THE MNEMONIC VALUE OF ORTHOGRAPHY FOR ELEMENTARY STUDENTS LEARNING NEW VOCABULARY WORDS

by

JULIE ROSENTHAL

A dissertation submitted to the Graduate Faculty in Educational Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York

2005

INFORMATION TO USERS

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleed-through, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

This manuscript has been read and accepted by the
Graduate Faculty in Educational Psychology in satisfaction of the
dissertation requirement for the degree of Doctor of Philosophy.

4-21-05 — Linnea C. Ehri
Date — Chair of Examining Committee

4/21/2005 —
Date — Executive Officer

Dr. Linnea C. Ehri, Distinguished Professor

Dr. David Rindskopf, Distinguished Professor

Dr. Hollis Scarborough
Supervision Committee

THE CITY UNIVERSITY OF NEW YORK

Abstract

THE MNEMONIC VALUE OF ORTHOGRAPHY FOR ELEMENTARY STUDENTS LEARNING NEW VOCABULARY WORDS

by

Julie Rosenthal

Adviser: Professor Linnea Ehri

The mnemonic value of spellings for securing vocabulary words and their meanings in memory was examined. Fifth graders were taught two sets of unfamiliar words and their definitions as oral responses in paired-association learning tasks. During study periods, students were shown spellings of one set of words, and they received extra practice reciting the other set of words but never saw their spellings. Learning to pronounce the words when their pictures were shown, and learning to state meanings of the words when the words were heard were the responses taught. Learning of words and meanings favored the spelling condition. Children with the largest printed word lexicons benefited most from seeing spellings. Results are interpreted as providing evidence for the mnemonic value of spellings in vocabulary learning because they provide readers with orthographic images useful for storing pronunciations along with their meanings in memory.

Acknowledgements

First and foremost, I wish to express my appreciation to Dr. Linnea Ehri, who served as chair of my dissertation committee. Many thanks go to her for the enormous amount of time she expended to help me conceptualize, plan, conduct and write this dissertation. Professor Ehri demands excellence from her students and gives multifold what she asks for in return. I am grateful for her expertise, scholarship, patience, and support.

Thanks to Dr. Hollis Scarborough for agreeing to join my committee on such short notice. Her thoroughness in reviewing the dissertation is greatly appreciated. Thanks for her guidance on aspects of conducting the study and on analyzing the data. Dr. Scarborough's valuable comments and suggestions helped make this work far better than it otherwise would have been. Thanks to Dr. David Rindskopf for providing much needed advice pertaining to statistical analysis of my data, especially in the early phases of my work. To Drs. Carol Tittle and Lois Dreyer, I extend my gratitude for agreeing to read my dissertation. Thank you both for pointing out issues and concerns small and large.

This work was funded in part by dissertation fellowship awards. Many thanks to The International Reading Association for the Jeanne S. Chall Research Fellowship. Thanks also to The CUNY Graduate Center for the Mario Capelloni Dissertation Fellowship.

This dissertation could not have been written without the participation of the students and staff of the school in which I collected data. Thanks to Principal FM for allowing me to conduct research in the school. Thanks to KM for coordinating teachers, students, schedules, and a room in which to work. Thanks to the teachers and students who participated.

Special thanks to my husband, Bill Sarkozy, for his encouragement and support throughout this seemingly endless process. Thanks also for assistance with many of the graphics included in the manuscript. You truly are the backbone of my recent accomplishments. I couldn't have done it without you.

To my parents, I express my gratitude for their unwavering love and belief in me. Dad, thanks for pushing me to get this degree and for all of your help of many sorts along the way! Mom, thanks for being a springboard for my ideas and for offering your insights from your own life's work with children.

And last but certainly not least, to my children, Miles, Stella, and Lia, thank you for making me happy every single day.

Table of Contents

List of Tables

List of Figures

Chapter 1

Introduction

The purpose of this study was to examine the mnemonic value of spellings in learning vocabulary words. It was expected that children with good word reading skills would learn pronunciations and meanings of new words faster when they not only heard pronunciations but also saw the words' spellings than when they heard pronunciations but were not shown spellings. The explanation is that seeing spellings causes readers to preserve letters as alphabetic images representing sounds in memory. According to Ehri's (1999) theory of word learning, meanings of words are amalgamated to words' pronunciations more effectively when pronunciations are orthographically represented in memory, by forming single lexical units with multiple identities.

The ability to learn new words is central to success in reading and to academic achievement (Beck & McKeown, 1999). The strength of the relationship between vocabulary knowledge and reading proficiency has long been recognized and is well documented (National Reading Panel, 2000). Children's vocabulary increases rapidly during their school years, with estimations of growth ranging considerably depending on whether counts are limited to root words or include derivations (Beck & McKeown, 1991). Another factor causing variation is the well-documented disparity between vocabularies of advantaged and disadvantaged populations (i.e. Chall, Jacobs, & Baldwin, 1990; Hart & Risley, 1995; Snow, Burns, & Griffin, 1998). Children who come to school with limited vocabularies tend never to catch up to their higher-quartile peers (Biemiller, 2001). In fact, students with below average vocabularies and reading skill begin to experience a reading slump in grade 4, when reading becomes increasingly

abstract and complex; this slump worsens in seventh grade and beyond, when skill in word meaning becomes more crucial (Chall et al., 1990). Thus, the need for better vocabulary-building curricula in school is clear, especially because students' home experiences provide little support for vocabulary growth.

Research on vocabulary acquisition has been extensive (Beck & McKeown, 1999). Most of this research focuses on receptive vocabulary growth, as measured by multiple-choice or matching tests. However, vocabulary production requires deeper knowledge of a word than does vocabulary recognition (Baumann & Kame'enui, 1991). Therefore, it is important to find methods that can enhance students' memory for words and their pronunciations as well as recognition of their meanings.

One promising method is the use of orthography as a mnemonic aid for remembering words' pronunciations. Orthography has been shown to improve memory for unfamiliar pronunciations. In a 1979 study, Ehri and Wilce showed that orthography has mnemonic value for beginning readers learning novel oral productions. Using paired-associate sound-learning tasks in four experiments, children were taught consonant-vowel-consonant nonsense sounds as oral responses to geometric figures or other visual stimuli. In the spelling condition, spellings of the CVC sounds were seen or imagined during study and feedback trials but not during recall test trials. In the control conditions, spellings were not seen but children practiced saying the sounds extra times. In all experiments, students learned the nonsense syllables fastest when spellings were seen or imagined.

In the pilot for the present study, second graders were taught two lists of low frequency, consonant-vowel-consonant nouns and their definitions in two conditions,

spellings-present and spellings-absent, during study and feedback trials. Results showed that second graders learned the words and their meanings significantly faster and more consistently when they saw the spellings than when they did not. This was true for all of the children although the effect was larger for students with large printed word repertoires, supporting amalgamation theory (Ehri & Wilce, 1979). Students with the largest printed word repertoires reached a criterion of three perfect trials in the spelling condition. In contrast, students with the smallest printed word repertoires did not reach criterion although their alphabetic knowledge was sufficient to produce more rapid learning of words in the spelling condition.

The purpose of the present study was to utilize the same design in order to examine whether older children who were taught unfamiliar, multi-syllabic vocabulary words would learn them more effectively when they were exposed to spellings during learning than when they were not. It was expected that older children with sufficient reading experience would possess knowledge of graphophonemic and graphosyllabic spelling patterns and could use this knowledge to benefit from the spellings of words in learning their pronunciations and meanings (Ehri, 1999). Older weaker readers with less orthographic knowledge were not expected to benefit as much from seeing spellings of the words they were taught.

Chapter 2

Literature Review

Vocabulary Learning and Amalgamation Theory

Vocabulary knowledge can be either expressive or receptive. Expressive, or productive vocabulary requires a writer or speaker to produce a specific word to express a meaning, whereas receptive vocabulary requires the reader/listener to recognize the meaning of a given word. In expressive vocabulary, a word, its pronunciation, meaning, and spelling must be adequately learned and retained in memory so that it can be retrieved and appropriately used for speaking and writing. In receptive vocabulary, the standards for knowing a word are not as stringent; the learner may discern the meaning by using morphological clues, or verbal context if it is available (Baumann & Kameenui, 1991). Senechal (1997) likened receptive and productive vocabulary to recognition and recall. While receptive vocabulary entails a comparison between internal and external representation of a word, expressive vocabulary entails the additional process of reproducing the phonological representation of the word. Henriksen (1999) further pointed out that while few words known receptively will ever become productive, along the receptive-productive continuum there are numerous levels of automaticity. Learners must ultimately be able to both encode and decode orthography to sound, and to map meanings onto word forms.

The majority of studies to date on vocabulary learning by native English speakers have examined growth in receptive vocabulary, most often as measured by multiple-choice tests (Senechal, 1997). The present study was intended to examine growth in

productive vocabulary over learning trials as measured by students' ability to pronounce words and state their meanings.

In order for receptive or productive vocabulary acquisition to occur, new words must be remembered. A word is known when one can attach a meaning to the word's pronunciation. The word's pronunciation is amalgamated not only to the meaning, but also to the syntactic function of the word, and these word identities are retained in memory. Amalgamation theory (Ehri, 1978) describes the process by which all of a word's identities, including semantic, syntactic, phonological, morphological, and orthographic identities, become bonded to form a single lexical unit.

The lexicon is conceptualized as a store of abstract units having several different facets. The phonological identity of a word consists of its articulatory, acoustic, and phonemic properties. The syntactic identity specifies how the word typically functions grammatically in sentences. The semantic identity is its meaning. Children acquire these identities as they learn to speak. When learning to read, the word's orthographic identity, or spelling, is added to the lexicon. The process by which the orthographic identity bonds to the word's other identities is referred to as amalgamation. The word's identities become amalgamated to form a single unit in lexical memory, with spellings, pronunciations, and meanings integrated (Ehri, 1980). Research on the reading of printed words has provided evidence to support this theory of printed word learning (Ehri, 1978, 1980; Ehri & Roberts, 1979; Ehri & Wilce, 1979, 1980a; Reitsma, 1983).

Contribution of Printed Language

When students practice reading words, orthographic identities become established in memory, and the reader no longer needs to depend on decoding skills to identify the

words. "Visual images replace sound as the address in memory, so the reader can recognize the word by simply matching the print to his stored visual representation" (Ehri & Roberts, 1979, p. 675). When thus acquired, visual properties of a printed word match the reader's stored image, enabling the reader to retrieve the entire unit as a gestalt, with sounds and meanings becoming evident simultaneously. Sound is not absent from the recognition process, but decoding ceases to be central once an orthographic image of the word exists in memory (Ehri & Wilce, 1979; Reitsma, 1983).

According to Ehri's theory of printed word learning, phonological awareness and alphabetic knowledge are central to the process. With reading instruction and experience, children progress through four phases of word reading, which reflect the predominant type of connections used to read words and store written forms of words in memory (Ehri, 1999). The four phases are: pre-alphabetic, partial alphabetic, full alphabetic, and consolidated alphabetic. In the pre-alphabetic phase, connections are made between selected visual cues and words. Children in this phase are unable to read words when the visual cues are absent. In the partial alphabetic phase, children have acquired some knowledge of the alphabetic system, and are able to use this knowledge to make connections linking the most salient (usually initial) letters to sounds. They use these connections to remember how to read words they have read before. When readers acquire more complete knowledge of the alphabetic system, they become full alphabetic phase readers, and connections are made between all letters in spellings and all phonemes in pronunciations. As readers gain experience and accumulate sight words in memory, recurring letter patterns become consolidated into units symbolizing phonological blends.

Consolidated alphabetic readers can then use these units to form connections to read and retain multi-syllabic words as sight words.

Ehri and her colleagues, and others, have provided evidence for the claim that knowledge of the alphabetic system enables readers to store orthographic images as symbols for sounds and meanings (i.e. Ehri, 1980, 1987; Ehri & Roberts, 1979; Ehri & Wilce, 1979, 1980a, 1980b; Reitsma, 1983; Roberts, 2003; Treiman & Rodriguez, 1999). While spelling-to-sound rules may initially be central, as children practice reading, they acquire word-specific knowledge that facilitates subsequent word identification processes. Orthographic images are stored as sequences of letters that bear systematic relationships to words' phonological identities, rather than as rote-memorized visual figures. As students gain knowledge of the alphabetic system, they come to acquire full alphabetic connections between graphemes in spellings and phonemes in pronunciations, thereby accumulating fully analyzed forms of words as sight words in lexical memory. With continued reading experience, recurring letter patterns become consolidated into units symbolizing phonological blends, allowing skilled readers to more rapidly read, and more efficiently store, multisyllabic words as visual images (Ehri, 1999).

The sound symbolizing function of letters has been found to be an important factor influencing students' memory for sounds and spellings, as well as their conceptualization of the phonemes that constitute words (Ehri, 1980; Ehri & Wilce, 1979, 1980; Kreiner & Gough, 1990). Experience with print may also enhance competence with speech by providing a visual-spatial model for spoken language (Ehri, 1984). Having a "...concrete picture of language in one's mind..." (Ehri, 1984, P. 360) can facilitate metalinguistic processes, clarify ambiguous sounds within words, influence

pronunciations, and improve memory for the words. Written language development can positively impact oral language development, as work by Sparks et al. (1997) has indicated. In this study of foreign language learning by high school students, foreign language word decoding was the best predictor of year-end foreign language oral proficiency, better even than foreign language grade from the previous year. The authors interpreted this finding as evidence of print's usefulness in representing spoken language in memory.

When a reader with sufficient grapho-phonological awareness sees a printed word, letters and multi-letter units are recognized and processed as symbols for sounds within the word; the letter sequence enters memory, and it becomes a visual symbol for the sound structure of the word (Ehri, 1999; Ehri & Wilce, 1980a; Reitsma, 1983). These visual symbols strengthen students' knowledge of words, and can therefore enhance their memory of how words sound and are spelled, as research by Ehri and colleagues, and others, has shown (Kreiner & Gough, 1990; Waters, Bruck, Malus-Abramowitz, 1988). As students learn to read, they increase their graphemic knowledge, and acquire an orthographic mnemonic system, which is activated spontaneously when words are seen in print. This system serves to glue print to sound and meaning, and enables readers to add words to their lexicons (Ehri & Wilce, 1979).

Ehri's research has also shown that different experiences with reading words contribute to multiple aspects of printed-word learning. In two studies (Ehri & Roberts, 1979; Ehri & Wilce, 1980b) beginning readers who practiced reading words in sentences learned more about the words' semantic and syntactic identities, while those reading words in lists learned more about the orthographic symbolization of pronunciations.

When reading words in sentences, meanings are activated and orthographic forms are seen simultaneously, accounting for the advantage in learning meanings and grammatical forms. When reading words in lists, it may have been hard for readers to determine meanings, especially for context dependent words, such as function words (Ehri & Wilce, 1980b). The advantage of reading words in lists, however, is that more attention is paid to spellings and how letters map sounds, allowing readers to store more complete images in their lexicons. During training, readers who saw words in sentences could use context cues to identify words, and unlike list readers, did not depend as heavily on graphic cues and how they map sounds.

Results of these studies indicate the interdependence of learning spellings and pronunciations of printed words, despite possible disparity between these skills and semantic processing of words. Frith (1978) similarly found that the fewer orthographic details spellers knew, the slower they were at pronouncing words, even when word meanings were known. Reitsma (1983) found latency effects in the reading of pseudowords when children were trained in identically pronounced, but differently spelled, nonwords. These findings can be interpreted to support the claim that printed words are in memory retained as orthographic images. When pronouncing or attempting to spell a word, subjects refer to their stored image and "read" it. The study reported here was conducted to explore the contribution made by spellings to fifth graders' ability to remember pronunciations and meanings of new words.

The claim that orthographic images are retained in memory is further supported by studies in which letters that are either silent or ambiguous were detected or produced successfully more often by children who had seen the printed words than by children who

had not (Ehri & Wilce, 1980b, 1982, 1986; Ehri, Wilce, & Taylor, 1987; Kreiner & Gough, 1990; Waters et al, 1988). Waters et al. found no difference in spelling ability among children in grades 3, 4, & 5 when they spelled rule governed, regular words. However, there was a positive effect of grade, and hence exposure to written language, on the spelling of morphologic and "strange" words. The authors interpreted these results as evidence that reading experience increases children's knowledge of word-specific orthographic patterns, and allows them to abstract generalizations about relationships between spelling, meaning, and phonology. Some written words have more opaque relationships to their pronunciations, and therefore demand a greater reliance on visual orthographic memory, which develops with increased reading skill.

Ehri and Wilce (1986) tested first, second, and fourth grade children on their judgment of intervocalic flaps and whether the flap sounds were /d/ or /t/. Older subjects more familiar with correct spellings made fewer errors than younger subjects. However, results of the study were not conclusive, so as a follow up, they trained second graders to pronounce and use words containing medial alveolar flaps, half spelled *D*, half spelled *T* (for example, mi<u>dd</u>le, li<u>tt</u>le). Half of the children saw the spellings, half did not. Children were then asked to select which of two words, one ending /d/, one ending /t/, rhymed with the syllable containing the flap. Results revealed that children who saw the spellings were more likely to conceptualize the flaps according to their spellings than those who did not see spellings. This indicates that the visual processing of spellings clarifies the words' phonological identities.

One major difficulty facing beginning readers learning new words is the ambiguity of vowels in many words. Vowel sounds vary continuously in the way they

are articulated, making learning to decode and spell vowel sounds more difficult than consonants. Ehri, Wilce, and Taylor (1987) conducted a study to determine whether beginning readers mistake vowels that are similarly articulated, and to assess the effect of knowing word spellings on vowel classifications. It was found that more advanced readers were better able to sort words by their vowel classification than beginning readers. As a second experiment, Ehri, Wilce and Taylor manipulated readers' knowledge of word spellings in order to determine if this would influence their categorization of vowel sounds in words. Two sets of 12 monosyllabic words drawn from fourth through sixth grade reading lists were taught to second graders. Pictures showing word meanings were printed on cards either accompanied or unaccompanied by the printed word. Children then sorted the 24 pictures by vowel sound without spellings present. An ANOVA was conducted on scores in the sorting task, and results revealed that children exposed to the spellings classified vowels more accurately than those not exposed to the spellings. Findings indicate that seeing the spellings of words impacts the processing of spoken language, how words are pronounced, and what sounds are thought to be in words.

Contribution of Spellings to Memory for Pronunciations

Seeing spellings also helps children remember pronunciations of unfamiliar words. In a study by Ehri and Wilce (1979), orthography was shown to have mnemonic value for beginning readers in four experiments. Using paired-associate sound-learning tasks, children in the spelling condition were taught consonant-vowel-consonant nonsense sounds as oral responses to geometric figures, letters, and numbers. Spellings as well as misspellings of the CVC sounds were shown during study and feedback trials

but not during recall test trials. In the control conditions, spellings were not seen but children practiced saying the words extra times. In one of the four experiments, children heard and were told to imagine spellings, rather than seeing them. In all experiments, students learned the nonsense syllables fastest when spellings were seen or imagined. Misspellings actually interfered with learning. Results were interpreted as providing support for the claim that "spellings improve response memory because they induce learners to preserve letters as visual images symbolizing sounds in memory" (Ehri & Wilce, 1979, p. 36). This effect was evident even when the visual images of the letters were imagined rather than seen by the children.

Ehri and Wilce (1979) found, furthermore, that the effect of seeing spellings on ability to remember pronunciations was stronger for students with greater knowledge of printed language. Specifically, those first and second graders with large printed word lexicons benefited from spellings in learning the nonsense syllables; those with small printed word lexicons did not. This result was interpreted as consistent with the authors' hypothesis that learning to read results in the acquisition of an orthographic mnemonic system, which in turn enables readers to build up a repertoire of printed words in lexical memory.

These findings carry important implications for the teaching of vocabulary. Hatch and Brown (1995) delineated five essential steps needed for the learning of vocabulary which, though intended for use by ESL teachers, can also likely be applied to vocabulary learning by most students (Blachowicz and Fischer, 2000). They suggest that teachers not only ensure that students encounter new words and learn their meanings, but also provide clear images of words to be learned in order to lessen confusion between them

and other words with similar forms. Hatch and Brown point to numerous examples of obvious confusion between words of similar form resulting in mistakes made by ESL students when trying to define English words. An example is a Spanish speaker defining *happened* as *felices*, meaning *happy*. The Spanish speaker in this instance apparently did not have a clear orthographic image of the form for *happened* and so confused it with a similar sounding word. Although the steps suggested by Hatch and Brown may be pedagogically appealing, in a recent review of the literature, Blachowicz and Fischer found no research that isolated and examined the steps in relation to instruction.

The purpose of the present study was to determine if seeing spellings during vocabulary learning would facilitate fifth graders' memory for pronunciations and meanings of new words. In the pilot study for the dissertation, second graders were taught two lists of low frequency, CVC nouns and their definitions in two conditions, spellings-present and spellings-absent, during study and feedback trials. Based on orthographic amalgamation theory, it was predicted that second graders would learn the words and meanings significantly faster and more consistently when they saw the spellings than when they did not. The effect was expected to be larger for students with strong alphabetic skills. Results supported hypotheses and are discussed further below.

