex words in the definitions because they knew that they would have to define those components separately to receive credit for knowing those words. For example, one Grade 8 participant defined the compound word *firesafe* as "not susceptible to burning." Another Grade 11 student said, "My trouble is putting it into words," before coming up with the definition, "protected from flames or burning." Older students are very aware of the fact that a good dictionary definition of a word is not circular. They, therefore, often are careful not to use the word or part of the word in their definition. This makes it difficult to tell if they are using morphological problem solving when defining the word. Despite this problem, it is still evident that around half of the participants' vocabulary may not be learned vocabulary but could be figured out at the time of testing. Therefore, word learning can be said to involve the learning of new root words and lexical idioms and the learning of inflectional and derivational morphology and compounding rules. Knowing root words, affixes, and word formation rules

allows children and adolescents to understand many words that they may not have ever encountered before.

Multiple Meanings of Words

This test extended previous vocabulary measures by including multiple meanings of words. As hypothesized, participants demonstrated knowledge of more meanings of polysemous words across age. The total estimated number of meanings known increased from 28,797 in Grade 2 to 185,990 in Grade 11. This roughly doubles total vocabulary estimates. Even as young as 7-years-old, children recognize more than one meaning for many words. For the participants in Grade 2 and 5 most of the multiple meanings for which they got credit for knowing were recognized in multiple-choice questions rather than produced in definitions or sentences. It was not until Grade 8 that participants started to be able to generate some multiple meanings of words in their definitions or sentences. This is consistent with C. Clark (1982) and W. Reckers (1984) findings that prior to the age of 12 years very few multiple meanings for words are produced.

The estimated total number of meanings known was also broken down by morphological word type. Similar to the findings for individual words, the largest increase in total meanings was for derived words. Trend analysis of the rate of growth of each of the five word types for total meanings revealed that knowledge of lexical idioms increased in a linear fashion across grades, root words and inflected words increased at a slightly decelerating rate between Grades 2 and 11, the compound words increased at a slightly accelerated rate between Grades 5 and 8, and the derived words increased at an extremely accelerated rate between Grades 5 and 8. Once again, knowledge of derived words and their meanings accounts for a large portion of the increases in vocabulary through the school years. This pattern of results is

the same as the pattern of results found for estimated total words known. This finding of differential rates of word meanings known across word types is mostly a result of the increases in the number of words known for each of those word types. However, there are some differences in the proportions of additional meanings (beyond the estimates of total vocabulary) accounted for by each word type. Overall, the additional meanings that participants were estimated to know increased the total vocabulary estimates by 1.60 times in Grade 2 (from 17,970 words to 28, 797 words and meanings), 1.85 times in Grade 5, 2.27 times in Grade 8, and 2.22 times in Grade 11. However, each word type within each grade did not increase by these same proportions. Relatively more additional root word and inflected word meanings were known than additional meanings of other word types. For example, in Grade 2, additional root word meanings accounted for an estimated vocabulary increase of 2.23 times (from 3,704 words to 8,272 words and meanings). In Grade 11, additional root word meanings accounted for an estimated vocabulary increase of 3.28 times (from 10,660 words to 34,976 words and meanings) and additional inflected word meanings accounted for an estimated vocabulary increase of 3.11 times (from 12,957 words to 40,232 words and meanings). Although derived words accounted for the greatest increases in estimated total vocabulary, additional meanings for derived words did not account for as great a proportional increase in estimated total meanings known as root words or inflected words did. In grade 11, additional derived word meanings accounted for an estimated vocabulary increase of only 2.08 times (from 36,429 words to 75,703 words and meanings). These findings, overall, give little new insight into how children are learning those multiple meanings of words.

The type of multiple meanings, homonyms, conversions, or metaphorically extended meanings, that children learn may however give some clue as to how children are learning

multiple meanings. In order to determine what types of multiple meanings children know, the multiple meaning scores were broken down by meaning type. It was hypothesized that the youngest children would know or be able to recognize meanings that are converted from one part of speech more easily than other types of multiple meanings. It was found that the estimated number of metaphorically extended meanings was greatest at each age. Homonyms were the least well known at each age. This indicates that, even in Grade 2, children are able to recognize and understand a large number of meanings that have metaphorical relations to the main meaning of words. However, it is not surprising that the largest number of multiple meanings known was for metaphorically related meanings rather than converted meanings. The sample was comprised of approximately 61% metaphorically related meanings, 19% converted meanings, and 20% homonyms. Therefore, to determine whether children learn one type of multiple meaning more easily than another, proportions of meanings known were analyzed. This was done in two different ways. First, the proportion of total meanings known was calculated for each meaning type. Even though this analysis still indicated that the metaphorically extended meanings represent the largest proportion of the meanings known at each grade (70.2% in Grade 2 increasing to 78.2% in Grade 11), it did reveal that the Grade 2 participants had the largest proportion of their correct multiple meanings that were converted from one part of speech to another (27.8%). This proportion decreased to 14.8% by Grade 11. The proportion of meanings known that were homonyms increased from 2% in Grade 2 to 7% in Grade 11.

The second proportional analysis measured the number of each type of meaning known as a proportion of the total number of each of those meaning types in the sample of words. This analysis revealed that the Grade 2 participants knew a significantly larger proportion of

the sample of converted meanings (approximately 3%) than homonym meanings (0.2%). By Grade 5, both metaphorically extended meanings and converted meanings are better known than homonyms. In Grade 8 and 11, significantly more of the sample of metaphorically extended meanings are known than the other word types (18% and 21% respectively). Therefore, it seems that although young school-aged children have some facility with converted and metaphorically extended meanings, it is not until adolescence that they become more adept at recognizing the multiple meanings of words that are related to a main meaning.

The degree of relation between two meanings for a word may have some influence on the child's ability to recognize both meanings of that word. As the age of the child tested increases, it was expected that the child would have a greater ability to recognize more distantly related meanings. Older children were expected to be able to recognize meanings that were more opaque transformations of the main meanings. The semantic relatedness of all the pairs of meanings for each polysemous word was measured in preliminary study one. Then, for each multiple meaning that a participant knew, they were given a semantic relation score corresponding to that meaning's relation to the first meaning that the participant received credit for knowing. Homonyms by definition are more distantly related than metaphorically extended or converted meanings. Therefore, homonyms were left out of this analysis so that any differences in semantic relatedness scores between converted meanings and metaphorically extended meanings would be detected with more ease. Although the analysis did find that the converted meanings that children received credit for knowing were more closely related than the metaphorically extended meanings were, there were no differences found across grade. The multiple meanings that children in Grade 2 knew were not more closely related than those that students in Grade 11 knew for converted and metaphorically extended meanings. There

was, however, an increase in the number of less closely related meanings that participants knew as they got older. Grade 8 and Grade 11 students knew a larger proportion of the homonyms than the younger children knew. Since homonyms are the least semantically related meanings, the degree of semantic relatedness between meanings may be an important factor in the learning of multiple meanings of words.

Relations between Multiple Meanings of Words

Children in this study were also asked about their knowledge of relations between the multiple meanings of words. It was expected that as children get older, they would be able to discuss the relations between converted or metaphorically extended words. Asch and Nerlove (1960) found that children under 9 years old could not discuss the relations between two meanings even though children who were 7 or 8 years old had knowledge of more than one meaning for the words tested. Since homonym meanings are, by definition, unrelated, none of the participants was expected to be able to discuss relations between meanings for homonyms. The present study found children in Grades 2 and 5 could discuss relatively few relations between meanings while, as expected, adolescents in Grades 8 and 11 could discuss significantly more of the relations between converted and metaphorically extended meanings.

Another way of investigating participants' ability to express the relations between meanings is to look at the degree of semantic relatedness between those meanings. It was expected that older participants would be able to express a relation between more distantly related meanings than younger participants would. This study found that the meaning pairs for which a relation was expressed were significantly more closely related than the meaning pairs for which participants could not express a relation. There were no differences between grades in the semantic relatedness of the meaning pairs for which participants could express a relation.

The only differences between grades were meaning pairs that participants could not express a relation. The meaning pairs for which participants in Grades 8 and 11 could not express a relation were more distantly related than those for which participants in Grades 2 and 5 could not express a relation. Overall, this indicates that it is easier to understand and express a relation for more closely semantically related meanings but the only developmental trend seems to be in overall ability to discuss relations between the multiple meanings of words. Although younger children are able to recognize and understand many multiple meanings of words, most times they are not able to discuss the relations between those words. This may be due to a limitation in their metalinguistic ability to put these relations into words, rather than a limitation in their ability to think about relations between meanings.

Conclusions and Future Research

The main findings of this study are that knowledge of words increases with age, knowledge of derived words increases at a faster rate than other word types, and knowledge of multiple meanings of words increases throughout the school years. From this, it can be concluded that vocabulary development in the school years has three important components. Expanding knowledge of words increases basic vocabulary, expanding knowledge of morphology increases vocabulary by adding many word types, and expanding knowledge of the different meanings of words in multiple different contexts increases facility with words.

This research, while suggesting significant conclusions about the development of vocabulary knowledge in the school years, may also have implications more generally for future research in language and cognitive development. This research can be extended in several ways. First, individual differences in vocabulary development can be investigated. This study like others has found dramatic increases in vocabulary knowledge in the school

years but also extreme variability in vocabulary knowledge across participants within each grade tested. For example, individual participants' total vocabulary estimates in Grade 2 ranged from 5,319 words to 34,795 words. Individual participants' total vocabulary estimates in Grade 11 ranged from 43,430 words to 122,468 words. Stanovich (1986) hypothesizes that individual differences in vocabulary between children entering school lead to increasingly greater differences between children as they progress through the school years. If a large increase in vocabulary is due to increasing ability to inflect, derive, and form compounds of the root word vocabulary that is already known, then one would expect that the children who have a larger root word vocabulary when they learn to use these morphological processes would show larger increases in vocabulary than children who have a smaller root word vocabulary. Biemiller and Slonim (2001) studied the development of root word vocabulary. They also found large amounts of variability in root word vocabulary. Children in the lowest quartile of those measured in Grade 2 knew 2000 fewer root words than average. They found that root words were learned in roughly the same order by most children and differences were due primarily to the number of words that had been learned. They suggest that the large individual differences in vocabulary test scores could be reduced by fostering growth of root word vocabulary in pre-school or early primary school. Biemiller (2004) reports evidence from a study of early elementary vocabulary instruction within the context of the classroom. He has found that the greatest gains in vocabulary knowledge occurred when the classroom teacher both read books repeatedly and explained the meanings of words encountered in those books. Results of his study suggest that early vocabulary instruction might be an effective strategy in attempting to decrease the gap between vocabulary knowledge levels of children in the highest and lowest quartiles.

Another important aspect of this study and other vocabulary studies is the finding that derived words add a substantially large number of words to later school-aged children's vocabulary. Children between Grades 3 and 5 (according to Anglin, 1993) and between Grades 5 and 8 (according to the present study) are making great gains in derived vocabulary. This development may be due to cognitive changes or experience with language. Marchman and Bates (1994) studied the development of inflectional morphology for past tense verbs. They found that in the early stage of past tense verb usage children seemed to be learning each verb separately, item by item, and so correctly inflected both irregular and regular verbs. However, when children's vocabulary reached a critical level of verb knowledge, they seemed to extract a general rule for past tense inflection, add *–ed*, and began to overregularize irregular verbs in the past tense. Lewis and Windsor (1996) found a significant correlation between derivational affix production in a nonsense word task and vocabulary knowledge for derived words for children in Grades 4 through 8. It is possible that children must learn a number of derived words (of each derivational affix type; -er, -ly, -ness, un-, etc.) before they can generalize a rule for each derivational affix use.

Another possible explanation for increases in knowledge of derived words during the middle school years, is that school curricula explicitly teach derivational morphology. Malloy (1992) found that the children who participated in her study of vocabulary development were experiencing some instruction in morphology in the classroom before the fifth grade. This instruction may be an important factor in accelerating vocabulary growth in the early school years. The evidence of morphological problem solving found in this and other studies (Anglin, 1993; Anglin et al., 1998; Malloy, 1992) suggests that knowledge of morphology should improve vocabulary. There is evidence to suggest that specific classroom instruction on the

meanings of inflectional and derivational affixes and the rules for forming inflected, derived, and compound words should enhance vocabulary knowledge (see Edwards, Font, Baumann, & Boland, 2004 for a review). Wysocki and Jenkins (1987) found that children in the sixth and eighth grades showed improvements in vocabulary tests of derived words after being taught to use morphological clues to figure out the meanings of unfamiliar words. Most research on vocabulary and morphemic analysis instruction has been conducted on children in Grades 3 or above. In addition, early vocabulary intervention studies as suggested by Biemiller and Slonim (2001) might also include explicit instruction in morphology rather than just teaching root word vocabulary to very young elementary school children.

Finally, another important area of research that emanates from this research is the study of how children learn the multiple meanings of words. This study established the fact that children as young as 7-years-old have some knowledge of multiple meanings of words but that that knowledge increases dramatically over the school years. This knowledge may come from experience with words used in multiple contexts. Younger children have less language experience than older children have. When children learn to read, they have an additional resource for encountering words in various contexts. Future research could investigate the relation between reading experience and knowledge of word meanings. The prediction would be that children, adolescents, and adults with more reading experience would know more multiple meanings of words.

Another possible way that children come to understand the multiple meanings of words is from figuring out the meaning from knowledge of a main meaning and making a metaphorical or metonymic transformation using contextual information. Many researchers have studied the development of children's ability to understand metaphors (see Nippold

(1988) for a review.) It is possible that children's increasing ability to understand figurative language allows them to understand multiple meanings of words.

Nerlich and Clarke (2001) emphasize the fact that polysemy occurs in everyday discourse and serves an important pragmatic function. It may be that there are pragmatic and social pressures facilitating children's development of knowledge of multiple meanings. Nerlich and Clarke (2001) point out that people commonly use multiple meanings as a tool to serve an explicit communicative function. For example, irony, sarcasm, metaphor, jokes, and explicit double entendres or double readings are common in everyday language. It is possible that children feel social pressure to comprehend this explicit use of multiple meanings. For example, children often respond to jokes by laughing before they actually comprehend the meaning of the joke (Nerlich, Todd, & Clarke, 1998). Children often like the idea of saying something that will make people laugh. They also imitate the structure of a joke before they can actually make up funny jokes. Nerlich et al. (1998) report the responses to jokes and joke telling behaviour of a child between the ages of 4.5 and 6.5 years. At 4.5 years of age, the child tells nonsensical jokes using the question and answer format. At 5.5, he tells a few meaningful jokes and explains why they are funny but he does not understand puns (jokes employing double meanings of words) until they are explained to him. At 6 years old, he can distinguish funny from unfunny jokes but still tells many unfunny jokes, which he laughs at himself. By 6.5, he shows the ability to distinguish various senses of polysemous words as used in jokes. This gradual development of the understanding and use of multiple meanings in humour may reflect a growing capacity to understand multiple meanings. However, Nerlich et al. (1998) suggest that it may be a bi-directional effect. It may be that social pressure to understand humour drives a child's ability to see multiple senses of words. Further research

into the development of children's ability to understand various forms of humour is necessary. One possible prediction might be that children who are better able to understand puns are also more likely to understand more multiple meanings of words. Again, as with root words and morphological knowledge, perhaps young children could be explicitly taught about multiple meanings of words. Jokes might be a fun context for developing this ability. Blachowicz and Fisher (2004) outline a classroom word learning program that includes fun activities such as jokes and riddles that can help children to be actively engaged and interested in words and word learning.

It is hoped that this study has served to further our understanding of vocabulary development. Vocabulary develops through root word knowledge, knowledge of morphological rules, and contextual knowledge of multiple meanings. The benefits of increased vocabulary knowledge have been well established with respect to the relationship between vocabulary and cognitive development (Dunn & Dunn, 1981; Wechsler, 1974), reading comprehension (Beck & McKeown, 1983; Beck, McKeown, & Omanson, 1987; Beck et al., 1982; Stanovich, 1986), writing ability (Duin & Graves, 1986), and general educational success (Walberg, Strykowski, Rovai, & Hung, 1984). In view of the findings of this study, educational practitioners could expect to help children increase vocabulary knowledge in the early school years by teaching them more about morphology and the multiple meanings of words.

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Appendix A

The 241 Main Entry Words and their Corresponding Sub-entries that were Used to Create the Vocabulary Test

The first 241 words from the sample and their 68 corresponding sub-entries are shown in Table A1. The words are numbered and ordered from simplest to most difficult as described in the word sample section of this paper. The morphological classifications (MC) are shown to the right of each word under the column heading MC. The classification symbols are defined as follows: R = root word; IW = inflected word; D = derived word with one derivational affix; C = literal compound made of two root words; I = idiom; DD = derived word with two derivational affixes; DDD = derived word with three derivational affixes; DDDD = derived word with four derivational affixes; DIW = derived word with one derivational affix and an inflectional suffix; CC = literal compound made of three root words; CCC = literal compound made of four root words; CIW = literal compound made of one root word and one inflected word; CCIW = literal compound made of two root words and one inflected word; CIWIW = literal compound made of one root word and two inflected words; CD = literal compound made of one root word and one derived word with one derivational affix; CCD = literal compound made of two root words and one derived word with one derivational affix; CDD = literal compound made of one root word and a derived word with two derivational affixes; C(I) = literal compound made of one root word and one idiom; 2CF's = word made of two combining forms (bound morphemes); CF+D = word made of a combining form and a derivational affix. (See Anglin (1993) for a more detailed explanation of morphological classifications.)