Levels of Word Knowledge

Any discussion of the best ways to teach vocabulary must take into account the goals of vocabulary instruction. Knowledge of a word is not an all-or-nothing proposition. The question of what it means to know a word involves the extent or degree of knowledge one might possess about individual words (Beck & McKeown, 1991). Word knowledge can be conceptualized as falling along a continuum, from no knowledge

(i.e. never encountered it before), to having a general sense (i.e. may have heard it, but doesn't know what it means), to having knowledge but not being able to access it easily (i.e. being able to recognize its meaning in context), to having rich, decontextualized knowledge of a word's meaning (i.e. being able to use it and recognize its relationship to other words) (Beck & McKeown, 1991; Beck, McKeown, & Omanson, 1987; Henriksen, 1999). Different methods of testing vocabulary knowledge may tap different levels of understanding. The most widely used measure, a multiple-choice test, is thought to tap low-level knowledge, especially if there is a great semantic difference between the target answer and distractors (Kameenui, Dixon, & Carnine, 1987). Production tasks, where students are required to give a definition, or pronounce the target word, or correctly use the word in a writing task, test deeper word knowledge (Beck & McKeown, 1991; Lee, 2003).

Interpretations of the effects of vocabulary instruction should be guided by the realization of the multidimensionality of word knowledge, and by the understanding that word learning is incremental. This is especially important when considering what forms of vocabulary learning – incidental, or explicitly taught – are most effective and efficient. Although it is widely suggested that direct instruction is not warranted due to the large part that learning from context plays, it should be noted that incidental word encounters probably only lead to general, low-level word knowledge. An individual may derive enough information about a word to understand it in the context being read or heard, but may not remember the pronunciation and/or meaning, and thus does not truly learn the word (Kameenui, Dixon, & Carnine, 1987). Consequently, vocabulary instruction that increases the level of both word understanding and memory is desirable.

The Size of the Task

When considering how vocabulary growth can best be fostered, two questions become central. What is the size of individuals' vocabularies? What is the rate of vocabulary growth for school aged populations? As Nagy and Anderson (1984) point out, if the number of words students must learn is fairly small, a program designed to teach individual words might teach a substantial proportion of the desired words. However, if the number of to-be-learned words is large, then a program of direct instruction might only scratch the surface of the vocabulary that is needed.

Nagy and colleagues (Nagy & Anderson, 1984; Nagy & Herman, 1987) developed estimates of the number of different word families found in printed school English materials used by children in grades 3 through 9. They estimated that printed school English contains approximately 88,000 different word families, a number that is impossible to teach through direct instruction (Nagy & Anderson, 1984). However, this number was calculated by looking at all materials used by all students nationwide. It is doubtful that any individual child would come across all of these words, considering he or she would not read all of the materials available (Graves, 1986). Nagy and Herman (1987) recalibrated the findings of several previous studies, and arrived at figures that suggest that average students learn approximately 3,000 new words per year, a number that is still beyond the scope of a direct instruction vocabulary program.

In contrast, research by Biemiller (1999, 2001) and Biemiller and Slonim (2001) has estimated the rate of word acquisition to be much lower than that suggested by Nagy and Anderson (1984), making it possible to think of instructional approaches to increase vocabulary acquisition. The difference, according to Biemiller and Slonim, is partly due

to making clear distinctions between root words and derivations, inflections, and compounds using these root words. If the average rate of word acquisition is two to four root words a day, rather than the eight per day suggested by Nagy and Anderson, direct instruction of word meanings becomes feasible.

Biemiller and Slonim (2001) have attempted to show that many words are learned in a similar sequence by children with different rates of vocabulary progress, a finding that could carry strong implications for instructional practices and construction of materials. Two normative English speaking Kindergarten through Grade 5 samples were administered grade appropriate vocabulary knowledge tests. One sample was economically advantaged, the second ranged widely in economic status. Words on the tests were taken from the "Living Word Vocabulary" which, according to Biemiller and Slonim, is a comprehensive assessment of words known by children. Results of this study showed that words are learned in a fairly fixed order, regardless of the socioeconomic status of the learner. This finding suggests that a plausible vocabulary sequence can be established empirically, and that bodies of vocabulary can be defined as needing to be taught at set points in the curriculum. Results also showed a large difference in root vocabularies between the normative and advantaged samples before Grade 2, although there appeared to be a catching up period subsequently, with less advantaged children adding words slightly faster than their more advantaged peers. Differences between high- and low- quartile groups were not similarly affected. The gap between these groups tended to remain, regardless of socioeconomic status. These findings lead the authors to suggest the importance of fostering vocabulary development

in the early years, in order to increase rates of vocabulary acquisition for the lowest quartile children.

Learning Word Meanings From Context

Based on their findings on the rate of vocabulary growth, Nagy and Anderson (1984) and Nagy and Herman (1987) concluded that the principal force driving vocabulary acquisition must be volume of language experience, primarily the amount of time spent reading. They argued that almost all vocabulary is learned in context, and that vocabulary instruction should focus on helping children become independent word learners (Nagy & Anderson, 1984). Other researchers have drawn the same conclusions. Krashen (1989) in reviewing studies on second language vocabulary acquisition described how students reading content-area material learn the content-specific words without being explicitly taught them. Sternberg (1987; Sternberg & Powell, 1983) pointed to the tens of thousands of words in the typical adult's vocabulary as proof of vocabulary acquisition from context. Only exposure to varied sources over a lifespan could account for the sheer number of words. This *default hypothesis* (Nagy, Anderson, & Herman, 1987; Nagy, Herman, & Anderson, 1985) has been used to explain how children can add as many as 3000 words per year. Direct instruction can only account for a fraction of this learning.

Educational research focused on acquiring vocabulary from context has looked almost exclusively at written context. Although it is intuitively obvious that oral language is also an important source for vocabulary acquisition, there is little investigation of it beyond the preschool years for native English speakers learning English vocabulary (Beck & McKeown, 1991). There has been a good deal of research

on how conversations with first language speakers affect vocabulary acquisition of second language learners (i.e. Jose de la Fuente, 2002) but a review of this literature will not be undertaken here. Examples of explorations of vocabulary acquisition from oral context in elementary classroom settings are studies in which stories are heard by students rather than read. These studies include younger prereaders who are native English speakers as well as learners of English as a second language (i.e. Eller, Pappas, & Brown, 1988; Elley, 1989; Robbins & Ehri, 1994; Segers, Takke, & Verhoeven, 2004; Senechal & Cornell, 1993). Overall, effects in these studies have been small but positive, suggesting that oral story reading constitutes a source of vocabulary acquisition.

Although a good deal of research has been done on the acquisition of vocabulary from context, several criticisms have been leveled at this work. The contexts have involved unnatural, contrived text (i.e. Sternberg & Powell, 1983). Excessive attention was directed to the target words (i.e. McKeown, 1985). To-be-learned words were repeated throughout the text, providing multiple clues (Carroll & Drum, 1983). The generalizability of results of these studies is limited because natural text encountered by students rarely contains the strong context or repetition of novel words appearing in materials used in these studies (Nist & Olejnik, 1995).

Work by Nagy and colleagues (Nagy et al, 1985; Nagy et al, 1987) has demonstrated that children do learn word meanings from context during normal reading. Their program of research was initiated under the assumption that evidence of learning from context had not been shown because of the incremental nature of vocabulary acquisition. That is, measures of learning used in previous studies were not sensitive enough to capture partial knowledge (Nagy et al, 1985). These researchers had students

read passages containing unidentified target words, and then respond to three levels of multiple-choice tests, the easiest of which required only very general knowledge of the word. Based on the results of this study, Nagy et al. calculated that the probability of learning a word well enough to answer a low level multiple-choice question was .05, a gain they consider substantial in light of the huge numbers of unfamiliar words average readers encounter each year.

In looking for effects of word properties on learning from context, Nagy et al. (1987) conducted a second, similar experiment. Shu et al. (1995) used a comparable design to test and compare incidental learning of word meanings in Chinese and American children. In both of these studies, the effects of morphological transparency and of conceptual difficulty of words on learning from context were examined. In addition, the effects of word length (number of syllables) and part of speech were examined by Nagy et al (1987). Although Nagy et al. found significant pre- to posttest word learning gains for all grades tested, they found no effect for word length, part of speech, or morphological transparency. In contrast, the Chinese students in Shu et al.'s study learned morphologically transparent words (those that are comprised of parts likely to be familiar to the reader, i.e. *nonliving)* more easily than morphologically opaque words. No such effect was seen for Shu et al.'s American students. This difference was explained by the need for context in clarifying meanings of even morphologically transparent words in Chinese, and the ensuing attention Chinese students would need to pay to context to understand the unknown words. In both studies, conceptual difficulty was found to significantly affect word learning from context. The more familiar the concept associated with a new word is to children, the easier it is to learn. Synonyms or

near synonyms for known words are more readily learned than words which in addition to a new pronunciation, require the learner to expand his or her concept base (Henriksen, 1999). Other researchers (i.e. Graves, 1986) have reported similar findings on the relationship between the level of conceptual difficulty of words and the ease with which those words are learned.

Studies on vocabulary acquisition from context have examined effects of either listening to or silently reading text. No study to date has examined the effect of seeing versus hearing words in context on students' ability to remember the words. The relative contributions made by these two modalities remain to be investigated.

Learning From Context and Volume of Reading

Results of the Shu et al. (1995) study, as well as those of Nagy et al. (1985, 1987) confirm that children can acquire new vocabulary during normal reading. It is widely agreed, however, that individual differences vary widely when it comes to actually adding vocabulary through reading. Volume of reading differs, based on several factors, as does ability to learn from context. The 90th percentile student has about 200 times more exposure to written language than the 10th percentile student (Nagy et al., 1987). Discrepancies have also been found between the reading volume of advantaged compared to disadvantaged populations (Chall, Jacobs, & Baldwin, 1990).

Volume of reading is thought to contribute directly to "Matthew effects" in reading (Stanovich, 1986). The term Matthew effects describes how the rich-get-richer and the poor-get-poorer in reading acquisition. Stanovich described the phenomenon showing that children who start school with little phonological awareness have trouble learning the code, difficulty with word recognition, are hindered in reading for meaning,

and fall further and further behind in reading and in motivation as school progresses. Children who start school with greater phonological skill quickly learn letter-sound correspondences, can identify words, find learning to read an enjoyable activity, and spend more time doing it, thus increasing their reading skill. It follows that if most vocabulary is learned from context, students who spend more time reading will add vocabulary faster than those who read less, thereby widening the gap between their vocabularies. Direct evidence for Matthew effects in reading and in vocabulary acquisition has been weak or nonexistent (i.e. Scarborough & Parker, 2003; Shaywitz et al., 1995) although this could be due to measurement and data analysis issues (Bast & Reitsma, 1998). That below average readers tend to remain below average, and that above average readers tend to stay above average is a relatively undisputed claim (i.e. Juel, 1988) although the increase in the gap between good and poor readers predicted by the Matthew effects hypothesis remains to be shown (Shaywitz et al. 1995).

Nagy and his colleagues (Nagy et al, 1985) found that the probability of learning a word well enough to identify it on a multiple choice test from a single encounter in context was .05. Based on the volume of new words students generally encounter, they concluded that this would result in the learning of a sizeable number of words. It is important to note that multiple choice items can be answered correctly with only partial word knowledge. It is not likely that inferring meaning from context leads to knowing a word well enough to produce it (Kameenui, Dixon, & Carnine, 1987). Specifically, even when incidental word learning impacts incremental receptive vocabulary growth, expressive vocabulary may not be sensitive to variables such as frequency of language exposure (Senechal, 1997).

Factors Affecting Ability to Learn Words From Context

Many researchers have found that ability to derive word meanings from written context, which is associated with general verbal ability, plays a significant role in how much vocabulary growth occurs while reading. Sternberg (1987; Sternberg & Powell, 1983) proposed ways to enhance learning from context, but admitted that ability to do so is based on intelligence level. Several others have found that higher ability students learn more words from context than their less able peers (Daneman & Green, 1986; Jenkins, Stein, & Wysocki, 1984; McKeown, 1985; Robbins & Ehri, 1994). Similarly, Segers et al. (2004) found that native language kindergarteners learned more new words from listening to storybooks than did a comparison group of immigrant children for whom the language spoken at school was a second language. Clearly, language proficiency dictates the efficacy of context as a vocabulary-learning medium.

Another factor influencing ability to abstract word meanings from context is reader background knowledge (Pulido, 2004). Studies on second language acquisition (Nassaji, 2004; Wesche & Paribakht, 2000) as well as on native vocabulary learning (Nagy et al., 1987) examining incidental word gain from reading arrived at the same conclusion: the richer a reader's schemata, the more likely he is to infer meanings and learn new words. In a study examining the effects of individual differences on ability to ascertain meanings of novel English words from English text by non-native English speakers, Nassaji (2004) found pre-existing knowledge to be the best predictor of success, above and beyond learner's strategy use. Pulido (2003) found that second language learners acquired significantly more L2 vocabulary from familiar-topic than

from unfamiliar-topic passages. Hence, when subject matter is unfamiliar, as it often is in content area school texts, children will be less likely to infer meanings.

Other researchers have found inference making ability a factor in determining vocabulary acquisition from reading, in addition to background knowledge, verbal ability, and working memory (Cain & Oakhill, 1999; Cain, Oakhill, & Bryant, 2004; Cain, Oakhill, & Lemmon, 2004.) Cain, Oakhill, and Lemmon found that students who were weak at making inferences, and therefore were poor at comprehending text, learned significantly fewer words while reading than students strong at making inferences. The effects of inferencing ability were evident even when vocabulary knowledge, short-term memory, and topic familiarity were controlled statistically.

One further problem with leaving children's vocabulary learning to chance by expecting them to deduce meanings and add new words incidentally is that "...all contexts are not created equal" (Beck, McKeown, & McCaslin, 1983, p. 177). Much of the research on learning from context has shown that variations in features of the text can strongly affect whether or not new words are acquired (Cain, Oakhill, & Elbro, 2003; Carnine, Kameenui, & Coyle, 1984; Herman, Anderson, Pearson, & Nagy, 1987; Sternberg & Powell, 1983). It is far easier to learn words when context contains helpful clues, in contrast to the often-minimal clues that students encounter during normal reading. Thus, although it is intuitively appealing that context introduces many new words to young learners, the uncertainty of context as an instructional tool drives the search for improved vocabulary-teaching methods.

Vocabulary Learning From Context With Word Learning Enrichment

Despite criticisms of research that investigates it, the fact that words are learned incidentally through listening or reading is undisputed. A recent review of research on vocabulary instruction stresses the importance of immersing students in words (Blachowicz & Fisher, 2000). The same review emphasizes the importance of ensuring repeated exposures and multiple sources of meaning to secure word learning. With that in mind, several researchers have considered ways to enhance context based vocabulary instruction, by adding activities to help students process meanings and/or phonological representations during reading or listening to text.

Brett, Rothlein, & Hurley (1996) attempted to use the hypothesis that most words are learned from context to construct a program that could be used in actual classrooms. Since context can be unreliable, they investigated two word-instructional methods. The researchers trained teachers to either simply read aloud, or read aloud and explain unfamiliar target words when they were encountered during reading. It was found that fourth graders made significant gains when they heard direct explanations of the words, although learning was not significant when words were not explained. Knowledge gain was measured using a multiple choice test, a factor that the authors considered a limitation in their findings based on the relative ease of multiple choice tests compared to alternate vocabulary measures.

Other studies have attempted to tease out read-aloud style variables on student vocabulary gain. Brabham and Lynch-Brown (2002) compared three major read-aloud styles they identified in reviewing a decade of research on read-aloud efficacy. These include interactional – where children are invited to discuss the story during reading;

performance – where discussion takes place before or after reading; and just reading aloud with no discussion. Vocabulary gain for first and third graders was measured. It was found that discussing the story significantly increased vocabulary learning, with the biggest gains occurring with the interactional style. Vocabulary was measured using multiple-choice tests.

Segers et al. (2004) compared the effect of a teacher reading aloud to the class to individual students hearing the same story read aloud by a computer. They examined vocabulary acquired in these two conditions for native and non-native speakers. Vocabulary learning was measured by free and cued definition recall. Children learned new words in both conditions. Although no difference was found between the methods for native speaking children, gains for the immigrant children favored the teacher read-aloud. Apparently, teachers were more adaptive, and were able to support the story with hand gestures and facial expressions. The authors felt that computers could one day be programmed to be as supportive as teachers, and interpreted findings as evidence of the great vocabulary instructional promise of computers for first language as well as foreign language learners.

In one of the first experimental studies to measure both productive and receptive vocabulary acquired from stories, Senechal (1997) found that having three- and four-year old children practice saying novel words, by labeling target items during a repeated read aloud, enhanced performance on expressive, as well as receptive, vocabulary posttests. In contrast, when children simply listened to the story read repeatedly, but did not say the target items, receptive, but not expressive, vocabulary was enhanced. Gains were nonsignificant when the storybook was only read once. Productive vocabulary was tested

by having children use the newly learned words to label alternate examples of the target items. Receptive vocabulary was tested by having the children choose the correct picture, from four choices, after hearing the target word. Results were interpreted as providing evidence for the language fostering effects of storybook reading – but only when exposures are repeated. Also, in order to enhance expressive vocabulary, retrieval practice is needed in order for children to associate the inferred meaning with the phonological representation of the novel word.

Penno, Wilkinson, and Moore (2002) conducted a study to examine if varied instructional methods, combined with reading aloud, could offset Matthew effects in vocabulary acquisition. Penno et al., built on research that studied differential vocabulary gains dependent on read aloud instructional methods, and differential gains dependent on student ability. They conducted an experiment to see if varied methods could help lower ability children catch up to their higher performing peers. Within a counterbalanced design, children of high and low ability (based on vocabulary scores) heard stories from one to three times, and heard them with or without explanation of target words. Receptive vocabulary gains were measured with multiple-choice tests, and productive vocabulary was measured by having students retell the stories. Results showed that multiple readings enhanced learning more than single readings, but that even single readings significantly affected vocabulary learning. Gains were significant when stories were read without explanations of target words, but were greater when target words were explained. However, listening to stories, regardless of read aloud variables, did not overcome the Matthew effect in this study. Students who scored well on the vocabulary pretest learned more new words than students who scored worse. The authors interpreted

this finding as support for the suggestion that low ability students benefit more from direct instruction than from deriving word meanings through context.

Direct Instruction of Vocabulary

Biemiller (2001) has argued that, at least before the age of 10, the majority of new root words are acquired through explanation rather than through inference while reading. He bases this claim on the lack of evidence that vocabulary gains occur by simply reading to children. Further support for his assertion comes from results of studies such as Elley (1989) and Brett et al. (1996) in which children learned more vocabulary when words were explained than when they were not. Biemiller also concludes, from his research findings and those of others, that while students with broad vocabularies may benefit from wide reading, those who understand less than 95 percent of the words in a text will lose the meaning of the text and be especially unlikely to infer meanings of new words. He maintains, therefore, that a program of explicit vocabulary instruction during the early school years and beyond is necessary.

Other researchers have taken a similar stance. *The Reading Crisis* (Chall et al., 1990) presents the findings of a study on literacy and language achievement of children from low-income homes. Results of this study provide evidence that strengthens the argument that vocabulary instruction must be enriched in schools in order to prevent reading failure in at risk, economically disadvantaged children. In particular, the "fourth-grade slump", which characterizes how the reading ability of many low-SES children diverges from that of the general population after the primary grades, was evident in this study. Apparently, movement from Chall's (1983) Stage 2 – learning to read – to Stage 3 – reading to learn – does not happen easily for these children. The effect is a slump in

linguistic performance, first on knowledge of word meanings, word recognition and spelling, and in turn on oral and silent reading comprehension. In effect, these children experience Matthew effects in their vocabularies due to their somewhat below average alphabetic skills. Vocabulary Matthew effects in turn lead to degraded performance in higher order reading skills. One way to ameliorate the "fourth-grade slump", according to the authors, is not only to ensure facility with advanced decoding and spelling, but also to address the problem of these children's vocabularies, which do not seem to grow adequately after the third grade. Their suggestion is to combine opportunities to read many challenging books with direct and appropriate instruction of the more sophisticated, abstract, literary words needed for academic success in the later grades.

In reviewing two decades of research on vocabulary instruction, Blachowicz and Fisher (2000) concluded that for poor readers, some form of explicit instruction, either in specific word learning, or in word learning strategies, is more effective than incidental learning from context or wide reading. Those studying ESL and foreign language instruction have reached the same conclusion: in order to deepen understanding and strengthen use of second language lexical items, some type of systematic L2 vocabulary instruction must be enlisted (i.e. Cobb, 1999; Lee, 2003).

Regardless of whether vocabulary-building activities include direct instruction of words or increased free reading, practitioners and researchers widely agree that the teaching of literature- and content-specific vocabulary is a central goal of school instruction (Blachowicz & Fisher, 2000). In other words, even if vocabulary is not considered a subject area of the curriculum in its own right, some direct instruction of words must occur in school, in order for certain content area learning to occur. Content

area instruction frequently requires the knowledge of key terms, necessary for the acquisition of central concepts. Vocabulary instruction is often associated with text selections in which students encounter difficult words essential for the understanding of that text (Beck & McKeown, 1991). Pre-reading activities therefore often involve direct instruction of specific words. Finding the best methods to explicitly teach new words is therefore clearly important.

Vocabulary Instructional Methods

Reviews of studies of the effects of vocabulary instruction reveal that many attempts to teach specific words have succeeded. Stahl and Fairbanks' (1986) meta-analysis computed an effect size of 2 when instruction on specific words was compared to no instruction, although these studies only looked at increases in receptive vocabulary as the outcome variable. Very few studies of English vocabulary learning in native English speakers have examined the contribution of different methods to increases in expressive vocabulary (Graves, 1986; Senechal, 1997). Studies on second language acquisition, on the other hand, have investigated methods of improving second language productive vocabulary (i.e. Jose de la Fuente, 2002; Lee, 2003) as well as receptive vocabulary (Bahr & Dansereau, 2001).

Extensive research on methods of improving receptive vocabulary in native English speakers has been done in the last 20 years (Beck & McKeown, 1991; Graves, 1987; Nagy & Scott, 2000). Researchers in second language acquisition have utilized many of these same methods. Two prominent methods have been the definition method, in which children are directed to look words up in a dictionary or glossary, and the context method, in which meaning clarifying sentences containing the word are provided.

In addition, the keyword method, and semantic processing, or multiple definition methods, have received a lot of attention. In the keyword method, students relate a salient part of the to-be-learned word to an acoustically similar, known referent. Semantic processing is often used to introduce new concepts

Several studies have compared the effectiveness of different methods of vocabulary instruction (e. g. Gipe, 1978-1979; Levin, McCormick, Miller, Berry, & Pressley, 1982; Levin, Levin, Glasman, & Nordwall, 1992; McDaniel & Pressley, 1989; McKeown, Beck, Omanson, & Pople, 1985; Nist & Olejnik, 1995; Pressley, Levin, & Miller, 1982; Pressley, Levin, Kupier, Bryant, & Michener, 1982; Rodriguez & Sadoski, 2000). The outcome measures used in these studies have primarily assessed low levels of vocabulary learning, by using multiple-choice, matching, or fill-in-the blank items, with target words provided. Not one study done to date has looked at the contribution of spellings to remembering words or their meanings.

Dictionary use as a method for obtaining meanings of unknown words has been common classroom practice for years (Nist & Olejnik, 1995) for native as well as second language learners (Orsini, 1999). It has not received much support in the research literature. Miller and Gildea (1987) studied the widely used vocabulary activity of having students generate sentences from definitions, and concluded that this practice is pedagogically useless. They found that children targeted only a fragment of the definition and failed to integrate all of the information provided. A particular problem in this and other studies was that children did not take part of speech into account (Scott & Nagy, 1997). Scott and Nagy found that definitions are often inadequate as sources of

information on word usage, and that students frequently have trouble extracting even a general idea of the meaning of a word from a definition.

Sometimes, the problems with using definitions stem from the definitions themselves. McKeown (1993) analyzed attributes of dictionary definitions that would lead children to incorrect interpretations of what words might mean and derived four categories: weak differentiation, likely interpretation, vague language, and disjointed components. McKeown then used these interpretations to devise guidelines for writing good dictionary definitions and subsequently conducted research on how children construct meaning from better definitions. She found that fifth graders did better on sentence generation and question-response tasks when given revised rather than traditional definitions. However, despite the implications for using revised definitions in learning word meanings, she discourages the use of "look up a word and write a sentence" as a primary means to develop vocabulary.

In a descriptive study intended to look at a combination of the dictionary approach and incidental-learning-through context paradigm, Orsini (1999) had college ESL students look up specific unknown words detected while reading and to write a definition of the words. He found that students were able to define approximately 80% of the words acceptably, although memory for the words was not tested. Nist and Olenjnik (1995) attempted to compare varying levels of word knowledge obtained when students encounter new words while reading, are given either adequate or inadequate dictionary definitions, or combine reading words in context with reading dictionary definitions. They found that the combined approach resulted in the deepest levels of word knowledge,

although only receptive memory for the words was tested. Outcome measures included multiple-choice tests and a cloze task with target words provided.

The use of specific context to teach word meanings directly has received some support (Gipe, 1979-80; McKeown et al., 1985). In this method a few, well constructed, defining sentences help clarify the meanings of new words. This is in contrast to learning words incidentally through natural context. A general finding has been that repeated exposures as well as elaborated meanings result in better learning of new vocabulary words. Outcome measures in these studies included multiple choice tests (McKeown et al. 1985) and fill-in-the-blank sentences with target words provided (Gipe, 1979-80). Ability to produce words or definitions was not tested.

In a widely cited study, Gipe (1978-1979) devised three methods of teaching word meanings, and compared them to the commonly used dictionary definition method. These three methods were the association method, where the target and a known synonym appeared in matched pairs; the category method, where the target appeared with known words in the same given category; and the context method, where the word appeared in a defining sentence, plus two additional meaning clarifying sentences. Each devised method had a cognitive theoretical basis for why it should help students retain vocabulary. Gipe hypothesized, based on theories of cognitive processing, that the context method would work best, because it incorporated suggestions for concept formation, and this is what she found. Children learned words in the context method better than in the other three methods, as shown by their scores on cloze tests, in which the target words were supplied in a list for the children to choose from. However, it should be noted that her context method had unfair advantages: the word appeared in

three sentences, thereby building on multiple sources of information, as suggested by Blachowicz and Fisher (2000). It also had students create a personally meaningful sentence using the word, a method to "personalize word learning", as suggested by Blachowicz and Fisher. In contrast, the other comparison methods neither built on multiple sources of information, nor personalized word meaning. The comparison methods included writing definitions, memorizing categories in which words appeared, or simply memorizing synonym pairs. The outcome measures more closely resembled the context method, namely the use of the word in a cloze sentence, thereby requiring less transfer than the other word-teaching methods.

Semantic processing methods, like the one termed semantic mapping (Johnson & Pearson, 1984) is often used in classrooms as a means of introducing new concepts and vocabulary related to central concepts. This method generally involves the teacher writing the word on the board or a chart, and having students and the teacher brainstorm super ordinate, subordinate, and coordinate relationships between it and known words and concepts. Semantic processing methods have proven effective in building conceptual knowledge, and have been shown to improve receptive vocabulary for second language learners (Bahr & Dansereau, 2001). However, they have not been shown to assist in native speaking students' memories for the vocabulary terms associated with concepts, as work by Pressley et al (1982) has shown. Pressley and colleagues have been more interested in how mnemonics can help students make associations between words and their meanings.

Research on the use of mnemonics in vocabulary instruction has focused primarily on the keyword method (Atkinson, 1975). This procedure requires the learner

to acquire a stable association between the unfamiliar first or second language vocabulary item and a familiar word that sounds like the to-be-learned item. This acoustically similar word is the keyword. The learner then encodes a meaningful interaction between the keyword and the new item's definition. For example, to remember that catastrophe means disaster, one might use the keyword *cat* and then picture a cat falling into a swimming pool. Sometimes, the subject is instructed to create a meaningful sentence using the keyword and new item, such as "The cat had a catastrophe" rather than visualizing the action.

Some studies on the use of the keyword method have been able to show its efficacy over no treatment controls, as well as alternative methods, such as definition repetition (Pressley, Levin, & Miller, 1982) semantic processing (Pressley et al. 1982) and semantic context (McDaniel & Pressley, 1989). Outcome measures in these studies included cued definition recall, free-definition recall, vocabulary-definition matching, and target-word imbedded reading comprehension. Use of the keyword mnemonic enhanced performance over other methods of word learning on all of these measures, except for free-recall of definitions, for which there was no significant difference in performance between the keyword and semantic processing methods.

Semantic based learning techniques are often used in classrooms but their use is questionable (Pressley et al. 1982). Although these methods might enhance knowledge of definitions, such processing does not necessarily operate on the word-definition link. No positive associative-learning effects were produced by semantic processing learning conditions in this study. Subjects in these conditions performed lower on the matching task than subjects in a no-strategy control condition. Keyword subjects' performance

was higher than performance by students in the other conditions on matching and on cued recall tasks. These findings provide support for the use of mnemonics in vocabulary definition learning. "Vocabulary learning...is an intentional associative learning task, in which connections must be formed between new, unfamiliar terms and their definitions" (Pressley et al, 1982, p. 694). Effects on productive vocabulary were not examined.

Most studies on the efficacy of the keyword method have looked at receptive vocabulary outcomes, although there are a few exceptions to this. Pressley and Levin (1981) conducted an experiment to examine the effect of the keyword method on college students' "backward recall", or recall of the vocabulary item when given the definition. In the first of three experiments, exposure to words in both conditions involved being presented the word printed along with its definition at a 10-second rate. Keyword subjects did no better than controls in recalling target words. The authors determined that the single, 10-second exposure was not enough for subjects to learn the words, so they designed a second experiment in which exposure time was extended. Before familiarizing subjects with the meanings of the words, the subjects were taught to correctly pronounce them by associating the first syllable (the keyword) with the whole word. The word was printed on one side of an index card, its first syllable on the reverse. Subjects were then given eight trials to learn to pronounce the words when shown the first syllable. Whether or not the word was recalled correctly, the experimenter would give feedback on each trial by showing the printed word, and pronouncing it for the subject. This procedure was repeated until the participant reached eight trials, or was able to pronounce all 10 words correctly on a single trial. Students were then shown the target word, with the first syllable underlined for keyword subjects, and given its

meaning. Keyword subjects were told to visualize an action related to the definition involving the underlined syllable. Keyword subjects outperformed controls on backward recall, but it must be noted that *all* participants performed much better than did participants in experiment one. Seeing the spellings of words and practicing how they map the pronunciations helped all subjects remember the words, although this conclusion was not investigated in the study. The authors interpreted results as providing evidence that the keyword method facilitates vocabulary recall.

Lutz and Lutz (1977) conducted a study to examine effects of interactive imagery on memorability of advertisements. They compared participants' ability to remember and produce brand names depending on whether the image in the ad interacted with the service or product being advertised. Images they termed "interactive" incorporated the printed brand name with the image. Those they termed non-interactive, in contrast, had the brand names printed above, below, or next to the image. In a third condition, just the printed brand name was shown, with no image. Participants remembered the interactive images best. The authors interpreted these results as providing evidence for level of interactivity as a determinant of memorability. They did not provide examples of the ads shown to participants in their report, making it impossible to determine if some other factor, such as salience of the spelling of the brand name, could have explained the difference in memorability of the brand names.

Several methods of direct instruction of individual words have been shown to be effective with varying levels of success. Most studies reported above involved increases in receptive vocabulary as measured by multiple choice or matching tests (i.e. McKeown et al., 1985; Nist & Olejnik, 1995; Pressley, 1982). Production tasks, where students are

required to give a definition, or pronounce the target word, test deeper word knowledge (Beck & McKeown, 1991). Although increased access to spellings of words facilitated participants' recall of the words in one work (Pressley & Levin, 1981), this factor was not examined. Exposure to spellings has never been manipulated experimentally in a vocabulary learning study.

Summary

Extensive research on vocabulary acquisition has been done over the last 25 years (Beck & McKeown, 1999). Methods studied include learning vocabulary from reading or listening to stories, with varied levels of attention directed to words. The definition method involves having students look words up in a glossary or dictionary, and often to generate sentences using the words. In the keyword method, students relate a salient part of the to-be-learned word to an acoustically similar, known referent. Semantic processing is a method commonly used in classrooms to introduce new concepts, and generally involves linking the new term to known words and concepts. In the context method, a few well constructed defining sentences help clarify the meanings of new words. Reviews of studies of the effects of vocabulary instruction reveal that many attempts to teach specific words have succeeded (Blachowicz & Fischer, 2000; Stahl & Fairbanks, 1986). Most studies on vocabulary acquisition have focused on receptive rather than on productive vocabulary, using tasks such as multiple-choice and matching tests to assess learning. Although ability to produce words signifies a deeper understanding of the words (Baumann & Kameenui, 1991), productive vocabulary growth has not received much attention (Senechal, 1997).

A promising method for improving students' productive vocabulary is the use of orthography as a mnemonic aid for remembering words pronunciations. Results of studies which examined the contribution of print to readers' memory for sounds and spellings of words indicate that printed words are stored in memory as orthographic images (i.e. Ehri & Wilce, 1979, 1980b, 1986; Frith, 1978; Reitsma, 1983). Experience with printed forms of words can disambiguate sounds within words influence pronunciations (Ehri, 1984). By providing a visual-spatial model for speech, print may enhance competence with spoken language and contribute to oral language development (Ehri, 1984; Sparks, 1997).

Ehri and Wilce (1979) found that seeing spellings helped children remember pronunciations of unfamiliar words. Using paired-associate sound-learning tasks, children were taught nonsense syllables in response to visual cues. When children saw spellings during learning, they remembered words better than when spellings were not shown. These findings carry important implications for the teaching of vocabulary. Hatch and Brown (1995) suggest that providing the forms of words to be learned is a necessary step in vocabulary instruction. However, viewing spellings during vocabulary learning has not been manipulated experimentally (Blachowicz & Fischer, 2000).

Chapter 3

Pilot study

The need for improved vocabulary building curricula is clear, especially in schools where homes provide little support for vocabulary growth. The relationship between vocabulary knowledge and reading ability is strong (National Reading Panel, 2000). Vocabulary size is influenced more by home literacy environment than by cognitive ability or schooling (Chall et al. 1990). However, a review of twenty years of research on vocabulary instructional practices indicates that direct instruction can improve vocabulary knowledge (Stahl and Fairbanks, 1985). Most studies on vocabulary growth have focused on receptive rather than on productive vocabulary, although ability to produce words signifies a deeper understanding of the words (Baumann & Kameenui, 1991).

In order for vocabulary acquisition to occur, new words must be remembered. Specifically, the word-definition link must be strengthened so that the pronunciation, meaning, and syntactic function of a word coexist as a single entry in lexical memory. A promising method for improving students' productive vocabulary is the use of orthography as a mnemonic aid for remembering words' pronunciations. The sound symbolizing function of spellings helps learners establish orthographic images representing pronunciations and meanings of words in memory (Ehri, 1984; Ehri & Wilce, 1979.) Ehri and Wilce showed that orthography has mnemonic value for second graders learning nonsense syllables in paired associate tasks. In all of four experiments, students learned words faster when they saw or imagined spellings than when they practiced hearing and saying words but did not see spellings. The facilitative effect of

seeing spellings on memory for pronunciations was strongest for students with the largest word repertoires.

The purpose of the pilot study was to examine the mnemonic value of spellings for second graders learning new vocabulary words. Within a counterbalanced, repeated measures design, children were taught two sets of low frequency nouns and their meanings in paired-associate tasks. Learning to say the words when shown pictures, and to say the definitions when given the words, were the responses taught. They saw the spellings for one set of words, but did not see the spellings for the other set. Instead, they received extra practice hearing and pronouncing the words. Effects were examined in second grade urban children of high and low reading ability. The question of interest was whether spellings would help students learn pronunciations and meanings of the words, and whether this effect would differ depending on the ability level of the students. According to Ehri and Wilce (1979), students with sufficient printed word knowledge have an orthographic mnemonic capability, which allows them to connect spellings to pronunciations to retain word forms in memory.

Hypotheses

Several hypotheses were tested. One was that children will learn the pronunciations of new vocabulary words faster and they will remember them better when they see spellings of the words during study trials than when they practice the words orally but do not see spellings. The explanation is that when spellings are seen, they are bonded to pronunciations of the words and both are retained in memory, thus creating more secure representations of the new words. The second hypothesis was that this effect will be more powerful for children with stronger alphabetic knowledge, because those

students will possess greater orthographic mnemonic capability, enabling them to store printed forms of words more effectively. Both of these hypotheses are derived from amalgamation theory (Ehri & Wilce, 1979). The third hypothesis was that both groups will do equally well on definition learning regardless of whether or not spellings were studied. Definition training consisted of presenting words in several meaning clarifying sentences. This method of vocabulary instruction was similar to that shown to be effective in other studies (i.e. Gipe, 1978-9).

Method

Participants.

Twenty second graders from a charter school serving a low-income population, in a mid-size city in eastern New Jersey participated in this study. All children with no known cognitive or behavioral disabilities who returned signed parent consent forms were invited to participate. Eleven were girls and nine were boys; 15 of the children were African-American, and five were Latin American. Mean chronological age of the participants was 90.6 months.

Materials.

1. Assessment of literacy. Several tasks were given to assess children's vocabulary and reading ability including the Woodcock Reading Mastery Test (Woodcock, 1988), the Peabody Picture Vocabulary Test (Dunn & Dunn, 1997), a subset of beginning level words drawn from the Harris and Jacobson (1982) word list, and several experimenter created word reading and spelling tests. Experimenter created tasks included reading and spelling nonwords constructed from letters drawn from the trained words and tests of consonant and vowel knowledge.

2. Vocabulary learning. Two lists of six concrete, low frequency, consonant-vowel-consonant (CVC) nouns were selected as target vocabulary words. Each word began with a different consonant. A variety of short vowels appeared accross words, such that every vowel appeared once, except for /a/, which appeared twice, in each list. A core definition, plus five meaning-clarifying sentences was constructed for each word. For the word-recall task, the stimuli were cards printed with pictures depicting the meaning of the words. The orally pronounced word served as the response. During training in the spellings-present condition, the printed word appeared along the bottom of the card. During training in the spellings absent condition, no printed word appeared. During recall trials, the printed word did not appear for either condition. For the definition-recall task, the stimuli were the words, either printed alone on a card and pronounced once in the spellings present condition, or pronounced twice with no visual cue in the spellings absent condition.
3. Posttests. Memory for words was tested after a one-day delay using three experimenter-devised tasks. In the word production task, students were asked to say the word when orally given the core definition. In the spelling task, students were asked to write the spelling of the word when they heard it pronounced. In the matching task, students were asked to complete sentences with target words written at the top of the test. Sentences were drawn from clarifying definitions heard on the previous day. Sentences were read with the target word omitted, and children responded orally with their choice.

Procedure.

All testing was done individually in a private room on school grounds. Testing took place over three consecutive days in sessions lasting approximately 40 minutes each. Before beginning each task, it was explained along with an example, one in each condition. Children were told that they would hear the name and meaning for each picture they saw, and that they needed to remember the word and its meaning since they would later be tested.

Two vocabulary-learning tasks were given to each child in two conditions in a repeated measures design, with the order of conditions as well as word lists counterbalanced. In one condition, children heard and saw spellings of words in addition to pictures representing the words' meanings during study and feedback trials. In the other condition, children saw the pictures but only heard words and repeated them an extra time; they did not see spellings. A defining sentence for each word was read on the initial training trial, and additional meaning clarifying sentences were read on subsequent trials. The tasks included two alternating types of test trial blocks requiring two different types of responses during learning. In the word-recall, or picture-word (PW) type, the child was shown a picture and learned to respond by recalling the vocabulary word. In the definition-recall, or word-definition (WD) type, the child heard the word pronounced and learned to say its definition. On all trials assessing students' memory for words and definitions, no spellings were present.

Children received a minimum of six and maximum of nine trials to learn the words and their definitions. If they reached a criterion of three perfect consecutive trials

on both tasks before nine trials, then learning for the tasks was terminated, provided that the minimum of six trials had been completed.

Results

Repeated measures ANOVAs were used to test effects of learning condition (spelling vs. no spelling) and response type (remembering the words vs. remembering meanings) over trials in the learning task. Results supported the hypothesis that seeing spellings contributes to vocabulary learning. Figure 1 shows the growth in number of words and definitions recalled correctly over the first five trials for the two conditions. The strong boost provided by spellings on students' learning of vocabulary words and definitions is evident in the figure.

Findings showed that second graders were able to use spellings as a mnemonic aid. They learned the words and meanings significantly faster and more consistently when spellings were seen during study and feedback periods than when only spoken forms of words and meanings were practiced. This was true for all of the children although the effect was larger for students with larger printed word lexicons as measured by scores on the Woodcock Reading Mastery Test-R (Woodcock, 1988) and on the subset of words drawn from the Harris and Jacobson (1982) word list. Students with the most printed word knowledge reached the criterion of three perfect successive trials on the word recall task in the spelling condition. In contrast, students with less printed word knowledge did not reach criterion although they recalled more words in the spelling present than the spelling absent condition.

These findings support the hypothesis that children learn pronunciations of vocabulary words faster when they see spellings, because seeing spellings allows learners

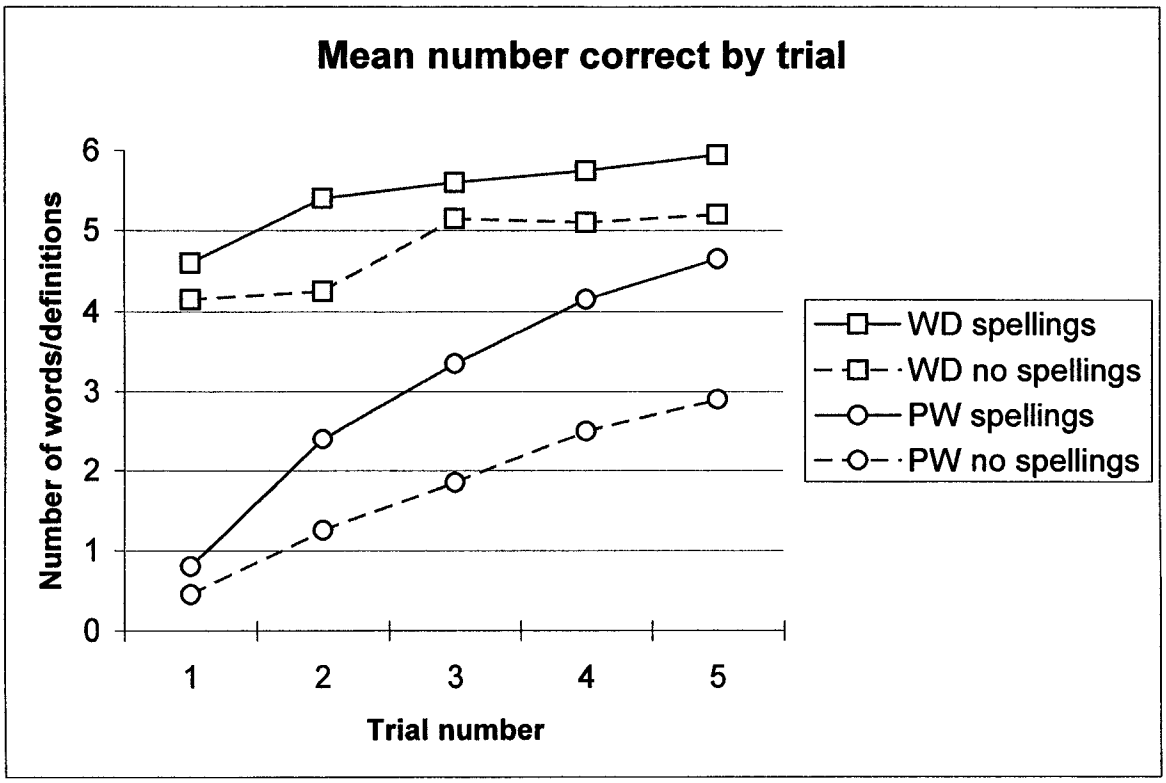


Figure 1. Mean number of words recalled (PW) and definitions recalled (WD) over trials as a function of whether spellings were present or absent during study trials.

to preserve letters as visual images representing sounds in memory. The hypothesis that this effect would be larger for children with stronger alphabetic skills was also supported by findings. However, it was predicted that both groups would do equally well on definition learning. This was not the case. Spellings facilitated recall of definitions as well. Meanings were learned faster and a greater proportion of students reached criterion when spellings were seen than when they were not.