Table A1

The 241 Main Entry Words and Corresponding Sub-entries on which Participants were Tested with Morphological Classifications

#	Word	MC
1	closet	R
2	elastic	R
3	milk cow	C
4	plenty	R
4a	plenties	IW
5	mucky	D
6	soaking	IW
7	low-level	C
8	changed	IW
9	forgotten	IW
10	live-born	C
11	enjoyable	D
11a	enjoyableness	DD
11b	enjoyably	DD
12	western saddle	CD
13	flop	R
13a	flopped (vt)	IW
13b	flopped (vi)	IW
13c	flopping	IW
13d	flops	IW
14	reports	IW
15	outgrow	C
16	stillness	D
17	improve	R
17a	improve on	C
18	scene	R
18a	scenes	IW
18b	behind the scenes	I
19	sourer	IW
20	untrusty	DD
21	firesafe	C
21a	firesafety	CD
22	serviced	IW
23	Japanese crab	CD
24	towering	IW
25	occasion	R
25a	occasions	IW
25b	on occasion	C

#	Word	MC
26	baits	IW
27	separately	D
28	off-camera	C
29	preservable	D
30	loose cover	C
31	recklessly	DD
32	dishing	IW
33	fenderless	D
34	treelet	D
35	modernish	D
36	titanosaurus	R
37	polyester	R
38	loft	R
39	clark	R
40	carrying-on	I
40a	carryings-on	I
41	inearth	D
42	skunk cabbage	I
43	doubting Thomas	I
44	moneybags	I
45	knotless	D
46	twenty questions	I

#	Word	MC
47	waahoo	R
48	suspicious	D
48a	suspiciously	DD
48b	suspiciousness	DD
49	cardinal flower	C
50	foundationless	DD
51	workable	D
51a	workableness	DD
52	pep	R
52a	pepped (vt)	IW
52b	pepped (vi)	IW
52c	pepping	IW
52d	peps	IW
53	northwest coast Indian	CCC
54	hermit	R
55	talkativeness	DD
56	incomparable	DD
57	readmission	DD
58	advisable	D
59	wild lilac	I
60	boomless	D
61	accusal	D

#	Word	MC
62	competitive	D
62a	competitively	DD
62b	competitiveness	DD
63	cousinly	D
64	hopelessness	DD
65	peasant	R
66	maned sheep	CIW
67	staggerer	D
68	custom-made	C
69	explorational	DD
70	amendable	D
71	ingatherer	DD
72	magnetization	DD
73	back along	C
74	semiliquid	D
75	raspberry rose	C
76	quarrelsomeness	DD
77	redefine	D
78	rational	R
79	seabound	C
80	ropy	D
80b	ropier	DIW

#	Word	MC
80c	ropiest	DIW
81	lady's slipper	I
82	unbribable	DD
83	priesthood	D
84	extremeness	D
85	unreluctant	D
86	noncommunicable	DD
87	waspishly	DD
88	corresponding	IW
89	ashfall	C
90	continuous kiln	CD
91	parole	R
92	Indian robin	CD
93	overfulfill	C
93	overfulfillment	CD
94	universalness	DD
95	softheaded	I
95a	softheadedly	I
95b	softheadedness	I
96	retailing	IW
97	zero hour	I
98	malarial fever	CD

#	Word	MC
99	meadow pea	I
100	share-out	C
101	ritual murder	I
102	clerkship	D
103	newsbeat	C
104	bare-eyed cockatoo	CCIW
105	viridine green	C
106	sparrow-tail	C
106a	sparrow-tailed	CIW
107	eleventh hour	I
108	delaying action	I
109	brights	IW
110	yew green	C
111	steady state	C
112	limby	D
113	ebony brown	C
114	wittily	DD
115	impassibility	DDD
116	slicking	IW
116a	slickings	I
117	pony league	I
118	pump cylinder	C

#	Word	MC
119	disreputation	DD
120	vegetive	D
121	right at	I
122	hypertonicity	DDD
123	unfooted	DIW
124	strange woman	I
125	airplay	C
126	dust bowl	I
127	alphabetico-classed catalog	I
128	despiritualization	DDDD
129	oppositive	D
129a	oppositively	DD
130	brother-in-arms	CCIW
130a	brothers in arms	CIWIW
131	exhaust-gas analyzer	CCD
132	disburden	D
133	driveling	IW
133b	drivelingly	DIW
134	drammatico	R
135	gathering coal	I
136	rehabilitant	DD
137	bushelage	D

#	Word	MC
138	centenary	R
139	underprize	C
140	erosible	D
141	thusness	D
142	hideosity	D
143	jovial	R
144	insatiable	DD
144a	insatiableness	DDD
145	causationist	DD
146	gamy	D
146b	gamier	DIW
146c	gamiest	DIW
147	adhesive	D
147a	adhesively	DD
148	trail boss	C
149	confidential communication	I
150	bluenosed	I
151	chateau grey	I
152	chuckleheaded	I
153	golden spoon	I
154	combat fatigue	I
155	head and front	I

#	Word	MC
156	motor carriage	I
157	supposition	D
158	Rembrandtish	D
159	limbic system	I
160	pyro	R
161	iodide	D
162	hematology	2CF's
163	frugalness	D
164	lay over	I
165	thing in action	I
166	referendum	R
166a	referenda	IW
167	convocate	R
168	spousal	D
168a	spousally	DD
169	Devonshire	R
170	cynicism	D
171	patriarchic	D
172	capital gain	I
173	abstractionism	DD
174	pubescent	D
175	hourglass stomach	C (I)

#	Word	MC
176	derisible	D
177	missive	R
178	salinification	DD
179	evulse	R
180	subconical	DD
181	sadomasochist	CD
181a	sadomasochistic	CDD
182	denervate	DD
183	nectarian	D
184	calorimeter	D
185	voice part	I
186	Hominidae	CF+D
187	filled board	CIW
188	duarchy	2CF's
189	shoemake	R
190	organdy	R
190b	organdies	IW
191	grandfer	R
192	freshet	R
193	jiggered	IW
194	break back	C
195	intransitivity	DDD

#	Word	MC
196	ruff out	C
197	sweet anise	C
198	block and tackle	CC
198b	block and falls	CCIW
199	agricultural geology	CD
200	Somersetshire	R
201	paramagnetism	DD
202	siliconize	D
203	turmeric	R
204	Edwardean	D
205	syphilitic	D
206	quincentenary	D
207	binomial theorem	I
208	bivalent	DD
209	flying buttress	I
210	monosaccharose	D
211	diphthongization	DD
212	gentrification	D
213	sexdigitism	DD
214	Sartrian	D
215	Utrecht	R
216	daw	R

#	Word	MC
216a	dawed	IW
216b	dew	IW
216c	dawen	IW
216d	dawed	IW
216e	dawing	IW
216f	daws	IW
217	glazing compound	I
218	conceptualism	DD
219	vicious circle principle	I
220	anthemwise	D
221	delta wave	I
222	appendicle	D
223	cobalt sulphate	CD
224	bois de rose oil	C
225	circumjacencies	D
226	scree	R
227	dyslalia	D
228	tubers	IW
229	wing deck	I
230	cryptanalyze	D
231	halterbreak	C
232	speedwell	R

#	Word	MC
233	native box	I
234	beretta	R
235	onymous	D
235a	onymously	DD
236	katabolism	R
237	deep fascia	I
238	jus naturae	C
239	hola	R
240	buddleia	R
241	peumus	R
17b	improve upon (syn. of 17a)	C
23a	Japanese crab apple (syn. of 23)	CCD
80a	ropey (syn. of 80)	D
81a	lady-slipper (syn. of 81)	I
81b	ladies' slipper (syn. of 81)	I
133a	drivelling (syn. of 133)	IW
133c	drivellingly (syn. of 133b)	DIW
146a	gamey (syn. of 146)	D
154a	combat exhaustion (syn. of 154)	I
166b	referendums (syn. of 166a)	IW
169a	Devon (syn. of 169)	R
171a	patriarchical (syn. of 171)	DD

#	Word	MC
180a	subconic (syn. of 180)	DD
190a	organdie (syn. of 190)	R
198a	block and fall (syn. of 198)	CC
200a	Somerset (syn. of 200)	R

#	Word	MC
203a	tumeric (syn. of 203)	R
204a	Edwardian (syn. of 204)	D
240a	buddleja (syn. of 240)	R

Appendix B

Polysemous Words and their Meanings

The following is a list of 118 polysemous words and their meanings. Grammatical classifications are indicated for each meaning in the column to the left of that meaning. The classification symbols are defined as follows: N = noun; V = verb; Adj = adjective; Adv = adverb; and Int = interjection. Results of preliminary study two are indicated in the column to the right of the meanings. These scores represent the sum of the number of people who defined or produced that meaning in a sentence and the number of people who recognized that meaning in a matching paradigm (each out of twenty participants for a total possible score of 40). Meanings that do not have a numerical score next to them are meanings that were eliminated from the list in preliminary study one because they were highly related to another meaning and were thus combined into a more general meaning (see Appendix D for a list of those meaning pairs).