These findings reveal that meanings of new vocabulary words were better secured in memory when both orthographic and phonological representations of the words were part of the amalgam being formed than when only phonological representations formed the amalgam in memory. A possible scenario of the learning process that explains the benefit of spellings for learning meanings can be constructed as follows. During test trials in the definition recall task, the experimenter provided the word before the child responded orally with the definition. In the spellings absent condition, the experimenter pronounced the word twice. In the spellings present condition, the experimenter pronounced the word once and simultaneously displayed the printed word for one second. It may be that knowledge of the phonological representations of new words is the starting point for learning and remembering the meanings of words. This is because phonological representations form the core identity of words. (A word is not a word without a phonological form.) When spellings accompanied pronunciations during word learning, phonological representations were established in memory earlier during learning, so more were available to amalgamate with meanings.

Another explanation is possible as well. In the spellings present condition, the cue prompting recall of the definition was provided in two modalities, both the spoken

and the printed form of the word, whereas the cue prompting recall in the spellings absent condition was only the spoken form. It may be that memory for meanings was superior when two modalities were available as retrieval cues than when only one modality was available. In order to rule this out as an alternative explanation, a third condition in which spellings were seen during learning and feedback trials, but were not seen as cues for definition retrieval during test trials would be needed.

Chapter 4

Rationale and Hypotheses

The purpose of the present study was to utilize the same design to examine the mnemonic value of spellings for fifth graders learning new multi-syllabic vocabulary words. The present study was designed to extend findings of the pilot study. The following changes were made. The participants in the present study were older, making generalizations to a second population possible. Multi-syllabic rather than single syllable words were chosen, because of the additional alphabetic knowledge older children are likely to possess. According to Ehri and Wilce (1979), students with sufficient printed word knowledge have an orthographic mnemonic capability, which allows them to store orthographic-phonological mappings of words in memory. Fifth-graders possess knowledge of graphosyllabic as well as graphophonemic spelling patterns, so they should be able to use this knowledge to retain spellings of multi-syllabic words in memory (Ehri, 1999). The sample size was enlarged from 20 to 32 participants in order to increase statistical power. The number of to-be-taught words was increased from six to ten because of greater memory capabilities of fifth than of second graders (Miller, 2002). Posttests were redesigned to include tests of ability to transfer knowledge of the words to new tasks. Posttests in the pilot study did not include transfer tasks.

In the present study, fifth graders were taught two lists of low frequency, concrete, multi-syllabic nouns and their definitions in two conditions, spellings-present and spellings-absent during study and feedback trials. It was expected that fifth grade children would learn pronunciations of multi-syllabic vocabulary words more effectively when they were exposed to spellings during study periods than when they were not,

because spellings help learners remember words by providing visual images of letters symbolizing those sounds in memory. Students with larger sight word lexicons indicating greater knowledge of spelling patterns, should benefit more from seeing the spellings of words than weaker readers with smaller sight word repertoires and hence less orthographic knowledge. It was expected that the effect would be most powerful for children with the largest printed word repertoires, because those students would have the strongest orthographic mnemonic capability, enabling them to store printed forms of words more effectively. Both of these hypotheses are derived from amalgamation theory (Ehri & Wilce, 1979). Based on findings of the pilot study, students were expected to benefit from seeing spellings in learning meanings as well as pronunciations of words. The instruction used to teach meanings in the present as well as in the pilot study involved providing multiple defining sentences. This method was found to facilitate vocabulary learning in another study (Gipe, 1979-80). The advantage to definition learning provided by spellings was expected to arise as a result of the presence in memory of more phonological representations to form unions with meanings.

Chapter 5

Method

Participants

The participants were 32 fifth grade students drawn from the only two fifth grade classes in a charter school serving a low-income population in a medium-size city in eastern New Jersey. Of the 450 children enrolled at this school, 58% qualify for free or reduced lunch. All children who returned permission slips were invited to participate. Teachers verified that none of the students exhibited any cognitive or sensory impairment. All but two of the participants spoke English at home. Two participants spoke Spanish at home. None of the participants were received English language services during the school year in which testing took place. Eighteen were female, 14 were male. Thirty-one of the participants were African American; one was Latin American. Mean chronological age at the time of testing was 10 years, 11 months. They were tested in the spring.

Materials

Assessment of literacy.

The following published instruments were used to test children's knowledge of printed language and vocabulary.

1. The Boder Test of Word Reading (Boder & Jarrico, 1982). Children were asked to read graded word lists of 20 words each until they were unable to read more than six in a set. Children began with the second grade list. The highest level administered was eighth grade. Within lists, phonetic words (i.e., words that sound as they are spelled) were alternated with nonphonetic words (i.e., words

with unusual letter-sound correspondences). Prescribed administration of this test involves using a flash method, in which children are given only one second to read each word. In the present study, children were given up to five seconds to read each word. Hence, neither grade equivalent norms nor reliability coefficients accompanying the test could be used. Reliability was therefore estimated by using a split-half correlation and was found to be .98.

2. TOWRE Test of Phonemic Decoding Efficiency (Torgesen, Wagner, & Rashotte, 1999). Children were given 45 seconds to read as many nonwords as possible from a list of increasingly difficult nonwords. The examinee's score was the total number of pseudowords pronounced correctly within 45 seconds. Test-retest reliability for this task is .83.
3. Ganske Spelling Inventory (Ganske, 2000). Twenty progressively more difficult words were orally pronounced and then used in a sentence. Words were grouped into sets of five. Children were asked to spell the word to the best of their ability. The task was terminated if the child spelled fewer than two words in a set correctly. Words were scored as correct or incorrect. The publishers do not provide reliability for this test. The estimated reliability of this test using a split-half correlation is .90.
4. Peabody Picture Vocabulary Test (PPVT)-III (Dunn & Dunn, 1997). In this individually administered oral test of receptive vocabulary, participants were shown pages each printed with four pictures. Progressively more difficult sets of words were orally pronounced, and the participants were asked which of the four pictures corresponded to the meaning of each of the words. The task was

terminated when students responded incorrectly to six or more words in a set. Test-retest reliability for this task ranges from .91 to .94.

Vocabulary Learning.

Two sets of ten decodable, low frequency, concrete, multisyllabic nouns were selected as target vocabulary words. Each list consisted of five two-syllable, and five three-syllable words. In each list, every word began with a different consonant. A core definition, plus four meaning-clarifying sentences, was constructed for each word. Words and definitions appear in Appendix C.

Some of the definitions and meaning clarifing sentences were simplified or made more concrete in order to be more readily understood, more easily instructed, or more appropriate for fifth grade learners. One of the target words, *koomkie*, specifically means a female elephant that is in heat. The meaning instructed was "an attractive female elephant". The target word *frenulum* specifically means the membrane that holds the tongue back from extending too far. The instructed meaning was simply a tongue. The word *juggernaut* specifically means a large, overpowering force or object, but was instructed in this study as a huge truck.

For the picture-word trials, the stimuli were cards printed with pictures depicting the meaning of the words. The orally pronounced multi-syllabic noun served as the response. Pictures appear in Appendix D. Two sets of cards, a training and a test set, were constructed for each word in each learning condition. The training cards consisted of 3 X 5 inch index cards with the pictures printed on them. For the spellings-present condition, words were printed at the bottom of the card, under the picture, in 22 point Times New Roman font. For the spellings absent condition, no spellings were printed.

Instead, the word was orally pronounced by the experimenter and repeated by the child an additional time. The test cards consisted of the same pictures printed on 4 X 6 inch cards without any spellings. During word-definition training, orally pronounced definitions were provided. The stimuli for test trials were the words, either printed on 3 X 5 inch cards and orally pronounced once, or orally pronounced twice with no spelling cards presented. Five complete sets of training and test cards were constructed. Each set was ordered differently. Trials six through eight followed the same order as trials one through three. On trial 6, the core definition was repeated. On trial 7, the meaning clarifying sentence read on trial 2 was repeated, and on trial 8, the meaning clarifying sentence read on trial 3 was repeated. The order of training and testing remained constant over participants.

Posttests.

Posttests assessed students' memory for words and for meanings. One measure followed the same format that students had experienced during training/test trials. The second measure required students to transfer vocabulary knowledge. Sentences heard and pictures seen were new and had not been experienced during learning. Knowledge of the two word sets was assessed using five experimenter-devised tests given in the following order. Experimenter devised posttests were considered to have content validity. Posttest materials can be found in Appendixes G and H.

1. Oral cloze. Students' ability to produce the vocabulary words they learned in a transfer task was assessed. Children were read a sentence not heard before, that made the meaning of the target word clear. The target word was omitted, and children were asked to orally provide the word to complete the sentence. Order of

presentation was different from the order of presentation received during training and test-feedback trials. Order remained constant across participants.

2. Picture naming. Students' ability to produce the vocabulary words they learned was assessed. Children were shown and asked to name stimulus cards. Order of presentation was different from the order of presentation received during training and test-feedback trials. Order remained constant across participants.
3. Oral definitions. Students' ability to produce the definitions of words they learned was assessed. The experimenter said each target word and asked the child to define it. Order of presentation was different than the order of presentation received during training and test-feedback trials. Order remained constant across participants.
4. Picture identification. Students' ability to produce the definitions in a transfer task was assessed. This task was modeled after the PPVT. Sheets were printed with pictures depicting the target words from both lists. Participants had not seen the target pictures previously. Each page had four pictures. The experimenter said a target word and asked the student to identify which picture best showed the meaning of the word. The foils were pictures of other target words. The same pictures were repeated as targets and foils across test pages.
5. Spelling. The experimenter said each word and asked the student to write it. Order of presentation was the same as in the initial training session.

Procedure

Two vocabulary-learning tasks were given to each child in a repeated measures design, with the order of learning condition and word list counterbalanced. In one

condition, children heard and saw spellings of words during study and feedback trials. In the other condition, children heard words and repeated them an extra time but did not see spellings.

The tasks included two alternating types of test trial blocks, each requiring a different response during learning. In the word- recall or picture-word (PW) type, the child was shown a picture and learned to respond with the vocabulary word. In the definition-recall or word-definition (WD) type, the child heard the word pronounced and learned to say its definition.

Before beginning, the tasks were explained along with an example, one in each condition. Children were told that they would hear the name and meaning for each picture they saw, and that they needed to remember the word and its meaning since they would later be tested.

Training procedures involved providing an initial study trial that exposed children to the pictures, pronunciations of words, and defining sentences. In the spelling-present condition, the spelling of the word appeared at the bottom of the training card. No attention was drawn to this cue. In the spelling-absent condition, no spellings appeared, but the experimenter pronounced the word an additional time. The children repeated the words and their defining sentences. In the spelling-absent condition they repeated the words an additional time.

Test/feedback trials then began. Picture-word (PW) trial blocks testing recall of 10 words were alternated with word-definition (WD) trial blocks testing recall of 10 definitions. In the spelling-present condition during PW trials, each stimulus picture was presented, and children were given 5 seconds to recall the word and its meaning. The

experimenter then gave feedback by showing the training card including the picture and printed form of the word, saying the word, and reading the defining sentence and additional meaning-clarifying sentences on subsequent trials. If the child responded incorrectly, he was prompted to repeat the word and defining sentence. During WD trials, each word was presented once orally along with spelling displayed for one second. Children were given 5 seconds to recall the definition. The experimenter then read the defining sentence. Additional meaning-clarifying sentences were provided on subsequent feedback trials.

In the spelling absent condition during PW trials, each stimulus picture was presented, and children were given 5 seconds to recall the word and its meaning. The experimenter then gave feedback by showing the training card including the picture but not including the printed form of the word. The experimenter said the word, and read the defining sentence and additional meaning-clarifying sentences on subsequent trials. If the child responded incorrectly, he was prompted to repeat the word and defining sentence. The experimenter then pronounced the word an additional time and the child repeated it. During WD trials, each word was presented twice orally with no spelling displayed. Children were given 5 seconds to recall the definition. The experimenter then read the defining sentence. Additional meaning-clarifying sentences were provided on subsequent feedback trials.

Children received a minimum of five and a maximum of eight trials to learn the blocks of ten words and ten definitions. If they reached a criterion of three perfect consecutive trials on both tasks before completing eight trials, learning for the tasks was

terminated provided that the minimum of five trials had been completed. Children were exposed to the tasks in one of four orders:

1. List A spelling; List B no spelling
2. List A no spelling; List B spelling
3. List B spelling; List A no spelling
4. List B no spelling; List A spelling

Eight children received each order. Thus, across tasks, each possible order was presented, and all words appeared in both conditions the same number of times.

All testing was conducted with individual children over three consecutive days in sessions lasting about 40 minutes each. Testing took place during the school day, in a private room on school grounds. Sessions were audio taped in order to examine the impact of instruction and to verify fidelity to the script and procedures.

On Day 1, children were taught one set of words in one of the conditions. On Day 2, they were posttested on their memory for Day 1 words and meanings. They were then taught the second set of words in the other condition. On Day 3, they were tested on their memory for Day 2 words, and then administered the tests of vocabulary and printed language.

Design and Statistical Analyses

An experimental design with repeated measures was utilized. The independent variables were: word list (List A vs. List B), learning order (spellings first and no spellings second versus no spellings first and spellings second), reader level (lower vs. higher), condition of learning (spelling-present vs. spelling-absent), task (recalling words vs. recalling definitions), and trials (1 – 5). The dependent variables were number of

trials to criterion or termination (maximum 8) and number of correct responses (maximum 10).

Two independent samples *t*-tests were conducted to assess the effect of list (A vs. B) on performance in each of the vocabulary tasks. The dependent variable for these analyses was the number of trials to criterion or termination. The independent variable was list (A vs. B). A three-way ANOVA was conducted to assess the effect of learning order on performance. The dependent variable was the number of trials to criterion or termination. The independent variables were learning order (spelling-present first vs. spellings-present second), condition of learning (spelling present vs. absent) and task (recalling words vs. definitions). The first variable was between subjects, and the latter two were repeated measures.

Two repeated measures ANOVAs were conducted to assess effects of reader level (higher vs. lower), learning condition (spelling present vs. absent), and test trial (1 – 5) on each of the vocabulary learning tasks. The first variable was between subjects, and the latter two were repeated measures. The dependent variable in each analysis was the number of correct responses on each of the first five trials.

Regression analyses were conducted to determine which factors predicted performance in vocabulary learning on the two tasks (recalling words vs. recalling definitions) in the two conditions (spelling present vs. absent). In these analyses, the dependent variables were the mean number of correct responses averaged across trials 2, 3, & 4 in each of the vocabulary learning tasks. The independent variables were scores on the various literacy assessment tasks.

Chapter 6

Results

Characteristics of Participants

The purpose of the study was to examine the impact of spellings on learning new vocabulary. It was hypothesized that students with stronger alphabetic skills, as assessed by word reading skill, would benefit more from seeing spellings than students with less word reading skill. Inspection of the distribution of scores on the Boder and Jarrico (1982) word identification test revealed a bimodal distribution as shown in Figure 2. Students were therefore split into the two naturally occurring groups. Those who scored at or below 92 were grouped to form the lower-level readers ($n = 18$). Students who scored at or above 107 were grouped to form the higher-level readers ($n = 14$).

The mean number of words read by lower-level readers equaled a grade equivalent of approximately 4.6. The mean number of words read by higher-level readers equaled a grade equivalent of approximately 7.3. Administration of this test did not follow flash procedures used for normative samples, so these grade equivalents are only approximations. Grade equivalents reported here were calculated by dividing the 20 test items per grade level by the ten months in a school-year calendar. The first list administered was the second grade list. A student who read 70 words would have a grade-equivalent score of approximately 4.5. A student who read 115 words would have a grade equivalent of approximately 6.8. Odd scores were rounded up to the next higher month.

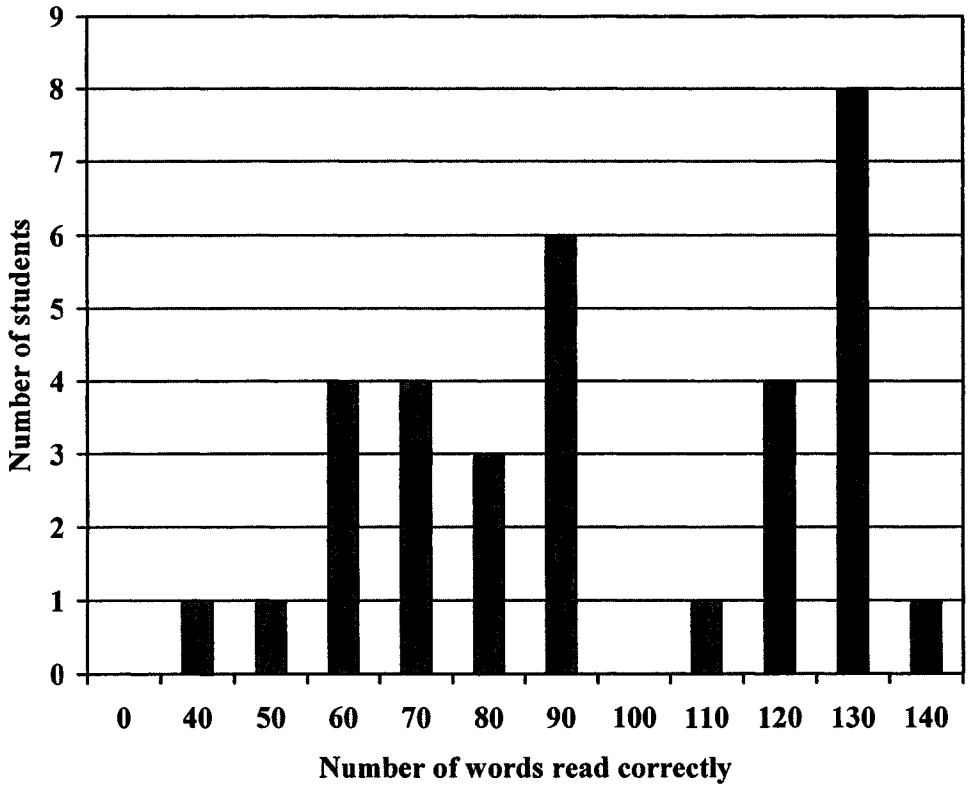


Figure 2. Distribution of scores on the Boder and Jarrico (1982) test of word reading.

T-tests were conducted to determine whether performance of the two groups differed on measures other than the Boder word identification test. Results revealed significant differences in nonword reading performance on the TOWRE Test of Decoding Efficiency (Torgesen et al., 1999), and on the Ganske Spelling Test (Ganske, 2000), but not on the vocabulary test.

Characteristics of the participants are shown in Table 1. Students were quite varied on several measures despite the fact that all were in fifth grade. The range of ages spanned three years, from 9 years, 6 months to 12 years, 3 months. Nonword reading scores ranged from 2 at rock bottom to 56, which was close to the maximum of 63. Students' success in spelling words ranged from 4 to 18 out of 20 maximum. The mean vocabulary standard score on the PPVT test was on the low end of average based on test norms, hovered around 90, and ranged from 68 to 116. Although the sample included students with lower vocabulary scores, none of them had difficulty understanding definitions or learning meanings of the target words, as results will show. The wide variation in these fifth graders' ability to read and spell justifies an examination of factors explaining individual differences in vocabulary acquisition in the present study.

Trials to Criterion in Learning Words

The study was intended to assess the contribution made by spellings in learning vocabulary words. A repeated measures design was used in which students were taught two sets of vocabulary words, one with spellings and one without spellings. Two variables were counterbalanced across students, the word list (A or B) learned in the two spelling conditions, and the order that the spelling conditions were learned. Four

Table 1

Student Characteristics, Mean Performance and Standard Deviations Given in Parentheses on Literacy and Language Tests as a Function of Reader Level as Determined by the Word Identification Test

Characteristics/ Measures	Reader Level		
	Lower	Higher	
	Mean (SD)	Mean (SD)	*t* stat
Gender	9 girls, 9 boys	9 girls, 5 boys	
Ethnicity			
African-American	17	14	
Latin-American	1	0	
Age (in years-months)	10;11	10;10	
Boder and Jarrico Word Ident.			
(140 max.)	71.72 (15.3)	125.07 (7.0)	-13.12*
Approx. Grade Equivalent	4.6 (.8)	7.3 (.4)	
TOWRE Test of Phonemic			
Decoding Efficiency			
Raw score (63 Max.)	16.72 (10.3)	33.57 (12.7)	-4.13*
Standard Score	2.2	4.8	
Ganske Spelling Inventory			
(20 max)	7.94 (3.1)	13.07 (3.1)	-4.62*

Table 1 (Continued)

Student Characteristics, Mean Performance and Standard Deviations Given in Parentheses on Literacy and Language Tests as a Function of Reader Level as Determined by the Word Identification Test

Characteristics/	Reader Level		
Measures	Lower	Higher	
	Mean (SD)	Mean (SD)	*t* stat
PPVT III Receptive Vocab.			
Standard Score	89.11 (9.2)	92.86 (12.0)	-0.99*ns*

Note: There were 32 students tested, 14 higher-level readers and 18 lower-level readers.