1		Closet means:	
N	a.	a small room in which clothes are kept	40
N	b.	a small room that is private	21
N	c.	a place to be alone	6
Adj	d.	that something is closely private	19
Adj	e.	that something is done in a place where you can be alone	6
V	f.	to shut something up in a small room	10
V	g.	to put something secret into a small room	12
2		Elastic means:	
N	a.	a rubber band	33
Adj	b.	able to recover size and shape after a change in shape	26
Adj	c.	able to recover quickly from low spirits or misfortune	9
Adj	d.	flexible	26
Adj	e.	able to adapt to new ideas	8
Adj	f.	changing readily in demand in response to change in price	7
N	g.	a kind of fabric woven of threads containing rubber	19

3	Milk cow means:	
N	a. an animal that goes moo and gives something white to drink	36
N	b. a source of easily acquired gain	6
4	Plenty means:	
Adj	a. more than enough	32
N	b. a more than good enough number	21
N	c. a lot of material things	29
N	d. the quality of being a lot	4
Adj	e. ample in amount	See a
Adv	f. more than sufficiently	20
5	Mucky means:	
Adj	a. that something is covered with mud	36
Adj	b. that something is disgusting	18
Adj	c. that something consists of mud	See a
V	d. to make dirty	19
6	Soaking means:	
V	a. that something is completely wet	29
V	b. that liquid is passing through the pores or fibers of something	16
V	c. that something is being able to penetrate the mind or feelings	9
V	d. that someone is drinking alcoholic beverages gluttonously	1
V	e. that something is submerged in a liquid	31
V	f. that a person's attention is engrossed in extensive study	1
V	g. that someone is being charged an unreasonable price	3
V	h. that something is remaining for a considerable time under heat treatment	0
V	i. that something is being cleaned by washing	17
V	j. that something is being drawn in as if by absorption	18
7	Low-level means:	
Adj	a. that something is near the ground	29
Adj	b. that something is of less importance	23

8	Changed means:		
V	a.	that something has been made different	39
V	b.	that someone has put on different clothes	26
V	c.	that something has been put in place of another	17
V	d.	that someone has given or taken an equal amount of money for another size bills or coins or for money from a different country.	13
V	e.	that a new cover has been put on to take the place of the one in use	14
V	f.	that something has been given to another, and something has been taken in return	11
V	g.	that someone has taken on different customs, methods, or attitudes	17
V	h.	that something has turned into something markedly different	See a
9	Forgotten means:		
V	a.	that someone was not able to remember something	40
V	b.	that something or someone has been neglected	24
V	c.	that someone or something has been treated with inattention	See b
V	d.	that someone or something has been passed over on purpose	19
11	Enjoyable means:		
Adj	a.	that something is fun	
Adj	b.	that something is capable of making someone happy	See a
13	Flop means:		
V	a.	to drop in a heavy way	16
V	b.	to move irregularly to and fro and up and down	13
V	c.	to throw oneself down heavily, clumsily, or in a completely relaxed manner	31
V	d.	to go to bed	4
V	e.	to change or turn suddenly	4
V	f.	to fail completely	14
N	g.	the act or sound of dropping heavily	16
N	h.	a sudden change to the opposite direction or position	4
N	i.	something or someone lacking success	26
N	j.	a cheap place to sleep	2

14	Reports means:		
V	a.	that someone is telling about something	27
N	b.	that there is more than one record of the work of someone in school	16
N	c.	more than one sudden, loud noise	5
N	d.	more than one account full of details	26
N	e.	more than one formal account of the results of research	26
V	f.	that someone is carrying a message	9
V	g.	that someone is making a written record of something	21
V	h.	that someone is giving an official account of something	See a
V	i.	that someone is gathering news	12
15	Outgrow means:		
V	a.	to become too big for something	35
V	b.	to exceed something in rate of development	24
V	c.	to develop to the point of being able to do without something	21
16	Stillness means:		
N	a.	that there is no movement	40
N	b.	freedom from agitation	8
N	c.	the quality of having no sound	25
N	d.	a place with no sound	18
17	Improve means:		
V	a.	to make better	40
V	b.	to make greater in amount	14
V	c.	to enhance in value or quality	See a
V	d.	to grade and drain a road and provide surface material other than pavement	3
V	e.	to turn to a profit	4
18	Scene means:		
N	a.	a sight	24
N	b.	the things that are used as a setting in a play or on a stage	20
N	c.	one of the small parts of a play	34
N	d.	the place of action	28
N	e.	the stage on which a play is presented	13
N	f.	an event seen in real or imagined action	20
N	g.	a show of explosive emotion	8
V	h.	to provide with the things that are used as a setting in a play	17
18b	Behind the scenes means:		
Adj	a.	out of public view	36
Adj	b.	in a position to see the hidden agencies or workings	26

19	Sourer means:		
Adj	a.	that something tastes more like a lemon than something else does	27
N	b.	a worker who treats yarn in a dilute acid solution in the process of bleaching or dyeing	2
Adj	c.	that something has more of the acid taste or smell of fermentation or decay than something else does	18
Adj	d.	that something is more unpleasant than something else	15
Adj	e.	that someone has more of a sullen nature than someone else	9
Adj	f.	that soil is more acidic than other soil	7
Adj	g.	that something is more inferior in quality than something else	4
22	Serviced means:		
V	a.	that something has been repaired	36
V	b.	that someone has been provided with help	28
V	c.	that interest and sinking fund payments have been met on a debt	3
V	d.	that a male has engaged in sexual intercourse with a female	7
V	e.	that business functions auxiliary to production or distribution have been performed	15
23	Japanese crab means:		
N	a.	a large sea creature that has long legs like a spider and is found off the shore of a western Pacific country which consist of many islands	35
N	b.	a profuse-blooming small tree or bush with rose-red to pink flowers	7
24	Towering means:		
Adj	a.	that something has great height	39
Adj	b.	that something is extremely high in relation to others	See a
Adj	c.	that something is reaching a high point of intensity or violence	9
Adj	d.	that something is going beyond proper bounds	7
N	e.	a mirage in which objects some distance away appear to be stretched vertically to unnatural heights	9
25	Occasion means:		
N	a.	a time when something happens	24
N	b.	something that produces an effect	3
N	c.	an event that provides reason for something	13
N	d.	a situation that is good for a particular development	12
N	e.	a need coming from a particular event	7
N	f.	a special event or ceremony	38
V	g.	to bring something about	5
V	h.	to cause to do something	5

26	Baits means:		
V	a.	that someone is putting worms on a fishhook	16
N	b.	more than one piece of food that is used to attract fish or other animals	30
V	c.	that someone is attacking another person or group in speech or writing so as to bully or tease	7
V	d.	that some hunting dogs are attacking by biting or tearing their prey	3
N	e.	more than one attraction meant to win something or make someone do something	25
N	f.	more than one preheated iron used in shaping molten glass	0
27	Separately means:		
Adv	a.	that something is done in an independent manner	34
Adv	b.	that something is done in a solitary manner	See d
Adv	c.	that something is done in a detached manner	See a
Adv	d.	that something is done in a manner that is not shared by others	See a
Adv	e.	that something is done in a manner that is sets it apart	19
28	Off-camera means:		
Adj	a.	out of the view of a machine that records movement and sound	33
Adj	b.	in private life	23
29	Preservable means:		
Adj	a.	that something can be stored without going bad	30
Adj	b.	that something can be kept safe from injury	20
Adj	c.	that something can be kept from decay	See a
Adj	d.	that something can be kept for special use	15
Adj	e.	that something can be kept in it's original state	27
Adj	f.	that something can endure the process of canning or pickling	21
31	Recklessly means:		
Adv	a.	that something is done without care	
Adv	b.	that something is done in a manner lacking in caution	See a
Adv	c.	that something is done in a manner marked by lack of consideration	See a

32	Dishing means:		
V	a.	that food is being served	18
V	b.	that something is being presented for acceptance	7
V	c.	that something is being made widely known, or talked about a lot	6
V	d.	that something is being made into a concave shape	7
V	e.	that something or someone is being defeated or ruined	0
V	f.	that something is being set aside	4
33	Fenderless means:		
Adj	a.	that something does not have a bumper	29
Adj	b.	that a press has no strip of stiff paper to prevent the sheets from sliding over the feed guides	4
35	Modernish means:		
Adj	a.	that something is somewhat in the present day style	34
Adj	b.	that something is produced by or represents somewhat recent techniques, methods, or ideas	22
Adj	c.	that something has the characteristics somewhat of the style in the arts marked by a break with tradition	17
38	Loft means:		
N	a.	a place in a barn for keeping hay	24
N	b.	an attic room	29
N	c.	a gallery in a church or hall	12
N	d.	an upper floor in a warehouse or business building	27
N	e.	a man-made home for pigeons	9
N	f.	the backward slant of the face of a golf-club head	4
N	g.	height	5
V	h.	to place or store in an upper storage area	11
V	i.	to strike or throw something so as to cause it to rise sharply through the air	10
V	j.	to rise high into the air when struck	9
39	Clark means:		
N	a.	a person who works in an office	10
N	b.	an ordained minister of the Church of England	7
N	c.	a salesperson in a store	7
N	d.	a medical student who performs routine clinical work	4
V	e.	that someone is working in an office	5
V	f.	that someone is acting as an ordained minister of the Church of England	5
V	g.	that someone is working as a salesperson in a store	7
V	h.	that someone is acting as a medical student who performs routine clinical work	2