***p*<.01 *ns* not significant

independent samples *t*-tests were conducted to assess the effects of word list (A vs. B) on performance on each of the two tasks in the two conditions. The dependent measure was the number of trials to reach a criterion of three perfect successive trials in learning the words, with a maximum of 8 trials. Results showed that word list did not have a significant effect on learning the words with spellings present ($t = -1.623, p > .05$) nor with spellings absent ($t = 0, p = 1$). Word list did not have a significant effect on learning definitions when spellings were present ($t = -1.22, p > .05$) nor when they were absent ($t = .40, p > .05$).

A repeated measures ANOVA was conducted to assess the effects of three variables on performance. All hypotheses were tested at $p < .05$. The dependent measure was number of trials to reach a criterion of three perfect successive trials in learning the words, with a maximum of 8 trials. The, the independent variables were learning order (spellings first and no spellings second versus no spellings first and spellings second); condition (spellings vs. no spellings); and task (recalling words versus defining the words). The first was a between subjects variable, and the latter two were within subjects variables. The reader level variable was not included in this ANOVA because there were too few observations when subdivided into levels of the independent variables. Test statistics reported in Table 2 revealed no significant main effect of order, and no interaction between order and list or condition. However, there were main effects of condition and task as well as a significant interaction between condition and task. Mean performance in Table 3 reveals that, for the main effect of condition, fewer trials were required to learn the words when spellings were present than when spellings were absent. For the main effect of task, fewer trials were needed to learn definitions than

Table 2

Test Statistics in Three-way ANOVA of Number of Trials to Reach a Criterion of Three Perfect Trials in the Word Learning Tasks with Order (O), Task (T), and Condition (C) as the Independent Variables.

Source	*df*	*MS*	*F*
Between subjects			
Order (O)	1	.20	.08*ns*
Error	30	2.50	
Within subjects			
Task (T)	1	142.38	179.03**
T x O	1	.01	.01*ns*
Error	30	.80	
Condition (C)	1	48.76	51.47**
C x O	1	.07	.07*ns*
Error	30	.95	
T x C	1	4.88	5.18*
T x C x O	1	.08	.08*ns*
Error	30	.94	

* $p < .05$ ** $p < .01$ *ns* not significant

Table 3

Mean Number of Trials to Criterion or Termination (Maximum 8) as a Function of Whether or Not Spellings were Present and Whether Students Recalled or Defined the Vocabulary Words.

	Spellings						
	Present		Absent		Mean	*t*-stat	*ES*[a]
	Mean	SD	Mean	SD	Diff.		
Recalling Words	7.09	1.2	7.94	0.2	-0.84	-4.29*	-0.99
Defining Words	4.59	1.3	6.22	1.3	-1.63	-5.89*	-1.25

$p < .01$

Note. There were 32 observations per cell.

[a]The negative effect sizes reflect the fact that fewer trials were needed to learn words with spellings than without spellings.

words. From Table 3, the source of the interaction between condition and task is apparent. The advantage of seeing over not seeing spellings was greater in the word-defining task than in the word recall task. This occurred mainly because ceiling effects suppressed the difference in recalling words, with means approaching the maximum of 8 trials in both conditions.

Effect sizes were calculated for both tasks using the formula $d = M1 - M2/\sigma_{pooled}$. This formula was used for all effect sizes reported in this study. Effect sizes are considered to be small when $d = 0.2$, moderate when $d = 0.5$, and large when $d = 0.8$ (Rosnow & Rosenthal, 1996). These effect sizes reported in Table 3 are large. It should be noted that they are negative, because they were computed on trials to criterion with fewer trials indicating better performance on the vocabulary learning tasks.

Many students failed to reach the criterion of three perfect consecutive trials in the word recall task, especially when they learned words without spellings. In contrast, almost all students reached criterion in the word-defining task in both conditions. Tests of the significance of the difference between two correlated proportions were conducted to assess the effect of learning condition on ability to reach criterion in each of the tasks. These results are reported in Table 4.

For the task of recalling words, results revealed a significant effect of condition, with half of the students reaching criterion, half not reaching criterion in the spellings present condition, but only 4 out of 32 reaching criterion in the spellings absent condition. Thus, many more students were able to reach criterion when they saw the spellings than when they did not. These results indicate that remembering the

Table 4

Tests of Significance of the Difference between Two Correlated Proportions: Proportion of Students Reaching Criterion with Spellings Present vs. Absent in the Tasks of Recalling Words or Defining the Words

	Criterion			
	Reached	Not reached	Proportion	*z*
Picture-word				
Spellings present	16	16	0.50	
Spellings absent	4	28	0.125	
				3.46*
Word-definition				
Spellings present	31	1	0.97	
Spellings absent	29	3	0.91	
				1.41*n.s.*

*$p<.01$ *ns* not significant

pronunciations of new vocabulary words is not an easy task for fifth graders, so they benefit substantially from viewing the spellings of the words during learning. This is thought to be because spellings symbolize and preserve the sounds of words in memory.

For the word-defining task, 31 out of 32 students reached criterion in the spellings-present condition, while 29 out of 32 reached criterion in the spellings-absent condition. A test of the significance of the difference between two correlated proportions revealed that this difference was not significant (see Table 4). Given sufficient practice, fifth graders can learn the meanings of new words both with and without seeing spellings although spellings speed up the learning process as was found above.

The effect of reader level on ability to utilize spellings to remember word pronunciations to criterion was examined. Most of the students who failed to reach the criterion of three perfect trials in the word recall task were lower-level readers. In contrast, the majority of students who reached criterion in this task were higher-level readers. Chi-square tests were conducted to assess the effects of reader level on ability to reach criterion in the word recall task when spellings were present. These results are reported in Table 5. Results revealed a significant effect of reader ability, with 11 out of 14 higher-level readers reaching criterion, and only five out of 18 lower-level readers reaching criterion in this task. These results suggest that readers with large printed word lexicons possess a greater orthographic mnemonic capability, which allows them to store printed forms of words in memory.

Table 5

Chi-square Tests of the Number of Higher-level Versus Lower-level Readers Reaching or Not Reaching Criterion in the Word Recall Task When Spellings were Present

	Reader level			
	high	low	*df*	$\chi 2$
Criterion reached	11	5		
Criterion not reached	3	13		
			1	8.127*

*$p < .01$

Vocabulary Learning Over Trials

The study was intended to examine the effect of spellings on the rate of vocabulary learning. Students were given a maximum of eight study-test trials to learn ten words in each condition. It was hypothesized that seeing spellings during study trials would help students learn to pronounce and define words faster than hearing and saying the words an extra time during study trials. Students with good word reading skill were expected to benefit even more from seeing spellings than weaker word readers.

Two repeated measures ANOVAs were conducted to assess the effects of spellings and student ability on word learning over trials in each of the word learning tasks. All hypotheses were tested at $p < .05$. The dependent measure was the number of correct responses on each of the first five trials. The independent variables were reader level (higher vs. lower), condition of learning the vocabulary words (spellings present vs. spellings absent), and test trials (1-5). Ability was a between subjects variable, and condition and trials were both within subjects variables.

In the word-learning task, main effects of reader level, condition, and trials were significant, as shown by test statistics in Table 6. In addition, all of the two-way and three-way interactions were significant (see Table 6). Mean performance is presented in Table 7 and depicted in Figure 3. It is apparent that higher-level readers outperformed lower level readers. Performance improved across trials. The presence of spellings improved word learning over no spellings. The boost that spellings provided compared to no spellings was much greater among higher-level readers than lower level readers. Whereas a boost was evident throughout all the trials among higher-level readers, a boost did not appear until Trial 2 among lower level readers (i.e. see *Mean Difference* across

Table 6

Test Statistics in Repeated-measures ANOVAs of Performance in Two Vocabulary Learning Tasks with Reader Ability (A), Condition of Learning (C), and Test Trials (T) as the Independent Variables and Number of Correct Responses as the Dependent Variable

Source		Learning Words		Learning Definitions	
	df	*F*	(Mean square)	*F*	(Mean square)
Between subjects					
Reader ability (A)	1	8.99**		4.59*	
Error	30		(25.51)		(4.06)
Within subjects					
Condition (C)	1	75.27**		12.13**	
C x A	1	16.12**		.19*ns*	
Error	30		(5.41)		(3.83)
Trials (T)	4	171.78**		56.92**	
T x A	4	3.37*		1.46*ns*	
Error	120		(1.83)		(1.25)
C x T	4	13.88**		2.54*	
C x T x A	4	2.48*		.19*ns*	
Error	120		(1.23)		(.98)

Note. Values in parentheses represent mean squares.

*$p<.05$ **$p<.01$ *ns* not significant

Table 7

Mean Number of Words Recalled and Standard Deviations in Parenthesis on Each Trial for Higher Level (N = 14) and Lower Level (N = 18) Readers as a Function of Whether or Not Spellings were Present

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	*ES*
High Level Readers						
Spellings Present						
	2.07(2.3)	6.21(2.5)	8.29(2.0)	8.57(1.8)	9.43(1.2)	1.79
Spellings Absent						
	1.07(1.0)	2.00(1.7)	3.93(2.2)	4.79(2.6)	6.14(3.1)	
Mean Diff.	1.00	4.21	4.36	3.78	3.29	
Low Level Readers						
Spellings Present						
	0.72(1.4)	3.11(2.2)	4.17(2.6)	5.83(2.7)	6.94(2.3)	0.73
Spellings Absent						
	0.89(1.0)	1.61(1.2)	3.00(2.0)	4.22(2.0)	4.94(1.7)	
Mean Diff.	0.17	1.50	1.17	1.61	2.00	

Note. The maximum number of words recalled is 10.

ES Effect size computed using $M1 - M2/\sigma_{pooled}$. Effect size calculations based on performance averaged across trials 1 - 5.

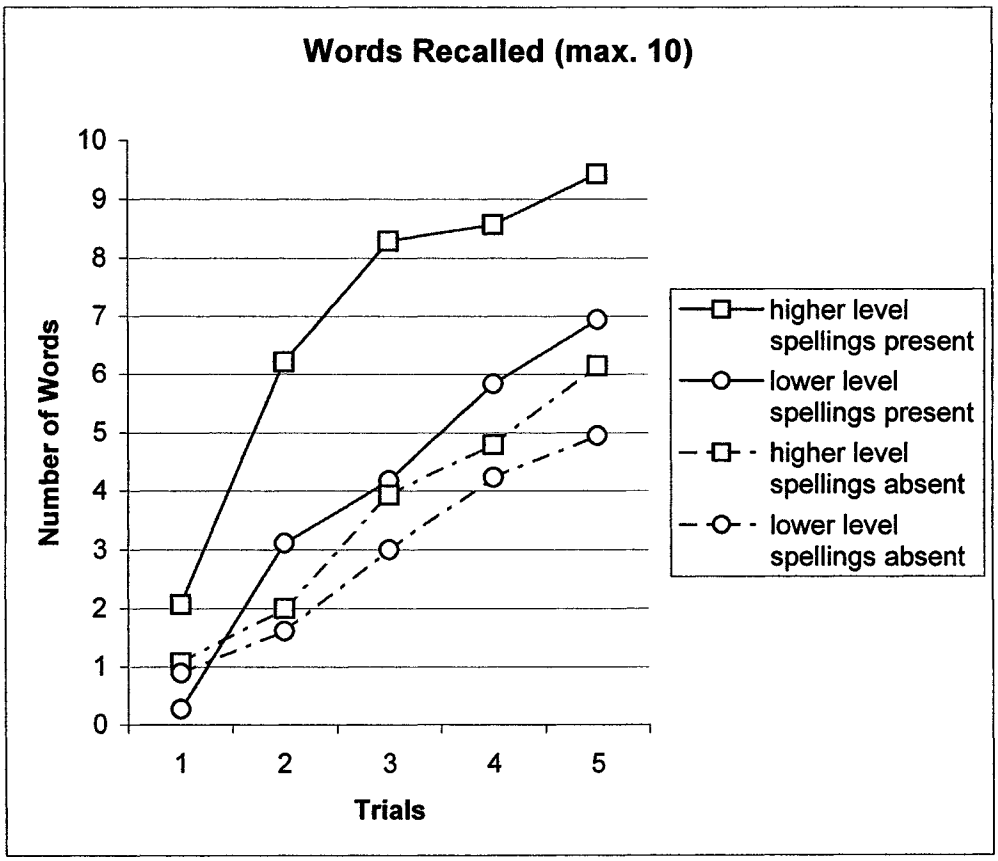


Figure 3. Word learning over the first five trials by condition and reader level.

trials in Table 7). The rate of word learning with spellings among higher-level readers was much greater than the other three rates of learning, as indicated by differences in the slopes in Figure 3.

In the definition-learning task, main effects of reader level, condition, and trials were significant (see Table 6) as well as a significant condition by trials interaction. Mean performance is reported in Table 8 and shown in Figure 4. Inspection of these values reveals that higher-level readers learned definitions faster than lower level readers. More definitions were recalled when spellings were studied than when they were not studied. Performance increased across trials. The boost provided by spellings was greater on earlier trials than on later trials as performance approached ceiling.

As can be seen in Tables 7 and 8, effect sizes for both reader level groups on both tasks were moderate to large. The effect size on the word recall task for the high ability students was large (*ES* >. 8). The effect size for the lower ability students on the word recall task was moderate (*ES* > .5). The effect size for the high ability students on the definition recall task was moderate (*ES* > .5) and for the lower ability students on this task, the effect size was large (*ES* >. 8). Effect size differences in word recall indicate that spellings exerted a greater impact on higher than lower ability readers. Effect size differences in definition recall favored lower readers but this difference arose because scores were close to ceiling among high readers, hence limiting the size of the effect on them.

To summarize, these findings show that students were able to use spellings as a mnemonic aid. Words and meanings were learned faster when spellings were seen during study and feedback periods than when they were not. In addition, the higher-level

Table 8

Mean Number of Definitions Recalled and Standard Deviations in Parenthesis on Each Trial for Higher LevelReaders (N = 14) and Lower Level Readers (N = 18) as a Function of Whether or Not Spellings were Present

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	*ES*
Higher Level Readers						
Spellings Present						
	8.07(2.3)	9.57(0.9)	9.86(0.4)	10.00(0)	10.00(0)	0.77
Spellings Absent						
	6.93(1.8)	8.34(1.9)	9.36(1.1)	9.71(1.1)	9.79(0.4)	
Mean Diff.	1.14	1.23	0.50	0.29	0.21	
Lower Level Readers						
Spellings Present						
	7.61(1.7)	8.67(1.7)	9.33(0.9)	10.00(0)	9.44(0.2)	0.96
Spellings Absent						
	6.44(1.8)	7.50(2.0)	8.33(1.4)	9.50(0.9)	9.44(1.2)	
Mean Diff.	1.17	1.17	1.00	0.50	0.0	

Note: The maximum number of definitions recalled is 10.

ES Effect size computed using $M1 - M2/\sigma_{pooled}$. Effect size calculations based on performance averaged across trials 1 - 5.

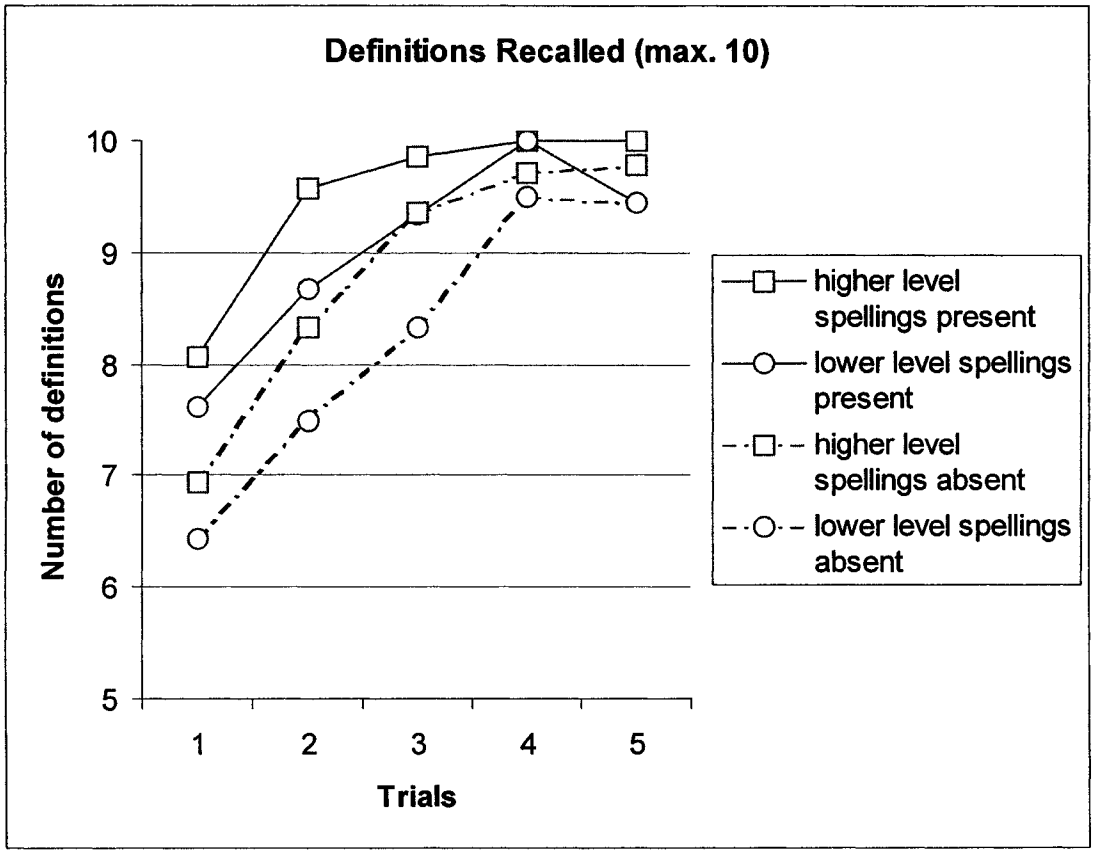


Figure 4. Definition learning over the first five trials by condition and reader level

readers learned words and definitions faster than the lower level readers, and the higher-level readers benefited much more from spellings in learning the words than the lower level readers.

Word Variables

In order determine whether the specific words that were taught followed the expected trend of being learned better with spellings than without spellings, performance with each word was examined. The number of children who responded correctly in recalling each word over the first five trials in each condition was tallied and divided by 5 (16 maximum per trial). These values are reported in Table 9. Mean performance in Table 9 reveals that every word was learned better when spellings were seen than when they were not.

Multisyllabic words and nonwords containing more than two syllables have been shown to be difficult for some children to learn (Gathercole & Baddeley, 1989). It was therefore of interest to determine if spellings eased the task of learning words of different lengths. A three way ANOVA was conducted to assess the effects of several variables on word learning. The individual words served as the units of observation in this analysis. The dependent measure was the number of children responding correctly per trial. The independent variables were condition (spellings present vs. spellings absent), trial (1– 5), and word length (two vs. three syllables). Condition and trial were both repeated measures variables, and word length was a between word variable.

Test statistics reported in Table 10 revealed significant main effects of word length, condition, and trial, and an interaction between word length and trial. However,

Table 9

Mean Number of Students Responding Correctly in Recalling Words per Trial Averaged over the First Five Trials (max. 16)

Word	Spellings present		Spellings absent	
	Mean	*SD*	Mean	*SD*
Dobson	9.40	4.6	6.20	2.7
Gangrel	8.80	4.1	8.60	4.6
Potlatch	9.60	3.8	9.40	4.6
Koomkie	9.20	4.5	4.40	3.8
Barrow	13.20	4.1	10.60	4.4
Juggernaut	11.00	3.4	6.20	2.9
Muleta	9.20	5.1	5.20	4.1
Tamarack	8.00	2.4	2.20	2.8
Vibrissa	9.20	3.7	3.40	3.6
Frenulum	5.80	3.8	2.00	2.5
Tandem	9.80	4.7	3.80	3.3
Wimple	10.60	5.7	6.80	2.6
Chigger	7.80	5.2	4.40	3.0
Fribble	9.80	4.7	2.80	2.2
Mullock	9.80	5.2	7.00	3.1
Kerfuffle	6.20	3.8	4.00	2.8
Laburnum	6.80	5.5	3.00	3.1

Table 9 (Continued)

Mean Number of Students Responding Correctly in Recalling Words per Trial Averaged over the First Five Trials (max. 16)

Word	Spellings present		Spellings absent	
	Mean	*SD*	Mean	*SD*
Proboscis	6.00	4.6	5.20	3.5
Scrivello	4.40	3.8	2.20	2.3
Hicatee	7.40	5.3	5.60	3.3

Table 10

Test Statistics in Three-way ANOVA of Performance on Individual Words with Word Length, Condition of Learning, and Trials as the Independent Variables

Source	*df*	Mean square	*F*
Between subjects			
Word length (W)	1	300.13	10.82**
Error	18	27.74	
Within subjects			
Condition (C)	1	595.13	61.55**
C x W	1	.13	.01*ns*
Error	18	9.67	
Trials (T)	4	502.21	198.24**
T x W	4	7.19	2.84*
Error	72	2.53	
C x T	4	25.44	11.77**
C x T x W	4	1.46	.67*ns.*
Error	72	2.161	

*$p<.05$ **$p<.01$ *ns* not significant

there was not a significant interaction between condition and word length, or between condition, trial, and word length.