42	Skunk Cabbage means:	
N	a. a perennial herb that is found in eastern Canada and United States and Asia, and that gives off a bad smell in the spring	18
N	b. a bog herb of the North Eastern U.S. with leaves modified into the form of broadly winged pitchers	10
44	Moneybags means:	
N	a. a person who is rich	37
N	b. abundance of things that are objects of human desire	25
45	Knotless means:	
Adj	that something is not tangled and tied tightly	35
Adj	that something is not perplexingly intricate	13
Adj	that something is not bound together	19
Adj	that a muscle does not have a contorting lump, swelling, or protuberance	12
Adj	that someone does not feel the sensation of a tight constriction	12
Adj	that a piece of wood does not have a hard lump or rounded mark from which a branch grew out	16
47	Waahoo means:	
Int	a. an expression used to show happiness and enthusiasm or to attract attention	34
N	b. a shrub or small shrubby tree known as a North American spindle tree	1
N	c. a large vigorous mackerel found in warm seas	1
N	d. any of various American trees or shrubs such as the Rock Elm, Winged Elm, and Basswood	1
48	Suspicious means:	
Adj	a. that someone is doubtful	31
Adj	b. that something makes someone feel mental uneasiness or doubt	28
Adj	c. that someone or something is showing mental uneasiness or doubt	25
49	Cardinal flower means:	
N	a. a vivid red blossom that grows in the United States or Canada	
N	b. a plant bearing a vivid red blossom that grows in North America	See a

50	Foundationless means:		
Adj	a.	that something does not have a base	27
Adj	b.	that something does not have funds given for it's permanent support	17
Adj	c.	that a piece of clothing does not have a stiffening or backing piece	10
Adj	d.	that something does not have a basis on which it might stand or be supported	37
Adj	e.	that someone does not have on a women's supporting undergarment	5
Adj	f.	that someone is not wearing a cosmetic used as a base for makeup	19
Adj	g.	that a canvas does not have a priming coat of pigment	14
51	Workable means:		
Adj	a.	that something can be put into practice	28
Adj	b.	that something can be brought to pass	18
Adj	c.	that something can be created by expending labour upon it	16
Adj	d.	that something can be made or decorated with needlework	5
Adj	e.	that something can be prepared for use by stirring or kneading	7
Adj	f.	that something can be solved	22
Adj	g.	that something or someone can be made to toil or labour	15
Adj	h.	that mail can be sorted by place of destination	1
Adj	i.	that a lure can be manipulated for maximum effectiveness in catching fish	4
52	Pep means:		
N	a.	energy	34
V	b.	to put energy into	17
54	Hermit means:		
N	a.	a person who lives away from all other persons	37
N	b.	a molasses cookie often containing chopped raisins and nuts	5
N	c.	a plainly coloured, forest-dwelling tropical hummingbird	1
55	Talkativeness means:		
N	a.	the quality of speaking a lot	38
N	b.	the quality of being inclined to discuss	20
N	c.	the quality of being inclined speak confidently or boastfully	15
N	d.	the quality of being inclined to use language for communicating	See a

56	Incomparable means:		
Adj	a.	that something is not capable of being matched	36
Adj	b.	that something is not suited for contrast	26
57	Readmission means:		
N	a.	the act of allowing entrance again	31
N	b.	the act of accepting as true or valid again	16
N	c.	the act of permitting again	20
58	Advisable means:		
Adj	a.	that something is the wise thing to do	32
Adj	b.	that someone is ready to receive counsel	23
60	Boomless means:		
Adj	a.	that something is without a loud, deep and hollow sound	12
Adj	b.	that a ship is without a long pole used to extend the foot of a sail	13
Adj	c.	that something is without a device resembling a ship's pole used to maneuver a piece of equipment into a desired position	11
Adj	d.	that a river is without a line of floating connected timbers	4
Adj	e.	that something is without a long wooden adjustable bar used as a support in gymnastics	6
Adj	f.	that a river is without a chain cable or line of poles extended across the mouth of the harbour	6
Adj	g.	that an airplane is without an outrigger connecting the tail surfaces and main supporting structure	8
Adj	h.	that a district is without a strong rapid expansion, settlement, and development	14
61	Accusal means:		
N	a.	the act of blaming	36
N	b.	a charge of wrongdoing	24
63	Cousinly means:		
Adv	a.	that someone is acting like an aunt and uncle's child	18
Adv	b.	that someone is acting like an equal	9
Adv	c.	that someone is acting like a friend	28
Adv	d.	that someone is acting like another person of similar race or culture	8
64	Hopelessness means:		
N	a.	the state of there being no chance to succeed	34
N	b.	the state of having no expectation of good	25

65	Peasant means:	
N	a. a poor person who does not have much education	29
N	b. one of a chiefly European class that works the soil as small free landowners or hired workers	17
Adj	c. something that is based upon and characterized by a simple agricultural economy	8
Adj	d. relating to native culture or art	1
Adj	e. something that looks like the designs in the clothing of the class of poor farm workers	16
Adj	f. something or someone that has the status of or is related to the class of poor farm workers	29
67	Staggerer means:	
N	a. one that does not move about steadily	35
N	b. something that causes one to move about unsteadily	15
N	c. something that rocks violently	7
N	d. something that causes something to rock violently	3
N	e. someone who hesitates	13
N	f. something that causes someone to hesitate	8
N	g. someone who places things alternately at equal distances on either side of a middle line	8
N	h. someone who arranges things in a series of overlapping or alternating periods	8
70	Amendable means:	
Adj	a. that something is capable of being made right	23
Adj	b. that something is capable of being improved	15
Adj	c. that something is capable of being changed	23
72	Magnetization means:	
N	a. the state of being attractive	15
N	b. the intensity of the attractive force that is measured between two objects	31
N	c. the state of being under the influence of animal attraction	8
N	d. the state of converting into an object of attraction	14
74	Semiliquid means:	
Adj	a. that something has the qualities of both a fluid and a solid	30
N	b. a substance that has the qualities of both a fluid and a solid	33
76	Quarrelsomeness means:	
N	a. the quality of being inclined to find fault	9
N	b. the quality of being inclined to argue	31

77	Redefine means:		
V	a.	to state the meaning of something again	32
V	b.	to prescribe clearly and with authority again	11
V	c.	to mark the limits of something again	16
V	d.	to make distinct in outline or features of something again	24
V	e.	to determine the essential qualities of something again	22
V	f.	to specify the interpretation of a concept again	23
78	Rational means:		
Adj	a.	that something is based on reason	29
Adj	b.	that something relates to or is one of the set of numbers that are integers or quotients of two integers	16
Adj	c.	that someone has reason or understanding	26
Adj	d.	that someone is intelligent	9
79	Seabound means:		
Adj	a.	that someone or something is traveling toward the ocean	35
Adj	b.	that someone or something is surrounded by the ocean	30
80	Ropy means:		
Adj	a.	that something looks like a large, thick cord that is made of natural or artificial fibers twisted together	14
Adj	b.	extremely unsatisfactory	0
Adj	c.	capable of being drawn into a thread	6
81	Lady's slipper means:		
N	a.	an orchid which has flowers shaped like light shoes	25
N	b.	an impatiens plant which has sharply serrated leaves and flowers ranging in colour from white to purple	11
N	c.	a columbine plant with spurred blue and purple flowers	8
N	d.	a European plant having claw shaped seed pods	3
82	Unbribable means:		
Adj	a.	that someone could not be persuaded to accept something of value in order to pervert their judgment or corrupt their conduct	
Adj	b.	that someone could not be persuaded to accept something favourable in order to influence a given line of conduct	See a
83	Priesthood means:		
N	a.	the vocation of a professional clergyman	14
N	b.	the order of professional clergymen	33
N	c.	the authority to speak and administer in the name of the Deity given in the Mormon Church by ordination	17

84	Extremeness means:		
N	a.	the state of being severe	19
N	b.	the state of existing in the greatest possible degree	22
N	c.	the state of exceeding the ordinary	24
N	d.	the state of being the most remote	11
85	Unreluctant means:		
Adj	a.	that someone does not hesitate to do something	36
Adj	b.	that someone does not offer opposition	14
88	Corresponding means:		
Adj	a.	that something agrees with something else in some way	35
Adj	b.	that someone writes letters	24
90	Continuous kiln means:		
N	a.	an oven which consists of a large chamber through which fire travels	13
N	b.	a long narrow oven which is hottest in the middle portion and through which ware travels on cars or a conveyor	13
91	Parole means:		
N	a.	a provisional discharge of a prisoner	27
N	b.	the promise of a prisoner of war upon his faith and honour to fulfill stated conditions in consideration of special privileges	11
N	c.	the state or period of freedom resulting from provisional release from custody	29
N	d.	the release of a defendant in a criminal case during the period between indictment and trial	16
N	e.	an act relating to language or the knowledge of language	1
V	f.	to release from custody	17
Adj	g.	that something relates to a release from custody	15
93	Overfulfill means:		
V	a.	to more than meet the requirements	39
V	b.	to more than make whole	17
V	c.	to more than measure up to	20
94	Universalness means:		
N	a.	the quality of being world-wide	25
N	b.	the quality of being all-inclusive	22
N	c.	the quality of including all of mankind	21
N	d.	the quality of being unrestricted in application	9
N	e.	the quality of involving the totality of a person's rights and liabilities	3
N	f.	the quality of being adjustable to meet varied requirements	4

97	Zero Hour means:		
N	a.	the scheduled time for an action or operation to begin	20
N	b.	the scheduled time at which a previously planned attack or other military operation is started	22
N	c.	a time when a vital decision or decisive change in the course of events is impending	20
N	d.	the time set as a basis for reckoning the time of day	21
98	Malarial Fever means:		
N	a.	an acute disease of people which is transmitted from an infected person to a healthy person by a mosquito bite and results in chills and rises in body temperature above normal	39
N	b.	a serious often fatal virus disease of horses and mules marked by intermittent rises in body temperature, depression, weakness, jaundice and anemia	10
N	c.	an infectious disease of cattle transmitted by the cattle tick resulting in a destruction of red blood cells	7
102	Clerkship means:		
N	a.	the profession of an office worker	21
N	b.	part of the undergraduate medical training during which the student performs routine clinical work	11
N	c.	a position as a minister or clergyman	12
N	d.	a position as a salesperson in a store	23
106	Sparrow-tail means:		
Adj	a.	that something looks like the deeply forked feathers found at the end of the body of a very common, small, brownish bird	28
Adj	b.	that something is joined with precisely interlocking parts which are tapered at one end and flared at the other	11
109	Brights means:		
N	a.	more than one headlight of a vehicle that sends light ahead on the road for as much long range illumination as possible	23
N	b.	more than one artist's brush with short flat square-edged bristles	4
N	c.	a type of coal with high moisture, nitrogen, and sulfur content	1
111	Steady State means:		
N	a.	a condition of a system that does not change in time	31
N	b.	a condition of stability of a generator or electric system under normal fluctuations of load and voltage	16
N	c.	a condition of physiological equilibrium	26

114	Wittily means:	
Adv	a. that something is done in a humorous way	25
Adv	b. that something is done in a way that requires good mental capacity	See c
Adv	c. that something is done in an intelligent way	24
Adv	d. that something is done in a cleverly facetious way	24
115	Impassibility means:	
N	a. the quality of not being capable of feeling	11
N	b. the quality of being incapable of suffering	12
N	c. the quality of being incapable of being harmed	11
116	Slicking means:	
N	a. the act of making something smooth	15
N	b. the act of making something flat or slippery	29
N	c. the act of giving something an elegant finish	11
N	d. the act of making someone presentable	6
118	Pump Cylinder means:	
N	a. a chamber of a machine that can raise, transfer or compress fluids by suction and/or pressure	32
N	b. a sliding telescopic gage used by chronometer makers	5
120	Vegetive means:	
Adj	a. that something has the ability to grow	12
Adj	b. that something is not an animal or a mineral	13
Adj	c. that something is related to involuntary bodily functions	2
Adj	d. that someone leads a passive or secluded existence	8
122	Hypertonicity means:	
N	a. the state of having excessive tone	8
N	b. the state of having a higher osmotic pressure than a fluid under comparison	16
132	Disburden means:	
V	a. to get rid of a load	19
V	b. to rid something or someone of a load	22
V	c. to relieve of something oppressive to the mind	22
133	Driveling means:	
Adj	a. that someone is being foolish in an infantile or feebleminded way	7
Adj	b. that someone is feeble like an infant in thought or action	8

138	Centenary means:		
N	a.	a period of one hundred years	13
N	b.	a commemoration of an event that occurred one hundred years before	12
N	c.	the governor of a county hundred	2
Adj	d.	marking a duration of one hundred years	20
Adj	e.	belonging to a county hundred	7
139	Underprize means:		
V	a.	to estimate the value of something below its real worth	22
V	b.	to treat as of little worth	21
V	c.	to cause to decrease in value	19
N	d.	a price less than the real worth	17
140	Erosible means:		
Adj	a.	that something is capable of being worn away by the action of water, wind or glaciers	See b
Adj	b.	that something is capable of being deteriorated as if by eating or wearing away	23
Adj	c.	that something is capable of being diminished or destroyed by degrees	16
141	Thusness means:		
N	a.	the condition of being a consequent of something	6
N	b.	the condition of being in this or that manner	4
N	c.	the condition of being to this degree or extent	1
142	Hideosity means:		
N	a.	the state of being offensive to the sight or dreadful	22
N	b.	the state of being offensive to the mind or moral sense	22
N	c.	a thing that is offensive to the sight	20
N	d.	a thing that is offensive to the mind or moral sense	21
143	Jovial means:		
Adj	a.	that someone has a merry nature	34
Adj	b.	that someone has the nature, disposition, or aspect that according to astrology is determined by Jupiter as ruling planet	4
146	Gamy means:		
Adj	a.	that something has the flavour or smell of animals hunted for food or sport	6
Adj	b.	that someone has the desire to gamble	2
Adj	c.	that someone shows an unyielding spirit	0
Adj	d.	that something is scandalous or sensational	1
Adj	e.	morally tainted	1

147	Adhesive means:	
Adj	a. that something has the ability to stick things together	27
Adj	b. that something tends to keep close to something	10
N	c. a substance that sticks things together	34
N	d. a stamp that has a gummed back	10
150	Bluenosed means:	
Adj	a. that someone has a strict moral code	10
Adj	b. that someone is a native of the Canadian Maritime Provinces	5
157	Supposition means:	
N	a. something that is assumed on slight grounds	16
N	b. a fraudulent substitution or alteration	2
N	c. one of the various connotations that a term might have in different passages	2
160	Pyro means:	
N	a. a person who cannot resist the urge to set fires	23
N	b. a chemical used in photography	0
N	c. a chemical used in smokeless gunpowder	2
163	Frugalness means:	
N	a. the quality of being thrifty	19
N	b. the quality of displaying economy in use of resources	11
164	Lay over means:	
V	a. to postpone	25
V	b. to surpass something	10
165	Thing in Action means:	
N	a. any right to a personal item that someone does not actually have but that can be recovered by a law suit	6
N	b. the personal item that someone does not actually have but that is the subject of a law suit to recover that item	8
166	Referendum means:	
N	a. a popular vote on something proposed by a legislative body or by a group of people	28
N	b. a diplomatic agent's note asking his government for instructions	8
168	Spousal means:	
Adj	a. that something is associated with marriage	38
N	b. the action of marrying	12

169	Devon means:	
Adj	a. that something is from a county (so named) in England	7
N	b. a breed of vigorous, red, dual-purpose cattle	4
N	c. any animal of the breed of vigorous, red, dual-purpose cattle	See b
170	Cynicism means:	
N	a. the quality of not believing in the goodness of people	18
N	b. the quality of finding fault, sneering, and sarcasm	31
N	c. the quality of displaying feelings of distrust or doubt	22
N	d. the doctrine of a member of the school of philosophers that taught that virtue is the only good	4
171	Patriarchic means:	
Adj	a. that something is governed by a founding father	12
Adj	b. that something is governed by a bishop of an ancient Orthodox or Roman Catholic church	9
Adj	c. relating to a dark reddish purple	0
Adj	d. resembling something that is ancient or venerable	4
173	Abstractionism means:	
N	a. the creation of a work of art which has an obscure resemblance to what it represents	27
N	b. the principles or ideals of art which has an obscure resemblance to what it represents	29
174	Pubescent means:	
Adj	a. having reached the stage at which the genital organs begin to mature	28
Adj	b. having a surface covered in fine soft short hairs	1
177	Missive means:	
N	a. a written message	3
Adj	b. specially sent	1
N	c. something that is thrown or used as a weapon	2
178	Salinification means:	
N	a. the process of making something salty	22
N	b. the process of making something contain salt	See a
N	c. the process of making something contain the salts of the alkali metals or of magnesium	15
192	Freshet means:	
N	a. a stream of pure, cool water	1
N	b. the sudden overflowing of a stream caused by heavy rains or melted snow	0