For the main effect of word length, two syllable words were learned more easily than three syllable words, $M = 8.10$ (2 syllable) and $M = 5.65$ (3 syllable). For the main effect of condition, the presence of spellings made learning easier. Words were learned by more students in the spellings present than in the spellings absent condition, $M = 8.60$ (spellings present) and $M = 5.15$ (spellings absent). The main effect of trials as well as the source of the interaction between word length and trial is apparent in Table 11 and Figure 5. The difference between 2 and 3 syllable word learning grows larger from Trial 1 to Trial 4 and then smaller on Trial 5. The absence of an interaction between spelling condition and word length shows that spellings were equally effective in learning both two and three syllable words.

The words in this study may have differed in conceptual difficulty. Other studies have shown that this variable affects word learning (i.e. Shu et. al, 1995). To examine this possibility, the words taught in this study were rated for their conceptual difficulty to examine whether this factor had any influence on word learning. Five elementary school teachers were asked to rate the words on two scales of conceptual difficulty. Two of these teachers taught fifth grade in the school in which this experiment was conducted. Two taught fifth grade in different schools in areas with populations similar to the participating school. The fifth rater was a reading tutor working with students in third through fifth grade in a school with a population similar to the participating school. The teachers were shown the twenty words, along with their core definitions and meaning

Table 11

Mean Number of Participants (Maximum = 32) Responding Correctly on the Word Recall Task Over Trials 1 – 5 for Two and Three Syllable Words

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Two syllables	5.2(2.8)	12.1(4.1)	18.1(4.9)	22.1(4.2)	23.5(3.4)
Three syllables	2.2(3.0)	7.8(4.4)	11.9(4.3)	15.0(3.2)	19.8(4.4)

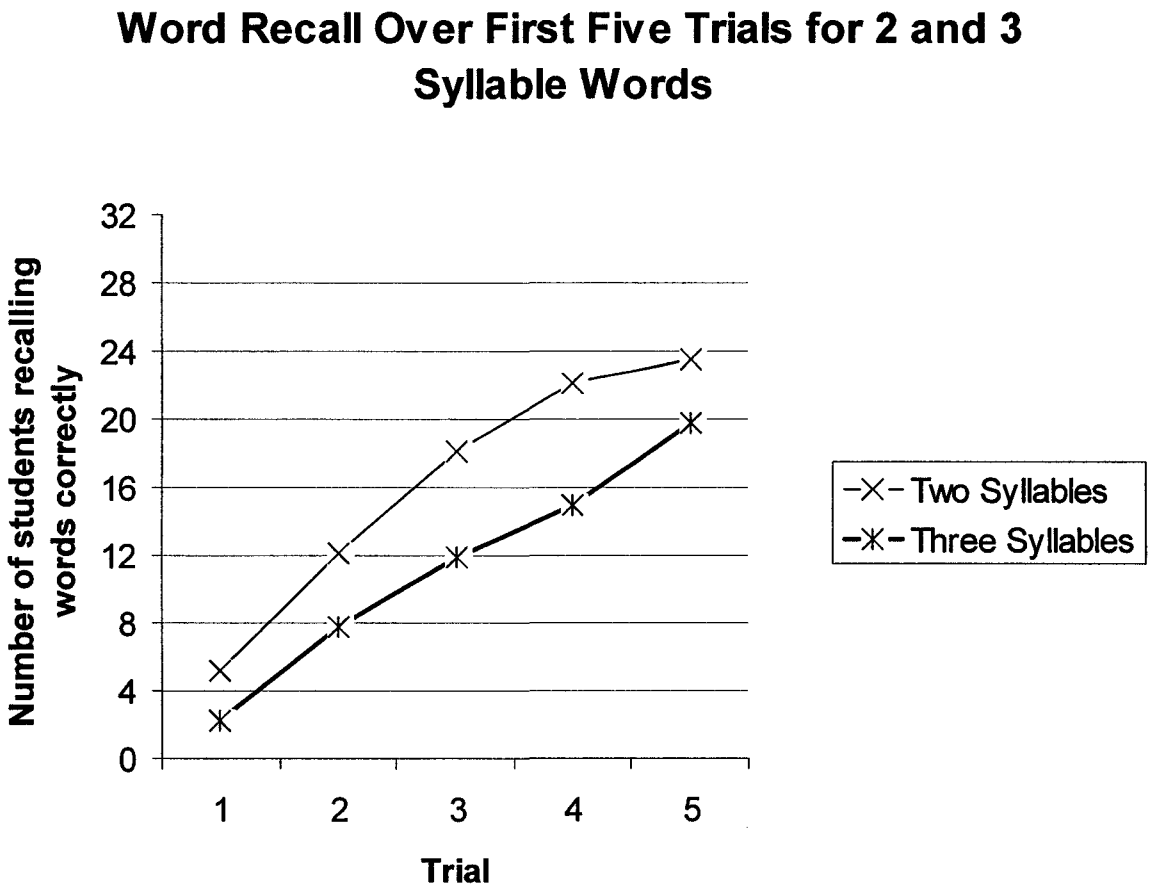


Figure 5. Number of participants responding correctly on the word recall task over trials 1 – 5 for two and three syllable words

clarifying sentences. They were asked to rate words on a scale of one to five on two variables: conceptual closeness (is the word a straight synonym for a known word, or words?). The mean of teacher ratings on the two variables was then calculated for each word. Word ratings appear in Table 12.

To determine whether conceptual difficulty had an effect on learning words and learning definitions, and to determine whether seeing spellings interacted with conceptual difficulty, two three way ANOVAs were conducted. To do these analyses, teacher ratings were summed to form a single score of conceptual difficulty. The distribution of word ratings was bimodal, so words were split into the naturally occurring groups. Words rated at or above 4.75 (n = 12) were classified as hard, and words rated at or below 3.75 (n = 8) were classified as easy. Individual words served as the units of observation in these analyses. The independent variables were conceptual difficulty of words (hard versus easy) and condition of learning (spellings present vs. spellings absent). The dependent variable on the word recall task was the mean number of participants responding correctly to the words per trial across the first five trials. For the word-defining task, only the first three trials were examined, since ceiling effects in later trials limited the amount of variability in performance on these trials. The dependent variable in this analysis was the mean number of participants responding correctly with the definition per trial over the first three trials. Test statistics, presented in Table 13, reveal a significant main effect of condition on both tasks. There was no main effect of conceptual difficulty of words on either task, nor did conceptual difficulty interact with condition on the word recall task. However, there was an interaction between conceptual difficulty and condition on the definition recall task.

Table 12

Mean Teacher Ratings of Words on Conceptual Closeness and Extent to Which Definitions Enriched Student Concept Base of Words (Maximum 5)

Word	Straight synonym = 1 New concept = 5	Repeated information = 1 Concept enrichment = 5
Dobson	2.25	4.00
Gangrel	1.00	1.00
Potlatch	4.50	5.00
Koomkie	4.50	4.00
Barrow	1.25	1.25
Juggernaut	1.75	1.50
Laburnum	3.75	4.25
Proboscis	2.00	1.00
Scrivello	2.25	4.25
Hicatee	4.00	4.00
Tandem	2.50	4.25
Wimple	4.00	3.75
Chigger	4.00	3.50
Fribble	1.75	3.00
Mullock	1.00	1.50
Kerfuffle	1.50	1.75

Table 12 (Continued)

Mean teacher ratings of words on conceptual closeness and extent to which definitions enriched student concept base of words (max. 5)

Word	Straight synonym = 1 New concept = 5	Repeated information = 1 Concept enrichment = 5
Muleta	1.25	2.00
Tamarack	3.75	3.00
Vibrissa	1.50	4.50
Frenulum	1.00	2.00

Table 13

Test Statistics in Two Three-way ANOVAs of Number of Students Responding Correctly on the Word Recall and Definition Recall Tasks with Conceptual Difficulty (hard vs. easy) and Condition of Learning (spellings present vs. absent during learning) as the Independent Variables

Source		Word Recall		Definition Recall	
	df	Mean square	*F*	Mean square	*F*
Between subjects					
Conceptual difficulty (CD)	1		.87*ns*		$F < 1$
Error	18	7.35		.000	
Within subjects					
Condition (C)	1		58.782**		71.15**
C x CD	1		.726*ns*.		4.55*
Error	18	1.86		.49	

*$p<.05$ **$p<.01$ *ns* not significant

Table 14

Mean Number of Students Responding Correctly per Word per Trial Averaged Over Trials 1-5 in the Word Recall Task and Over Trials 1-3 in the Definition Recall Task as a Function of Conceptual Difficulty of the Words (hard vs. easy) and Condition of Learning (spellings present vs. absent) During Learning

	Spellings Present	Spellings Absent	Mean Diff.	*t*-stat	*ES*
Word recall					
Easy	8.90(2.3)	5.90(2.8)	3.00	--	.51
Hard	8.40(2.0)	4.65(2.1)	3.75	--	.67
Mean Diff.	0.50	1.25			
Definition recall					
Easy	14.54(.6)	12.17(1.0)	2.38	5.40**	.82
Hard	14.01(1.1)	12.64(1.5)	1.42	2.68*	.46
Mean Diff.	0.53	-0.47			

Note. The maximum number of students contributing to each mean is 16.

* $p < .05$. ** $p < .01$.

ES Effect size computed using $M1 - M2/\sigma_{pooled}$.

Mean performance in Table 14 reveals that, for the main effect of condition, more students responded correctly with words and with definitions when spellings were present during learning trials than when they were not. From Table 14, the source of the interaction between condition and conceptual difficulty on the definition recall task is apparent. The difference between words learned with and without spellings was greater for the easy than for the hard words. Spellings boosted performance more on easy than on hard words.

To verify that the main effect favoring spellings over no spellings held across hard and easy words in the word-defining task, post hoc t-tests were conducted to compare means within the two sets of words. Results confirmed that differences were statistically significant (see *t*-statistics in Table 14). Thus, the interaction between condition and conceptual difficulty did not undermine the main effect of condition.

Error analyses

Analyses of the errors characterizing students' responses in the word recall task revealed that learning to pronounce words correctly was the central difficulty. Errors in which a new word was correctly produced but matched with the wrong stimulus picture comprised only 2% of the total errors made on trials 1- 5, and made up less than 1% of errors when spellings were present. Most of the errors involved either a failure to respond, or a failed attempt at producing the correct pronunciation for the stimulus. This indicates that spellings helped to implant in students' memory the full array of sounds in the specific words.

Further inspection of errors made during learning-test trials revealed that many errors contained some sounds from the correct pronunciations. Incorrect responses that

contained correct phonological elements indicated some memory for correct pronunciations of the words. In order to assess the relationship between the presence or absence of spellings during study periods and the extent to which errors reflected knowledge of the words' pronunciations, errors were coded for phonological elements. Errors containing phonological elements were coded as the correct initial consonant or sound, or one or more correct syllables. Errors that involved a failure to respond, a mismatch with the stimulus cue, or a verbal attempt, did not fall under the aforementioned categories, and hence were coded as not including phonological elements. The proportion of total errors including each type of phonological element was then calculated for each student. Of the 32 students, a total of 26 (81%) made at least one error containing the correct initial sound when spellings had been studied. Twenty-five students (78%) made at least one error containing the correct initial sound when spellings had not been studied. Twenty-five students (78%) made at least one error containing one or more correct syllables in both the spelling-present and the spelling-absent conditions.

In order to compare the patterns of errors made in the two learning conditions, trials 2 and 3 in the spellings present condition were compared to trials 4 and 5 in the spellings absent condition. These trials were chosen because, as can be seen in Figure 6, the mean number of correct responses made on trial 2 in the spellings present condition was comparable to the mean number of correct responses made on trial 4 in the spellings absent condition; the mean number of correct responses made on trial 3 in the spellings present condition was comparable to the mean number of correct responses made on trial 5 in the spellings absent condition. The numbers of errors made on these pairs of trials were approximately equal. It was thought that equating the mean number of correct

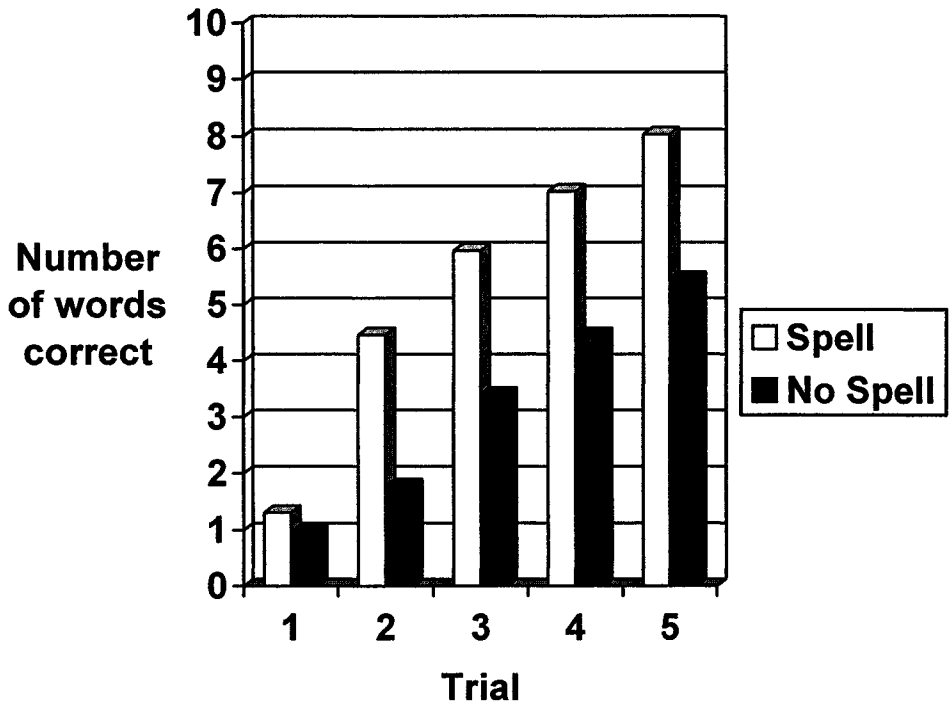


Figure 6. Number of words recalled on the picture-word task on trials 1-5

responses and errors would yield comparable levels of memory for the words across the two conditions.

A three-way ANOVA was conducted to assess which variables affected the proportion of errors that contained phonological elements. All hypotheses were tested at $p < .05$. Independent samples t-tests revealed no significant difference in error patterns between ability groups (all $p > .05$) so this variable was left out of the analysis. The dependent variable was the proportion of total errors that contained phonological elements. The independent variables were condition of learning (spellings present vs. spellings absent), trial (2/3 vs. 3/5), and type of phonological element (initial sound vs. one or more syllable). Test statistics reported in Table 15 revealed significant main effects of condition and of phonological element. There was no significant main effect of trial, and no interactions between the variables.

Mean performance in Table 16 reveals that, for the main effect of condition, a greater proportion of errors contained phonological elements in the spellings present than in the spellings absent condition. Seeing spellings enhanced more to students' memory for parts of the words more than not seeing spellings but instead hearing and saying the words. For the main effect of phonological element, a greater proportion of errors contained the correct initial sound than contained one or more correct syllables. Producing correct syllables requires more extensive memory for the correct pronunciation of words and was therefore more difficult.

Errors made on the word recall task were inspected more closely. Errors that involved correct pronunciation of a vocabulary word mismatched with the stimulus cue were tallied. It was found that only 11 errors of this type were made during the first five

Table 15

Test Statistics in Three-way ANOVA of Proportion of Errors Containing Phonological Elements, with Condition of Learning, Test Trials, and Type of Phonological Element, as the Independent Variables

Source	df	Mean square	F
Within subjects			
Condition (C)	1		6.19*
Error	31	.16	
Trial (T)	1		.71*ns*
Error	31	.13	
Phonological Element (P)	1		22.63**
Error	31	.02	
C x T	1		.81*ns*
Error	31	.12	
C x P	1		.00*ns*
Error	31	.02	
T x P	1		.27*ns*
Error	31	.01	
C x T x P	1		.32*ns*
Error	31	.01	

*$p < .05$. **$p < .01$. *ns* not significant

Table 16

Mean Proportion of Errors Containing Phonological Elements

	Spellings present Mean (*SD*)	Spellings absent Mean (*SD*)	Mean
Initial consonant	.36 (.3)	.24 (.2)	.30(.3)
One or more syllable	.28 (.2)	.16 (.2)	.22(.2)
Mean Proportion	.32(.3)	.20(.2)	

learning-test trials in the spellings-present condition. All of these involved intra-list mismatches, regardless of whether students studied spellings first and no spellings second, or the opposite order. The pattern was slightly different for errors made in the first five trials in the spellings-absent condition, which yielded a total of 22 errors involving a mismatch. Of these, 4 were made on Day 2 after the spellings-present condition had been completed on Day 1. All 4 errors were inter-list mismatches. That is, students produced words from the list that they had learned with spellings present on the previous day. One of these errors involved producing a word for a stimulus picture whose meaning was close to the meaning of the word produced. The word "scrivello", meaning an elephant's tusks, was produced for the stimulus "koomkie", meaning an attractive female elephant. The other three involved producing a word learned on the previous day's list (with spellings) for a stimulus picture whose name had a similar initial syllable. The word "tandem" was produced for the stimulus "tamarack" twice; the opposite occurred one time. These mismatch errors, involving words learned on the previous day, underscores the contribution of spellings to students' memory for words, as inter-list errors of this sort never occurred when the spellings-absent condition was completed first. The remainder of the 18 mismatch errors that occurred when spellings were absent were intra-list mismatches.

Posttests

Five posttests were given to examine the impact of spellings on students' memory for the words after the passage of time. Seeing words' spellings was expected to provide greater help in remembering pronunciations, meanings, and spellings of words one day later than not seeing spellings but instead hearing and saying the words an extra time. It

was hypothesized that students with stronger word reading skill would benefit more than students with less word reading skill.

Five posttests for each set of words were administered at the beginning of the sessions, one day after training of the words had taken place. The spelling test measured students' memory for spellings of the words they had seen, and their ability to produce plausible spellings of words they had not seen. Two of the tests, oral cloze and picture naming, measured memory for words' pronunciations. Oral cloze was a transfer measure, in that students had not heard the test sentences before. The picture-naming task followed the format of the test trials. Students were asked to name the pictures they had seen on the previous day. Two of the tests, picture identification and oral definitions, measured memory for words' meanings. Picture identification was a transfer measure, in that students had not seen the test pictures before. The oral definitions task followed the format of test trials. Students were asked to orally give the definitions of words, spoken by the experimenter. No spellings were shown in these tasks. Scores on the two tests of meanings were close to perfect for all students in both conditions. Therefore performance on these two tests were not analyzed statistically.

Three two-way ANOVAs were conducted to assess the effects of condition (spellings present or absent during learning trials) and reading level (higher vs. lower) on the spelling, oral cloze, and picture naming posttests. All hypotheses were tested at $p <$ .05. Reader level was a between subjects variable, and condition of learning was a within subjects variable. The dependent variable was number of correct responses in each of the three tests. Test statistics reported in Table 17 reveal a main effect of reader level and a main effect of condition of learning for all three tests, as well as a significant interaction

Table 17

Test Statistics in Three Two-way ANOVAs of Posttest Scores with Reader Level (higher vs. lower) and Word Learning Condition (spellings present vs. absent) as the Independent Variables

Source	*df*	*F*		
		Oral cloze	Picture naming	Spelling
Between subjects				
Reader level	1	9.31**	9.87**	22.82**
Error	30	(6.16)	(5.89)	(5.19)
Within subjects				
Condition	1	21.99**	20.32**	96.23**
Condition x Reader Level	1	4.26*	2.80*ns* .	10.65**
Error	30	(3.11)	(3.20)	(1.64)

Note. Values enclosed in parentheses represent mean square error

* $p<.05$. ** $p<.01$. *ns* not significant

between reader level and condition for the oral cloze and spelling tests. The interaction between ability and condition was not significant for the picture-naming task.

Mean performance in Table 18 reveals that, for the main effect of reader level, higher-level readers were better able to remember words' spellings than were lower-level readers. Higher-level readers also recalled pronunciations of more words than did lower-level readers, on both tests of word recall. For the main effect of condition, posttest scores were higher on words that had been learned with spellings present. From Table 18, the source of the interaction between reader level and condition on the spelling test is apparent. The contribution made by seeing spellings to students' ability to remember the spellings was much greater for the higher-level than for the lower-level readers. Also the source of the interaction between ability and condition on the oral cloze task is apparent in Table 18. The advantage of seeing spellings was somewhat greater for higher-level than for lower-level readers on this task. There was no significant interaction between reader level and condition on the picture-naming task. The difference in performance on this task between words learned with spellings present versus spellings absent was more similar for higher- and lower-level readers, possibly because scores of higher-level readers were suppressed by ceiling effects.

To verify that the main effect favoring spellings over no spellings held for both groups, post hoc *t*-tests were conducted to compare group means on the posttest. Results confirmed that all differences were statistically significant (see *t*-statistics in Table 18). Thus, the interaction between reader level and condition did not undermine the main effect of condition.

Table 18

Mean Number of Correct Responses on the Vocabulary Posttests for Higher and Lower Level Readers as a Function of Whether Spellings were Present or Absent During Learning (Maximum = 10)

Posttest Reader level	Spelling Present	Spelling Absent	Mean Diff.	*t*-stat	ES
Spelling					
Higher-level	7.07 (1.6)	2.86 (1.8)	4.21	8.35**	.78
Lower-level	3.28 (2.4)	1.17 (1.4)	2.11	5.13**	.47
Oral Cloze					
Higher-level	8.21 (1.2)	5.21 (2.7)	3.00	4.71**	.58
Lower-level	5.39 (2.4)	4.22 (2.0)	1.17	1.92*	.26
Picture-Naming					
Higher-level	8.79 (0.8)	6.00(2.6)	2.79	4.36**	.60
Lower-level	6.11 (2.4)	4.83 (2.1)	1.28	2.06*	.27

*$p<.05$. **$p<.01$

ES Effect size computed using $M1 - M2/\sigma_{pooled}$

From Table 18, it is apparent that the picture-naming task was slightly easier than the oral cloze for both groups of students, in both conditions. Whereas the picture-naming task was identical to the test trials that students had already experienced, the oral cloze task required knowledge transfer, and was therefore more difficult. Paired samples *t*-tests confirmed that students performed better on the picture naming than on the oral cloze task, in both conditions ($t = 6.03$, $p < .01$).

Correlations and regression analyses

In order to assess relationships between performance on the vocabulary learning tasks and children's knowledge of printed language, Pearson product-moment correlation coefficients were calculated. Mean number of correct responses averaged across trials 2, 3, & 4 for each student in each of the two vocabulary learning tasks in the two conditions was correlated with scores on the various measures of printed language and vocabulary knowledge. Results, presented in Table 19, revealed significant correlations between all measures of printed language knowledge. In contrast, PPVT-III (Dunn & Dunn, 1997) receptive vocabulary scores did not correlate significantly with any of the printed language measures.

Of interest were correlations between vocabulary learning over trials and various measures of printed language. It was expected that printed language measures would correlate strongly with vocabulary learning tasks in which spellings were present. Correlations between scores on the Boder word identification task (Boder & Jarrico, 1982) and performance on word and definition learning with spellings present were

Table 19

Intercorrelations Among Word Learning and Printed Language Measures

Measure								Mean	SD	Max score achieved
Vocabulary Learning	1	2	3	4	5	6	7			
1. PW (spelling present)								5.82	2.7	10
2. PW (spelling absent)	.57**							3.22	1.9	7
3. WD (spelling present)	.64**	.05						9.54	0.7	10
4. WD (spelling absent)	.45*	.54**	.12					8.75	1.2	10
Literacy Assesment										
5. Boder	.71**	.26	.44*	.34				95.06	29.5	136
6. TOWRE	.54**	.39*	.13	.43*	.69**			24.09	14.1	56
7. Ganske	.64**	.56**	.27	.55**	.78**	.82**		10.19	4.0	18
8. PPVT standard score	.15	.07	-.15	-.03	.16	-.02	.10	90.75	10.5	116

*p< .05 (2-tailed). **p< .01 (2-tailed). No other correlations were significant.

Note. PW is the word recall task. WD is the definition recall task. PPVT is the Peabody Picture Vocabulary Task. Boder is a word reading task. TOWRE is a nonword reading task. Ganske is a spelling task.

significant. Correlations between scores on this task and vocabulary learning with spellings absent were not significant. These results were expected.

Particularly interesting is the fact that correlations between the Ganske (Ganske, 2000) spelling test and word recall in the spellings absent condition were very high, similar to the correlation between the Ganske spelling and word recall with spellings present (i.s. *r*s = .64 vs. .56). In addition, the TOWRE (Torgesen et al., 1999) test of nonword decoding correlated significantly with word recall in the spellings absent condition. One explanation is that in the absence of spellings, students with good spelling and decoding skills use their alphabetic knowledge to remember new vocabulary. Perhaps potential spellings are activated spontaneously in their memory when they hear new words (Ehri, 1984). Alternatively, perhaps better spellers possess superior phonological memory that contributes to learning new vocabulary words without seeing spellings.

To determine which language skills were central in explaining individual differences in vocabulary learning in the two conditions, four regression analyses were conducted. For these analyses, the dependent measure was the mean number of correct responses across trials 2, 3, & 4 in each of the vocabulary learning tasks. The independent variables included the Boder word identification task, TOWRE phonemic decoding, and Ganske spelling tests. Scores on the PPVT had close to zero correlations with learning (see Table 19) so this variable was excluded from the analyses.

In conducting these analyses, distributions on the three measures of printed language ability were examined for skewness and for outliers. It was found that the distribution of scores on the TOWRE phonemic decoding task had two outliers at the

upper end of the distribution, and the distribution was positively skewed. When these outliers were removed from the dataset and regression analyses were repeated, results did not differ significantly from the analyses with the outliers. These scores were therefore included in analyses reported below..

The three predictor variables were entered freely into the four regression analyses to determine the total variance learning explained.. Variables were then forced into the model individually to determine unique variance explained by scores on each of the tasks when that variable was entered last. Test statistics are reported in Table 20.

Results of the analysis of variables predicting performance on the word recall task when spellings were present showed that scores on the three tasks accounted for a statistically significant total of 52% of the variance. Of this, the Boder word identification task accounted for a statistically significant 12% of unique variance. No other measure accounted for significant unique variance on this task.

Results of the analysis of variables predicting performance on the picture-word task when spellings were absent showed that scores on the three tasks accounted for a statistically significant total of 39% of variance.. Of this, scores on the Ganske spelling test accounted for a statistically significant 24% of unique variance. No other measure accounted for significant unique variance on this task.

The analysis of variables predicting performance on the word-defining task when spellings were present showed that scores on the three tasks accounted for a statistically significant total of 25% of variance on this task. Of this, the Boder word identification

Table 20

Summary of Unique Variance Explained by Each Predictor When Entered Last Into the Regression Analyses of Performance on Vocabulary Learning in the Two Conditions (N = 32)

Variable	*B*	*SE B*	β	Unique *R2*
Learning Words in the Spellings-Present Condition				
Boder	.05	.02	.56	.12*
Towre	.01	.04	-.03	.00 *ns*
Ganske	.15	.18	.23	.01 *ns*
		Total variance explained = .52.		
Learning Words in the Spellings-Absent Condition				
Boder	-.03	.02	-.43	.07*ns*
Towre	-.02	.04	-.13	.01 *ns*
Ganske	.47	.14	.99	.24**
		Total variance explained = .39		
Learning Definitions in the Spellings-Present Condition				
Boder	.01	.01	.64	.16*
Towre	-.02	.01	-.37	.00 *ns*
Ganske	.01	.06	.07	.04 *ns*
		Total variance explained = .25		

Table 20 (Continued)

Summary of Unique Variance Explained by Each Predictor When Entered Last Into the Regression Analyses of Performance on Vocabulary Learning in the Two Conditions (N = 32)

Variable	*B*	*SE B*	β	Unique *R2*
Learning Definitions in the Spellings-Absent Condition				
Boder	-.01	.01	-.24	.02 *ns*
Towre	-.01	.02	-.06	.00 *ns*
Ganske	.24	.10	.79	.15*
		Total variance explained = .33		

* $p<.05$ **$p<.01$ *ns* not significant

task accounted for a statistically significant 16% of unique variance. No other measure accounted for significant unique variance on this task.

The analysis of variables predicting performance on the word-defining task when spellings were absent showed that scores on the three tasks accounted for a statistically significant total of 33% of variance. Of this, scores on the Ganske spelling test accounted for a statistically significant 15% of unique variance. No other measure accounted for significant unique variance on this task.

Results of the regression analyses show that word reading ability was the best predictor of vocabulary word recall in the spelling present condition. This is interpreted as evidence for the mnemonic value of spellings for vocabulary learning. Students who are best able to retain visual images of printed words in memory have large sight word repertoires, and use this capability to retain spellings that symbolize sounds in the words. Results of the analyses of variables predicting performance when spellings were absent show that students who were the most successful at learning words and definitions in this condition were good spellers above and beyond their word reading ability. It is thought that good spellers spontaneously create spellings of words they hear when spellings are not seen in order to assist their memory for the words' pronunciations. Results of these analyses support this possibility by showing that the better spellers produced the words better than the poorer spellers when spellings of words were absent.

In order to examine this possibility further, spellings of target words produced by students on posttests were examined. It was thought that if good spellers do spontaneously imagine spellings of words not seen, and if these images help them to remember the words, then good spellers, who were better at generating phonetic spellings

of words not seen, would produce closer approximations to correct spellings than their less successful peers. Posttest spellings were scored for number of letters correct. To be counted, letters had to be in the correct order. For example, the spelling of "potlatch" as "potlacht" would receive a score of 7 rather than 8, because the final *t* is out of order. Superfluous letters were ignored. For example, the spelling of "koomkie" as "koomikie" received a score of 7. Scores were calculated for number of letters correct on spelling posttests for each student.

To further assess relationships between performance on the vocabulary learning tasks and children's spelling ability, Pearson product-moment correlation coefficients were calculated. Mean number of correct responses averaged across trials 2, 3, & 4 for each student in each of the two vocabulary learning tasks in the two conditions was correlated with scores on spelling posttests of words learned with and without spellings. Results, presented in Table 21, revealed significant correlations between scores on spelling posttests and word learning in both conditions and between scores on spelling posttests and definition learning in the spellings absent condition. Correlations between spelling posttests and definition learning were not significant because variance in performance on this task was limited due to ceiling effects. As can be seen, correlations between vocabulary learning performance and posttest spellings were higher when words spelled were correlated with words learned in the same condition. For example, the correlation between performance in word learning when spellings were present and posttest spellings of words seen was higher than the correlation between performance on this task and posttest spellings of words not seen ($r = .70$ vs. $r = .57$), although this

Table 21

Intercorrelations Among Word Learning and Posttest Spellings

Measure	1	2	3	4	5	6
1. PW (spelling present)	---	.57**	.64**	.45**	.70**	.57**
2. PW (spelling absent)			.05	.54	.49**	.54**
3. WD (spelling present)				.12	.31	.14
4. WD (spelling absent)					.44*	.51**
5. Posttest spellings words seen						.84**
6. Posttest spellings words not seen						---

*p< .05 (2-tailed). **p< .01 (2-tailed). No other correlations were significant.

Note. PW is the word recall task. WD is the definition recall task

difference was not significant ($t = 1.24, p > .05$). Performance on word learning and definition learning in the spellings absent condition correlated more highly with posttest spellings of words not seen than with words seen although these differences were not significant (.54 vs. .49, $t = .40, p > .05$ and .51 vs. .44, $t = .83, p > .05$).

These results indicate that word specific orthographic knowledge is strongly related to vocabulary learning. This is interpreted as providing evidence for the claim that good spellers spontaneously create spellings of words that are heard but not seen in order to facilitate memory for words' pronunciations. Those students who created plausible spellings for the words they did not see performed the best in vocabulary learning when spellings were absent.

Stepwise regression analyses with independent variables entered freely were conducted on each of the four tasks. Stepwise regressions were conducted in order to determine which spelling posttest was the better predictor of learning in each of the tasks. It was thought that if students were in fact imagining spellings of words they did not see, then posttest spellings of those words would best predict performance on learning of those same words.

The dependent variable for each of the analyses was the number of correct responses averaged across trials 2, 3, & 4. The independent variables were (1) number of letters correct in posttest spellings of words learned with spellings present and (2) number of letters correct in posttest spellings of words learned with spellings absent. One of these analyses (definition recall task in the spelling present condition) could not be computed because variance was so limited due to ceiling effects. Results of the three

Table 22

Stepwise Multiple Regression Analyses Predicting Performance on Three Vocabulary Learning Tasks with Scores on the Spelling Posttests as the Predictor Variables

Variable	*R2*	*B*	*SE B*	*β*
Word learning (spellings present)				
Spelling posttest: same words	. 47	.25	.05	.70**
Spelling posttest: other words				-.06*ns*
Word learning (spellings absent)				
Spelling posttest: same words	.29	.11	.03	.54*
Spelling posttest: other words				.13*ns*
Definition learning (spellings absent)				
Spelling posttest: same words	.26	.07	.02	.51*
Spelling posttest: other words				.05*ns*

* $p<.01$. ** $p<.001$. *ns* not significant

remaining analyses, presented in Table 22, reveal that in all three, performance learning vocabulary words was predicted only by posttest spellings of those same words, not by the other set of words, regardless of whether spellings were present or absent. These results indicate that word specific orthographic knowledge predicted vocabulary learning. Those students who created more plausible spellings for words they did not see learned to read these same words more easily than students who created less plausible spellings. This is interpreted as providing evidence for the claim that good spellers spontaneously create spellings of words that are heard but not seen in order to facilitate memory for words' pronunciations.

Chapter 7

Discussion

Mnemonic Value of Orthography in Learning Pronunciations

Results of the present study yield evidence for the mnemonic value of spellings in learning pronunciations and meanings of new vocabulary words. A greater proportion of students reached the criterion of three perfect trials in word learning when spellings were present than when they were not. Among the students who did not reach criterion words were learned faster when spelling aids were seen during study periods than when spellings were not seen. This is interpreted as providing evidence for the hypothesis that spellings help learners remember pronunciations of words by providing visual images of letters symbolizing those sounds in memory. This conclusion is similar to one made by Ehri & Wilce (1979), who found that sounds of nonsense syllables were more easily remembered when spellings were seen or imagined than when they were not seen. Similarly, second graders in the pilot study learned words and meanings faster when spellings were present during study and feedback trials than when they were not.

Seeing the spellings of words aided learners' memory for pronunciations. This is interpreted as providing support for the hypothesis that print provides learners with a visual-spatial model for speech (Ehri, 1987). The spoken word cannot be seen and has no duration; it is gone as soon as it is said. The printed word, on the other hand, supplies a concrete picture of language and allows a reader to establish and store pronunciations as clear lexical entries in memory, as indicated by present results.

Mnemonic Value of Orthography in Learning Meanings

Seeing spellings also helped students learn the meanings of words. Although most students reached criterion on the definition production task both with and without spellings, learning was faster on this task when spellings were present. These findings reveal that meanings of new vocabulary words were better secured in memory when both orthographic and phonological representations of the words were part of the amalgam being formed than when only phonological representations formed the amalgam in memory. A possible explanation for the benefit of spellings for learning meanings can be constructed as follows. When spellings accompanied pronunciations during word learning, phonological representations were established in memory earlier during learning, so more were available to amalgamate with meanings.

Students learned to say meanings before they were able to produce pronunciations of words in both conditions. However, spellings facilitated memory for sounds, making phonological representations familiar, although recall was not sufficient for production of words. Meanings were associated with phonological representations sooner in the spellings-present condition because of this increased familiarity with words' sounds. Results of this study provide evidence for this claim, which is derived from amalgamation theory (Ehri, 1980).

Differential Contribution Made by Spellings Based on Reading Ability of Students

As was expected, students with large printed word lexicons benefited more from spellings than did students with small printed word lexicons. More higher level readers reached criterion in learning words in the spellings-present condition than lower-level readers. Higher-level readers were also able to use spellings to learn words more quickly

over trials and the difference between their performance with and without spellings was greater than that for lower-level readers, indicating that spellings were more helpful for these students in learning to pronounce new words. In order to fully benefit from spellings, people must be able to recognize how spellings map pronunciations. This orthographic mnemonic capability enables them to represent, store, and retain the printed forms of words as orthographic images in lexical memory (Ehri & Wilce, 1979). All of these children had sufficient alphabetic knowledge to use spellings to help them remember the pronunciations of words as shown by faster learning in the spellings-present condition. However, children with larger printed word repertoires, and presumably with greater mnemonic orthographic capability, were able to learn the words to criterion more easily than children with smaller printed word repertoires.

Alternative Explanations for the Contribution Made by Spellings

The interpretation for the facilitative effects of seeing spellings favored by present findings is that spellings induce learners to spontaneously preserve letters as visual images that map sounds. One possible alternative explanation however is that having spellings available gave students increased opportunity to subvocally practice pronunciations. Two facts make this interpretation unlikely. First, the training card with spellings printed on it was only displayed for a matter of seconds. In the spellings absent condition, this opportunity for practice was balanced by having the child hear and repeat the word an additional time. Observations made during word learning lend additional credence to the preferred explanation. During test trials in the spellings-present condition, two students orally named letters in the spellings of words before attempting to pronounce them. Another student, having mispronounced the word, said, "Oh, I

misspelled it." on being shown the training card. A fourth student, when trying to recall the word "hicatee" said, "I know there is two e's at the end." One student, when trying to recall the word "hicatee" produced "nicatee" before shaking his head and self-correcting. Similar observations were made of second graders learning single syllable CVC words in the pilot study. Two students orally named letters in the spellings of words before pronouncing them, and a third student was observed covering her eyes and trying to pronounce the word, effectively trying to "see" the image of the word's spelling. It appears that students formed visual images of words' spellings, and attempted to use these images to "read" words from memory.

A second possible alternative explanation is that children decoded the words, thereby attending to spellings out of necessity. If children had decoded words, deliberate attention to how spellings map sounds may have served as extra practice in learning pronunciations. However, not one child was seen attempting to decode the printed words. There was no need to do so as the word had just been pronounced by the experimenter when it was seen. More likely, orthographic images were formed spontaneously. Children were not told how to benefit from seeing spellings, nor was their attention drawn to this learning aid. For students with sufficient graphophonemic knowledge, connections between letters in spellings and sounds in pronunciations were activated automatically and spontaneously. This secured amalgams of orthographic and phonological representations in memory, and learners were able to access these amalgams to retrieve and produce pronunciations of the words

A third possible explanation for the facilitative effects of spelling aids considered is that seeing spellings enabled students to clarify the separate sounds within the words.

Two facts make this interpretation unlikely. First of all, the words taught were comprised of familiar syllables and blends, and all participants pronounced them correctly and easily during learning trials. Second, examination of errors showed that although learning to say words accurately was easier when spellings were present, students were able to produce many of the sounds correctly given ample practice even when spellings were absent. Apparently, spellings served to improve memory for the sounds in words, thereby speeding up the learning process.

Recalling Versus Defining Words

Remembering how to pronounce the vocabulary words was more difficult than remembering their definitions. This is not surprising considering the different requirements for success in these two tasks. There were ten meanings which were concrete and familiar or were conceptually close to words that were familiar (see Table 11 for ratings of conceptual difficulty of words), and which constituted a finite set. When students were asked to produce meanings of words after being exposed to a finite set, they only needed to choose from among the 10 possibilities, in essence the equivalent of a ten-item multiple-choice test. Multiple-choice tests have been shown by many researchers to tap low levels of vocabulary knowledge, and are easier for students than many other kinds of vocabulary measures (i.e. Kameenui et al., 1987). Learning to pronounce words, on the other hand, requires the learner to acquire and produce brand new combinations of sounds when the meaning is given, making erroneous responses much more likely. Producing new words for known concepts has been shown by other researchers to be more difficult than the reverse (i.e. Senechal, 1997).

The Effect of Word Variables

Previous studies have found variables in to-be-learned words to affect the learnability of words. Gathercole & Baddeley (1989) found that nonwords longer than two syllables were harder for young children to repeat than were one or two syllable words, and that difficulty increased with word length. Word length was found to have an effect on learning in this study as well: three syllable words were harder to learn than were two syllable words. However, the effect of word length did not undermine the main effect of condition. The facilitative effect of seeing spellings on learning to pronounce words was strong for both two and three syllable words. It should be noted that participants in the present study were fifth graders and hence were much older than Gathercole & Baddeley's four and five year olds. Also, only two and three syllable words were used in the present study, so it is not clear that the benefit of seeing spellings would hold for longer words.

Shu et al (1995) and Nagy et al (1987) found conceptual difficulty of words to affect the likelihood that the words would be learned from written context. Level of conceptual difficulty did not affect how easily words or definitions were learned in the present study. Easy and hard words, and their definitions, were learned equally well. However, comparing these studies may not be justified because of differences in their methods. Shu et al and Nagy et al examined incidental word learning during reading, whereas the method of vocabulary instruction used in the present study involved directly teaching specific words and their meanings. In Nagy et al and Shu et al, no attention was directed to the target words whereas the present study included pictures and meaning-clarifying sentences to increase understanding of word meanings. The method of

meaning elaboration utilized in this study, that is, providing multiple contexts and building on multiple sources of information, has been shown to be effective in teaching definitions in other studies (i.e. Gipe, 1979-80) and is a recommended method of teaching vocabulary (Blachowicz & Fisher, 2000).

Errors Made During Learning

Examination of errors made during the learning trials provided further evidence for the strong effect of spellings on students' memories for words. All target word substitutions made on test trials when words were learned with spellings were intra-list errors. In contrast, substitutions made when spellings were absent included inter-list substitutions with erroneous words drawn from the list trained with spellings on the previous day. The opposite pattern did not occur.

Spellings improved participants' memory for sounds in the words better than extra practice hearing and saying the words. This was shown by the greater proportion of errors containing correct sounds when words were learned with spellings than without the spellings. This was true even though earlier trials (2 and 3) in the spellings present condition were compared with later trials (4 and 5) in the spellings absent condition. By trial 2 in the spellings present condition, students were remembering a greater proportion of the sounds in words that they misrecalled than they did by trial 4 in the spellings absent condition. This too shows that seeing spellings helped students store and remember sounds.

Vocabulary Retention

Spellings helped children remember pronunciations and meanings of words both during training, and on delayed posttests. Students were better able to recall words after

a delay of one day when they had learned those words with the spellings present than without spellings. They were better able to remember words learned with spellings not only on a posttest that followed the format of the test trials but also on a transfer task. This indicates generalized knowledge of the words and their meanings. Spelling production was also better when spellings were seen during training. These findings provide further evidence for the claim that spellings aid readers in representing, storing, and retaining the printed forms of words as orthographic images in lexical memory.