194	Break back means:		
V	a.	to return abruptly to a former position or state	9
V	b.	to return inward from a projection	4
200	Somerset means:		
Adj	a.	that something is from the county (so named) in England	8
N	b.	an act of turning end over end	3
N	c.	a reversal of policy, tactics, or position	4
V	d.	to cause to turn end over end	3
V	e.	to cause a reversal of policy, tactics, or position	3
V	f.	to execute a move of turning end over end	4
V	g.	to execute a reversal of policy, tactics, or position	5
202	Siliconize means:		
V	a.	to treat with an abundant nonmetallic element or a compound of it to form a protective surface alloy	25
V	b.	to treat with an organic compound for the purpose of waterproofing, lubrication or electric insulation	15
203	Turmeric means:		
N	a.	a yellow East Indian herb used as a colouring agent and a condiment	7
N	b.	any plant that yields coloured juices or other wise felt to resemble the yellow East Indian herb used as a colouring agent and a condiment	5
Adj	c.	something that relates to or is obtained from the yellow East Indian herb used as a colouring agent and a condiment	7
204	Edwardean means:		
Adj	a.	that something relates to the doctrines of an American Congregational clergymen who lived in the 1700's	6
N	b.	an adherent of the theology of an American Congregational clergymen who lived in the 1700's	7
204a	Edwardian means:		
Adj	a.	that something relates to the doctrines of an American Congregational clergymen who lived in the 1700's	6
N	b.	an adherent of the theology of an American Congregational clergymen who lived in the 1700's	7
Adj	c.	relating to the era of a King of England who reigned between 1901 and 1910	29
N	d.	one belonging to the era of a King of England who reigned between 1901 and 1910	21

206	Quincentenary means:	
N	a. a five hundredth year anniversary	13
Adj	b. that something relates to a five hundredth year anniversary	13
208	Bivalent means:	
Adj	a. that an element in a compound has an oxidation state of two	11
Adj	b. that a cell has two sites for combination with antibody or antigen	11
N	c. a pair of synaptic chromosomes	4
216	Daw means:	
N	a. a common black and gray bird found in Europe and Asia	2
V	b. the rising of the sun above the horizon in the morning	1
N	c. a lazy person	1
N	d. a slovenly woman	0
N	e. the pinkish yellow colour of the eyes of some game fowl	0
228	Tubers means:	
N	a. more than one short, fleshy stem which is usually formed underground	6
N	b. a crop of potatoes	3
N	c. more than one person who works with long hollow cylinders of metal, plastic or rubber	12
N	d. more than one machine that makes long hollow cylinders of metal, plastic or rubber	11
N	e. more than one textile worker who rewinds cloth from large rolls onto small rolls	7
N	f. more than one person who makes round belting from strips of leather	3

Appendix C

Sample Cover Page and Sample Page of Test Booklets Used in Preliminary Study One

Semantic Relatedness of Word Meanings - Booklet A

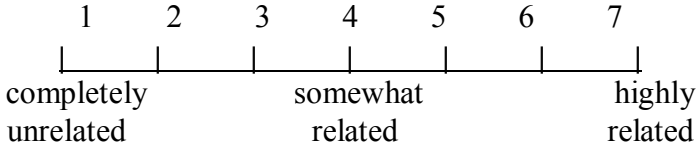
Age: _____ Gender: M F

Instructions:

1. Carefully read each word and the pair of meanings listed below it.

2. Indicate how related the two meanings are to each other using the following scale.

3. Write the rating in the space provided beside each pair of meanings.



The following are some examples:
Some words have meanings that are very similar. These meanings may seem like they are two different ways of saying the same thing. These meanings should be rated as highly related. For example:

1. *Earth* means:
a. the third planet from the sun in our solar system _____6_____
b. the world which we inhabit

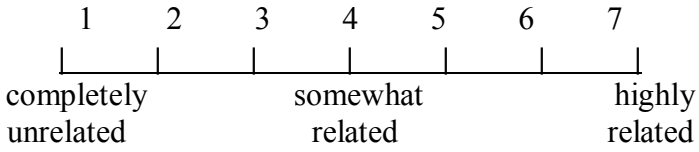
Some words have meanings that are not at all related. These are words representing different ideas that just happen to be spelled and pronounced the same. These meanings should be rated as completely unrelated. For example:

2. *Bat* means:
a. a nocturnal flying animal _____1_____
b. a wooden stick used to hit a ball

Some words have meanings that are related in some way but yet represent different ideas. Some of these words may have one meaning that is a different part of speech than another meaning (i.e., *help* (n.) - assistance, *help* (v.) - to give aid). Other words have meanings that are related by some other similarity. These words should be rated as fairly related. For example:

3. *Cone* means:
a. a geometrical shape that is circular at one end and pointed at the other _____4_____
b. an edible container for ice cream

Use the following scale to rate the relation between each pair of word meanings. Write the rating in the space provided beside each pair of meanings.



1. Accusal means:
a. the act of blaming _____
b. a charge of wrongdoing

2. Adhesive means:
a. that something has the ability to stick things together _____
b. a substance that sticks things together

3. Adhesive means:
a. that something tends to keep close to something _____
b. a substance that sticks things together

4. Adhesive means:
a. a substance that sticks things together _____
b. a stamp that has a gummed back

5. Baits means:
a. that someone is putting worms on a fishhook _____
b. more than one piece of food that is used to attract fish or other animals

6. Baits means:
a. that someone is putting worms on a fishhook _____
b. that some hunting dogs are attacking by biting or tearing their prey

7. Baits means
a. that someone is putting worms on a fishhook _____
b. more than one preheated iron used in shaping molten glass

8. Baits means:
a. more than one piece of food that is used to attract fish or other animals _____
b. that some hunting dogs are attacking by biting or tearing their prey

9. Baits means:
a. more than one piece of food that is used to attract fish or other animals _____
b. more than one preheated iron used in shaping molten glass

Appendix D

Word Meaning Pairs with a Semantic Relatedness Rating of 6.0 or More

Cardinal flower means:
a. a vivid red blossom that grows in the United States or Canada
b. a plant bearing a vivid red blossom that grows in North America

Changed means:
a. that something has been made different
b. that something has turned into something markedly different

Devon
a. a breed of vigorous red dual-purpose cattle
b. any animal of the breed of vigorous red dual-purpose cattle

Enjoyable means:
a. that something is a source of pleasure
b. that something is capable of making someone happy

Erosible means:
a. that something is capable of being worn away by the action of water, wind or glaciers
b. that something is capable of being deteriorated as if by eating or wearing away

Forgotten means:
a. that something or someone has been neglected
b. that someone or something has been treated with inattention

Improve means:
a. to make better
b. to enhance in value or quality

Mucky means:
a. that something is covered with mud
b. that something consists of mud

Plenty means:
a. more than enough
b. ample in amount

Preservable means:
a. that something can be stored without going bad
b. that something can be kept from decay

Recklessly means:
a. that something is done without care
b. that something is done in a manner marked by lack of consideration

Recklessly means:
a. that something is done without care
b. that something is done in a manner lacking in caution

Recklessly means:
a. that something is done in a manner lacking in caution
b. that something is done in a manner marked by lack of consideration

Reports means:
a. that someone is telling about something
b. that someone is giving an official account of something

Salinification means:
a. the process of making something salty
b. the process of making something contain salt

Separately means:
a. that something is done in an independent manner
b. that something is done in a detached manner

Separately means:
a. that something is done in a solitary manner
b. that something is done in a manner that is not shared by others

Separately means:
a. that something is done in a detached manner
b. that something is done in a manner that is not shared by others

Separately means:
a. that something is done in an independent manner
b. that something is done in a manner that is not shared by others

Talkativeness means:
a. the quality of being inclined to express in speech
b. the quality of being inclined to use language for communicating

Towering means:
a. that something has great height
b. that something is extremely high in relation to others

Unbribable means:
a. that someone could not be persuaded to accept something of value in order to pervert their judgment or corrupt their conduct
b. that someone could not be persuaded to accept something favorable in order to influence a given line of conduct

Wittily means:
a. that something is done in a way that requires good mental capacity
b. that something is done in an intelligent way

Appendix E

Instructions and Sample Questions from Test Booklet Used in Preliminary Study Two

Frequency and Dominance Questionnaire, Version 1, Section 1

Age: _____
Gender: M F

1. Below is a list of words. For each word that you know, write the first meaning that comes to mind. A definition has to be expressed in words. For each part of the word, define all parts without using the word itself in the definition.

The following is an example of an unacceptable definition for the word *lunchroom*:

A *lunchroom* means a room where you eat lunch.

This example is unacceptable because it uses the words *room* and *lunch* rather than defining these terms. In order for the above definition to be acceptable, subsequent definitions for the terms room and *lunch* must also be provided.

In contrast, an acceptable definition for *lunchroom* would be:

A *lunchroom* means a place where you go and eat a mid-day meal.

2. If you cannot think of a definition for every word, write a sentence that shows that you know what it means. Make the sentence as detailed as possible in order to show that you understand the word's meaning.

The following is an example of an unacceptable sentence using the word *lunchroom*:

I went to the *lunchroom*.

This example is unacceptable because it does not explicitly state any characteristics or functions of the word, such that it is uncertain that the word is truly understood and known.

In contrast, an acceptable sentence using the word *lunchroom* would be:

I went to eat in the *lunchroom* at noon.

3. There may be some words that you are unfamiliar with. In fact, most people do not know the meaning(s) of all the words. However, please attempt to complete definitions or sentences for all the words.

Flop

Definition:

_____

Sentence:

_____

Overfulfill

Definition:

_____

Sentence:

_____

Frequency and Dominance Questionnaire, Version 1, Section 2

Instructions:

Now consider the same list of words as Section 1.

1. For each word that you know, write as many new definitions that you can think of that illustrate other meanings for each word.

2. If you cannot think of other definitions for a word, write sentences to illustrate that you know other meanings for a word.

3. There has been more than sufficient space allowed in order to provide as many definitions or sentences as possible.

4. There may be some words that you are unfamiliar with. In fact, most people do not know the meaning(s) of all the words. Please attempt as many definitions or sentences as possible.

Flop

_____

_____

_____

_____

_____

_____

_____

_____

Frequency and Dominance Questionnaire, Version 1, Section 3

Instructions:

The following pages consist of groups of words followed by a list of meanings.

1. Carefully read each meaning.

2. Indicate in the space provided beside each meaning the corresponding number of the word that is defined by each meaning.

3. In some cases, it is possible that more than one meaning will define the same word correctly. For instance, in the example below "means to become exhausted or weary" and "means a hollow rubber hoop or band inflated with air that surrounds a wheel" are both correct definitions of the word tire.

4. Some of the meanings do not define these words. Indicate with an "X" meanings that you do not recognize as defining any of the words. Try not to guess at the words! If you do not know the word for a particular meaning, put an "X" beside the meaning. The following is an example:

1. Tire **2. Hydrogen** **3. Camel**

__1__ means to become exhausted or weary

__X__ means an obscuration of the light of sun or moon by some other body

__3__ means an animal of Asia or Africa that is known for its long neck and endurance in desert conditions

__1__ means a hollow rubber hoop or band inflated with air that surrounds a wheel

__2__ means a gaseous element which is the lightest substance known

__X__ means a cud-chewing animal covered with wool

Frequency and Dominance Questionnaire, Version 1, Section 3A

1. Break back **2. Flop** **3. Overfulfill** **4. Clerkship**

5. Hopelessness **6. Bluenosed** **7. Moneybags**

_____ means with a sound of dropping heavily

_____ means that someone has a strict moral code

_____ means that something is the wise thing to do

_____ means a person who is rich

_____ means to move irregularly to and fro and up and down

_____ means to more than meet the requirements

_____ means to return inward from a projection

_____ means that something is capable of being changed

_____ means to drop in a heavy way

_____ means the profession of an office worker

_____ means the state of having no expectation of good

_____ means that something is not bound together

_____ means a cheap place to sleep

_____ means to change or turn suddenly

_____ means to more than make whole

_____ means capable of recovering quickly from low spirits or misfortune

_____ means to throw oneself down heavily, clumsily, or in a completely relaxed manner

_____ means an abundance of things that are objects of human desire

_____ means to go to bed

Appendix F

Word Meaning Pairs with a Frequency Score of One or Zero From Preliminary Study Two

6	Soaking means:	
	that someone is drinking alcoholic beverages gluttonously	1
	that a person's attention is engrossed in extensive study	1
	that something is remaining for a considerable time under heat treatment	0
26	Baits means:	
	more than one preheated iron used in shaping molten glass	0
32	Dishing means:	
	that something or someone is being defeated or ruined	0
47	Waahoo means: (Only one meaning remaining for *Waahoo*)	
	a shrub or small shrubby tree known as a North American spindle tree	1
	a large vigorous mackerel found in warm seas	1
	any of various American trees or shrubs such as the Rock Elm, Winged Elm, and Basswood	1
51	Workable means:	
	that mail can be sorted by place of destination	1
54	Hermit means:	
	a plainly coloured, forest-dwelling tropical hummingbird	1
65	Peasant means:	
	relating to native culture or art	1
80	Ropy means:	
	extremely unsatisfactory	0
91	Parole means:	
	an act relating to language or the knowledge of language	1
109	Brights means:	
	a type of coal with high moisture, nitrogen, and sulfur content	1
141	Thusness means:	
	the condition of being to this degree or extent	1

146	Gamy means:	
	that someone shows an unyielding spirit	0
	that something is scandalous or sensational	1
	morally tainted	1
160	Pyro means:	
	a chemical used in photography	0
171	Patriarchic means:	
	relating to a dark reddish purple	0
174	Pubescent means: (Only one meaning remaining for *Pubescent*)	
	having a surface covered in fine soft short hairs	1
177	Missive means:	
	specially sent	1
192	Freshet means: (Only one meaning remaining for *Freshet*)	
	the sudden overflowing of a stream caused by heavy rains or melted snow	0
216	Daw means: (Only one meaning remaining for *Daw*)	
	the rising of the sun above the horizon in the morning	1
	a lazy person	1
	a slovenly woman	0
	the pinkish yellow colour of the eyes of some game fowl	0

Appendix G

Words Used in Multiple Choice Alternatives that are Less Frequent than the Test Word

The following is a list of words used in multiple-choice alternatives that are less frequent than the corresponding test word. In the first column, the test word is listed. The second column lists the frequency score for that test word as given by Zeno et al. (1995). The third and fourth columns list the word that has been used in the multiple-choice alternative and the frequency score for that word. The fifth column lists the letter indicating which multiple meaning the less frequent word has been used in: A = first meaning, B= second meaning etc. Sub means sub-entry. NP means non-polysemous word. The last column indicates the frequency score as obtained in study two (out of 40) for each of those meanings (except in the case of a sub-entry or non-polysemous word, in which case, the last column is blank). For example, the word profit is used in the correct alternative of the third meaning of the word improve. This third meaning was only produced or recognized 4 times out of 40 in study two. Therefore, it is not very well known and not very likely to be known by younger participants in the vocabulary test.

Table G 1

Test Word	Frequency (U)	Word in MC Question	Frequency (U)	M #	S2 -F
Plenty	49	Sufficiently	10	D	20
Changed	168	Clothes	126	B	26
Changed	168	Talked	69	D	17
Changed	168	Cover	89	E	14
Changed	168	Equal	84	F	13
Changed	168	Bills	21	F	13

Test Word	Frequency (U)	Word in MC Question	Frequency (U)	M #	S2 -F
Changed	168	Coins	17	F	13
Changed	168	Return	121	G	11
Forgotten	9	Neglected	7	B	24
Improve	52	Profit	25	C	4
Improve	52	Grade	42	D	3
Improve	52	Drain	8	D	3
Improve	52	Pavement	6	D	3
Improve	52	Insurance	41	D	3
Improve	52	Damage	49	D	3
Improve	52	Destroy	29	D	3
Scene	36	Imagined	17	E	20
Scene	36	Loneliness	8	E	20
Scene	36	Exhibition	2	H	8
Scene	36	Explosive	5	H	8
Scene	36	Emotion	10	H	8
Towering	6	Mirage	.5328	C	9
Towering	6	Bounds	3	D	7
Occasion	21	Ceremony	11	A	38
Occasions	15	Celebrate	9	Sub	
Clark	9	Ordained	.9879	B	7
Clark	9	Clinical	4	G	4
Clark	9	Surgery	7	G	4

Test Word	Frequency (U)	Word in MC Question	Frequency (U)	M #	S2 -F
Suspicious	7	Doubtful	5	A	31
Suspicious	7	Uneasiness	2	B	28
Suspicious	7	Doubted	3	B	28
Competitive	10	Rival	7	NP	
Competitive	10	Jealous	8	NP	
Peasant	8	Hunts	2	C	17
Peasant	8	Fishes	4	C	17
Peasant	8	Rented	6	C	17
Rational	7	Quotients	0	C	16
Rational	7	Integers	.1624	C	16
Parole	.5908	Indictment	.5467	D	16
Cynicism	.7388	Sneering	.3530	A	31

Appendix H

Test of Vocabulary and Multiple Meanings Sample Multiple Choice Questions

1A. Closet means:
   a. a small room in which clothes are kept *
   b. a trunk on a car
   c. a room in which there is a stove
   d. a book which can be locked

1B. Closet means:
   a. a small room for parties
   b. a large room for parties
   c. a small room that is private *
   d. a small box for keeping money

1C. Closet means:
   a. that something is out in the open
   b. that something is far from private
   c. that something is fairly open
   d. that something is closely private *

2A. Elastic means:
   a. a long string
   b. a rubber band *
   c. a round ball
   d. a narrow river

2B. Elastic means:
   a. able to remain the same size and shape after being made
   b. able to remain the same size and shape after being decorated
   c. able to recover size and shape after a change in colour
   d. able to recover size and shape after a change in shape *

2C. Elastic means:
   a. flexible *
   b. favourable
   c. noticeable
   d. incredible

3A. Milk cow means:
   a. an animal that barks and drinks something dark in colour
   b. an animal that goes moo and gives something white to drink *
   c. an animal that goes moo and gives something dark in colour
   d. an animal that barks and drinks something white