The nature of the task of learning new words is one of remembering, at least when words for familiar concepts are being learned (Blachowicz & Fischer, 2000). Clearly, seeing spellings aided students' memory for definitions during the learning trials. However, on delayed posttests, no advantage for spellings was detected. In this task, students were asked to produce definitions for words in the same manner they had done during learning trials. Most students reached or came close to ceiling, which was not surprising, considering several factors. As suggested above, this task resembled a multiple-choice test in what it required of students. Students were asked to choose which, of ten familiar or conceptually close concrete nouns, a given word referred to. As Kameenui et al. (1987) pointed out, different types of learning are assessed by different performance tasks, and multiple choice/matching tasks tap low levels of word knowledge. Also, the format of this test had been practiced a minimum of five times on the previous day, and so most students had already achieved mastery in both conditions.

Variables Predicting Performance

Interestingly, the capabilities of students that predicted how easily they learned new vocabulary words during the learning trials differed depending on whether or not

they saw spellings when they learned the words. In the regression analyses of word learning with spellings, the size of students' lexicons of sight words was the only variable that explained significant variance in learning words and learning their definitions (see Table 21). However, in the regression analyses of word learning without spellings, students' spelling ability as measured by the Ganske (2000) spelling test was the only variable that explained significant variance in learning these words' pronunciations and learning their meanings. The latter finding was not expected. However, in previous studies, namely that by Ehri and Wilce (1979) and the pilot study, the relevance of spelling ability was not examined.

One explanation for the contribution of spelling ability in learning words whose spellings had not been seen is that good spellers spontaneously imagined plausible spellings of these words. This enhanced their memory for the words' pronunciations and it made phonological representations of the words more available in memory for bonding to meanings. Some evidence supporting this hypothesis was uncovered in results of regression analyses. The dependent variables were word learning over trials and definition learning over trials in the condition where spellings were not seen. Two predictor variables were examined, students' success in generating plausible spellings of those same words whose spellings had not been seen, and success in recalling spellings of the other set of words whose spellings had been seen. Predictors were drawn from spellings posttests administered the next day. Results showed that the only predictor explaining significant variance was that involving spellings of the same words that were learned. The fact that the better word learners were those students who generated more plausible spellings of words learned without visible spellings is consistent with the idea

that they may have imagined these spellings during the learning trials and this improved their learning of the words.

Vocabulary knowledge as measured by the PPVT was not predictive of performance in any of the vocabulary learning tasks. This is in contrast with other studies, which found vocabulary knowledge to be an important predictor of incidental vocabulary learning from context (i.e. Penno et al., 2002; Robbins & Ehri, 1994; Senechal et al., 1995). This may have occurred because vocabulary learning in the present study involved direct instruction rather than incidental learning. When students are assisted in learning new vocabulary words, their existing vocabulary levels may make less of a difference than when they are left on their own to learn new words through exposure. In the present study, vocabulary words were taught using multiple contexts and pictures as instructional aids because theses methods had been found effective by other researchers. Gipe (1979-80) found the method of instruction of word meanings used here to be the most effective of several examined, and Blachowicz and Fischer (2000) recommended the use of multiple sources in vocabulary instruction. Blachowicz and Fisher stressed the importance of direct instruction in word meanings for struggling readers.

Explanation for a Matthew Effect?

Literature abounds chronicling discrepancies in vocabulary levels distinguishing good and poor readers as they move through school (i.e. Biemiller, 2001; Chall et al., 1990; Hart & Risley, 1995; Juel, 1988; Snow et al., 1998; Stanovich, 1985). The term "Matthew effects" (Stanovich, 1985) has been used to indicate progressive widening of differences in reading achievement between good and poor readers, although direct

evidence for the fan spread effects predicted by the model has been weak (Scarborough & Parker, 2003; Shaywitz et al., 1995). Despite this, researchers still use the model to explain differences between high and low achieving students on learning tasks (i.e. Penno et al., 2002). Divergence in vocabulary levels between upper and lower quartile students has been attributed to differences in vocabulary sizes on entry into school (Biemiller, 2001).

In the present study, higher-level readers showed a much steeper slope in learning the pronunciations of new vocabulary words when spellings of the words contributed to learning than lower level readers. As shown in Figure 3, the gap between higher and lower ability readers became increasingly wide from Trials 1 through 3. After that ceiling effects suppressed the performance of higher-level readers. This faster rate of vocabulary learning for higher-level readers might lead one to conclude that present findings have yielded some evidence for Matthew effects. However, scores on the PPVT-III (Dunn & Dunn, 1997) raise doubt about this possibility. There was no difference in standard scores on the receptive vocabulary test between higher- and lower-level readers. If vocabulary Matthew effects were present, it would be expected that the higher-level readers would have stronger vocabularies than the lower-level readers.

Implications for Instruction

These findings carry important implications for the teaching of vocabulary in schools. A direct implication for instruction of vocabulary indicated by these results is that access to the printed forms of words should always accompany the learning of pronunciations and meanings of the words. As has been shown, seeing spellings helped students remember how to say and define words. Therefore, even when to-be-learned

words are introduced primarily in oral contexts, spellings of words should be shown while words and meanings are pronounced.

The recommendation of ensuring that vocabulary learners get a clear image of the word form was included as one of five essential steps for vocabulary learning by Hatch and Brown (1995). The value of learning word spellings, according to these authors, is evident when students make mistakes in defining or using words because they confuse words similar in form. Although they made a good case for suggesting that students get a clear image of the word, the benefit of doing so had not been tested experimentally prior to the present study. Findings of this study provide evidence that supplying the printed form of the word during vocabulary instruction facilitates learning.

A secondary implication for instruction carried by these findings relates to the importance of ensuring that students are highly proficient word readers. The best word-readers in this study benefited the most from seeing spellings, by learning words to criterion when spellings accompanied pictures during training. In addition, helping students become good spellers could aid them in retaining new vocabulary, even when spellings are not seen, because good spelling skills will allow them to generate spellings of new words to assist their memory for words, as results indicate.

The impact of increased graphophonemic knowledge on the enhancement of orthographic mnemonic capability is the interpretation favored by present findings. However, this implication is based on correlational evidence, and is therefore tentative. Findings indicate the importance of the ability to form and retain orthographic images in memory. However, it is not known how this ability is acquired or how it might be taught. It is clear that the students with the largest printed word lexicons were the strongest in

this capability, but it is not clear whether the strength of their orthographic memory allowed them to build up their printed word lexicons, whether experience with print enhanced their memory for orthography, or whether a third factor underlies performance in both of these aspects. An experiment is needed to determine the direction of causality in this relationship.

Results shed some light on the relative ease of learning meanings versus learning pronunciations of new words. It took students in significantly longer to learn pronunciations than definitions of the words. Typically, students do not practice words more than a few times. Results of this study underscore the need for more practice than students typically engage in, especially for learning the pronunciations of new words.

Strengths and Limitations of the Present Study

The results of this study are interpreted as providing evidence for the mnemonic value of spellings in remembering the pronunciations and meanings of vocabulary items, a benefit not generally included in methods of teaching vocabulary. Vocabulary instruction generally focuses on semantic processing strategies, which, while strengthening understanding of definitions, does not seem to foster growth of the link between words and their meanings (Pressley et al, 1982). Studies on the use of mnemonics in vocabulary learning primarily focus on the use of keywords, a method that has been shown to enhance vocabulary-definition associations, as measured by matching tasks. However, this method has not been shown to enhance the ability to recall and produce pronunciations or meanings of vocabulary words. The results of the present study hold promise that the use of spellings can enhance memory of pronunciations as well as definitions, thereby improving production of newly learned items. Vocabulary

production, according to Baumann and Kamenuii (1991), requires a deeper understanding of a word than does receptive vocabulary, where meanings can be guessed.

One strength of the present study was its use of a counterbalanced design. Each student received vocabulary instruction in both conditions. Every student performed better at learning words and definitions when spellings were present than when they were not, regardless of list on which they saw the spellings, or order in which the conditions were received. This finding supports the hypothesis that seeing spellings facilitates vocabulary learning by fifth grade students.

The present study has provided evidence for the mnemonic value of spellings in learning pronunciations and meanings of new words. However, there were several possible weaknesses of this study. First, the words taught were all concrete nouns, which are thought to be easier to learn than other parts of speech (Elley, 1989). Future research should examine whether spellings are helpful for remembering other types of words, such as verbs and adjectives. All the words followed regular spelling patterns. Future research should examine whether spellings are helpful for remembering less regularly spelled words.

A second weakness of this study is that the population of participants was quite narrow, possibly limiting generalization of findings to other populations. Only fifth graders were tested in the present study. Participants were almost entirely African American, and were drawn from a school in a low SES urban area. In the pilot for the present study, second graders from the same school participated, and findings were similar, which adds some generalizability. However, a broader population of participants needs to be included to strengthen interpretations.

A third weakness involves posttest materials that were used. The picture identification task was designed to assess student ability to apply knowledge of the words to new instances, by having them identify target-word pictures not seen before. However, the foils were all pictures of other target words, and the same pictures were repeated as targets and foils across test pages, making this task very easy. All student performed perfectly on this task, except for one student, who missed only one of 20 words. In future studies, posttest tasks will need to be made more difficult in order to better measure individual differences in vocabulary learning.

Directions for Future Research

Several possible directions for future research are suggested by results of this study. One question that future research could address is direction of causality in the acquisition of an orthographic mnemonic capability, and factors that contribute to it. For example, regarding individual differences in cognitive and linguistic skills, are some people predisposed to store and recall orthographic images with ease, thereby adding sight words to their lexicons with greater facility than others? Or is orthographic memory a capability that can be enhanced through instruction? A future study could examine the possibility that forming orthographic images to aid in memory for pronunciations could be taught. Using a design similar to the present study, students would be taught two lists of words in two conditions: spellings present with no attention drawn to them versus spellings present with instructions to attend to how the spellings map speech. If students who were instructed to deliberately attend to spellings learned pronunciations faster than students who saw spellings but were not instructed, this would point to the possibility that orthographic memory can be enhanced through training.

Other questions to be answered by future research are whether directing students to construct mentally inventing plausible spellings for words that are heard but not seen can aid their memory for the words, and whether inventing spellings in this way happens spontaneously. In order to answer the second question, students could be interviewed about their strategy use during oral vocabulary instruction. In order to answer the second question, a design similar to the present study could be used in which students would be taught three lists of words in three conditions: spellings present, spellings absent with no instruction, and spellings absent with instructions to imagine plausible spellings for the words. Students would be tested on their reading and spelling ability.

It is thought that, as in the present study, the list learned with spellings present will be learned fastest by all students. Students with large printed word lexicons will benefit more from seeing spellings than students with small printed word lexicons. In the two spellings-absent conditions, an interaction between spelling ability and condition of learning (instruction to imagine plausible spellings vs. no instruction) will become apparent. Good spellers will learn words faster than poor spellers in both conditions where spellings are absent, due to their greater facility with thinking about how sounds are represented by graphemes. However, poor spellers will benefit more from explicit instructions on thinking about spellings than will good spellers. Good spellers are thought to spontaneously create plausible spellings of new words, thereby facilitating learning of those words. Poor spellers probably do not spontaneously think about spellings when learning new words. Hence, the difference in rates of learning between the two conditions will be smaller for good spellers than for poor spellers.

Appendix A

To Parents of Students at _____ Academy:

My name is Julie Rosenthal and I am a student in the Ph.D. program in Educational Psychology at the Graduate Center of the City University of New York City (CUNY). I am Principal Investigator of a research project called "Does Seeing Spellings Help Beginning Readers Learn New Words?". I will be doing this research in your child's school. I have been trained to tutor children in reading.

I invite your child to participate in this research project. The reason for this project is to study how we can improve ways to help growth in students' vocabulary, which has been shown to be an important part of learning to read. I will work with students individually. I will work with each child three times, during the school day. Each session will last about 40 minutes. All of the sessions will be tape-recorded. First, children will be taught a group of new words, and will practice these words until they understand and can pronounce them. Next, I will give students some vocabulary and reading and writing activities to see how far they have come in building reading skills, and to test if they have learned the words I taught them. There are no known risks for children participating in the study. In fact, instruction should help children by improving their reading skills. There will be about 50 students who will participate in this study.

In order for your child to participate, I must first get your written permission. If you agree to this, please sign this permission form below and return it to your child's teacher as soon as possible. You may keep the second copy for your files.

Participation in this study is voluntary. Parents and the children are free to withdraw from the study at any time without consequence. Information about your child's strengths and weaknesses in reading skills will be shared with your child's teacher, provided you have no objection. The information will be kept in a locked file cabinet in my advisor's office at CUNY. Only I, and my advisor, will have access to the data. The identities of all participants in the study will remain confidential and no names will be used in written reports.

Results of the study should further our understanding about how to better help student's vocabulary growth. If you would like a copy of the study results when it is completed, please provide me with your address and I will send you a copy in the future. Please use the attached index card for this purpose.

If you have any questions about the project, please feel free to contact me (Julie Rosenthal) at 973-662-0294 or e-mail Julie_Rosenthal2003@yahoo.com, or my advisor (Professor Linnea Ehri) at 212-817-8294, email lehri@gc.cuny.edu. If you have any questions concerning your child's rights as a participant in this project, you may call

Hilry Fisher, Office of Sponsored Research, CUNY Graduate Center, 212-817-7523, hfisher@gc.cuny.edu.

Thank you for considering this request. If you agree to have your child participate, please sign below:

I grant permission for my child _____to participate in the study.

I agree to have the sessions tape-recorded.

(Please check one) YES_____ NO_____

_____ _____
(Signature of parent/guardian) (Date)

_____ _____
(Signature of principal investigator) (Date)

You may share information about my child's strengths and weaknesses in reading skills with my child's teacher.

(Please check one) YES_____ NO_____

Appendix B

Script for containing oral consent from children

My name is Julie Rosenthal. I am a researcher, or student, working for the City University of New York, a school for adults. I am doing a project about how children learn new words. I am ready to begin working with you, but first I need to tell you what we will be doing, and you need to tell me that you want to work with me.

The reason for my project is to find ways of helping students learn new words. Today, I will teach you some new words. Next time we meet, I will teach you some more new words. Then, we will meet a third time, and you will show me if you've learned the words. I will also ask you to do some reading and writing.

It is up to you whether or not you want to work with me. You can stop working with me any time you decide, and that will be okay.
Would you like to work with me?

Oral consent granted by student? Yes No

If child denies consent, express thanks and dismiss child from study.

Appendix C

Target Words, Core Definitions, and Meaning Clarifying Sentences

Word	Core definition and meaning clarifying sentences
List A	
Dobson	A dobson is a bug that is a kind of beetle. A dobson lives in plants and will eat the plant it lives on. A dobson has big, strong jaws, and can bite through a lot of leaves. A dobson beetle is usually very colorful. Dobson beetle babies start out as larvae, like worms, and then grow into beetle-bugs.
Gangrel	A gangrel is a homeless person. Life is very hard for a gangrel, especially during the winter. Sometimes, a gangrel will have to beg or look in the garbage just to get food. Not every gangrel can find a place to live. Sometimes, a gangrel does not get to take a bath or sleep in a real bed, for many many days.
Potlatch	A potlatch is a Native American festival where the chief gives out gifts. Native Americans would have a potlatch to celebrate important events. A tribe might have a potlatch to celebrate a birth or a wedding. The chief gives gifts to a visiting tribe. Many times, the visiting tribe would give gifts as well.

Target Words, Core Definitions, and Meaning Clarifying Sentences (Continued)

Word	Core definition and meaning clarifying sentences
List A	
Koomkie	A koomkie is a female elephant that attracts male elephants.
	To a male elephant, a koomkie is the most beautiful creature alive!
	When hunters are out trying to catch a male elephant, they use a koomkie to get the male to come over.
	A koomkie helps the hunters get the ivory tusks from the male elephant.
	A koomkie could win a beauty contest for elephants.
Barrow	A barrow is a small hill.
	You could walk up to the top of a barrow quite easily.
	A barrow would be good for sledding in the winter if there were snow.
	A barrow is what Jack and Jill went up to fetch a pail of water.
	A barrow would be fun to bicycle or roller skate down.
Juggernaut	A juggernaut is a large truck.
	A juggernaut is much bigger than a car.
	You can see a juggernaut if you go driving on a road.
	A juggernaut can carry all sorts of different things, like food, cement, toys, or wood.
	Someone has to drive a juggernaut.

Target Words, Core Definitions, and Meaning Clarifying Sentences (Continued)

Word	Core definition and meaning clarifying sentences
List A	
Muleta	A muleta is a red cape.
	For some Halloween costumes, you might wear a muleta – like a vampire, or a devil.
	If you know anything about bull fighting, you may have seen how they use a muleta to make the bull angry.
	Superman wears a muleta – it helps him to fly.
	Little red riding hood wore a muleta – that's how she got her name.
Tamarack	A tamarack is a big tree found all over America.
	A tamarack has leaves that turn red in the fall and then fall off.
	A tamarack is very big and would give you shade on a sunny day.
	You could climb a tamarack.
	A bird could build its nest in a tamarack.
Vibrissa	Vibrissa are the whiskers on a cat.
	A cat uses her vibrissa as feelers to let her know how large a space is.
	A cat uses her vibrissa to help her hunt at night.
	All cats have vibrissa on their faces.
	A cat's vibrissa can let you know her mood: forward when the cat is happy, pulled back when the cat is mad.

Target Words, Core Definitions, and Meaning Clarifying Sentences (Continued)

Word	Core definition and meaning clarifying sentences
List A	
Frenulum	A frenulum is a tongue You use your frenulum to lick an ice cream cone. Don't stick your frenulum out at people – that would be rude! Have you ever seen anyone with their frenulum pierced?? That must hurt. You could burn your frenulum if you eat food that is too hot.
List B	
Tandem	A tandem is a horse-drawn carriage Sometimes two horses pull a tandem. 100 years ago, many people got around using a tandem. Before there were cars, people walked or used a tandem to get to school or work. If you drive a tandem, you stop to let the horses eat instead of stopping for gas!
Wimple	A wimple is what nuns wear on their heads. Sometimes, other religious women wear a headdress that looks like a wimple. Nuns wear a wimple to show respect for god. Nuns wear a wimple because it shows they are devoted to god. Sometimes, a nun wears a wimple so her hair does not show.

Target Words, Core Definitions, and Meaning Clarifying Sentences (Continued)

Word	Core definition and meaning clarifying sentences
List B	
Chigger	A chigger is a kind of bug that eats the blood of animals and people.
	If a chigger bites you, it will be very itchy.
	A chigger is very small – you might not even see it.
	If you go walking in the country, check yourself after for a chigger.
	A chigger might bite your dog or cat as well.
Fribble	A fribble is a foolish, shallow person.
	A fribble might care more about looks than what is inside of a person.
	A fribble might be your friend only for what you can give them.
	A fribble might lie or cheat for his or her own benefit.
	A fribble probably does not have many interesting things to say.
Mullock	A mullock is a pile of trash.
	A mullock is where your garbage goes when the sanitation workers pick it up.
	A mullock probably smells pretty bad.
	You can picture a mullock, with old sneakers, fish heads, and empty cans on top.
	Recycle and reuse so we have one less mullock in this world

Target Words, Core Definitions, and Meaning Clarifying Sentences (Continued)

Word	Core definition and meaning clarifying sentences
List B	
Kerfuffle	A kerfuffle is a fuss or fight. If you are angry at someone, you should try to talk it out before getting into a kerfuffle. When people have a kerfuffle, someone usually gets hurt. A kerfuffle sometimes starts when one of the people feels insulted or mistreated. By no means should you have a kerfuffle at school – you could get suspended!
Laburnum	A laburnum is a small tree with bright yellow flowers. A laburnum is not a tall tree – it is almost as small as a bush. A laburnum grows big yellow flowers in the springtime. You might want to plant a laburnum in your garden, because of the flowers. A laburnum looks really pretty and grows well.
Proboscis	A proboscis is a really big nose. A proboscis could take up almost a person's whole face. A person or animal with a proboscis could probably smell from very far away. An elephant has a proboscis – think of his trunk! If a person with a proboscis gets a cold, she'll use a lot of tissues.

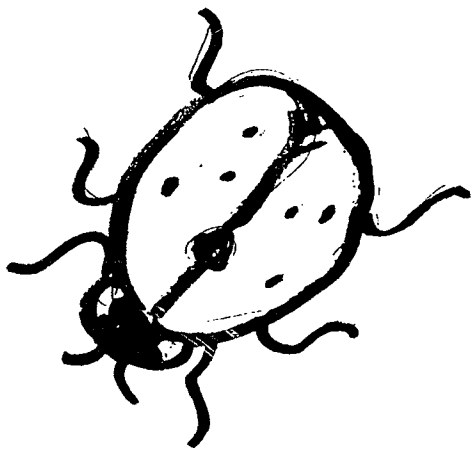
Target Words, Core Definitions, and Meaning Clarifying Sentences (Continued)

Word	Core definition and meaning clarifying sentences
List B	
Scrivello	Scrivello are the tusks on an elephant. An elephant uses his scrivello to push through plants he wants to eat. Sometimes an elephant might use his scrivello to fight with. The sad thing is that people kill elephants to get their scrivello – ivory is worth a lot of money to some people. An elephant's scrivello gets bigger as the elephant gets older.
Hicatee	A hicatee is a kind of turtle that lives in the water. A hicatee might live in a river or a lake. A hicatee has a hard shell that it can hide inside of. A hicatee is usually brown and green. Some people eat hicateee – they make it into a kind of soup.

Appendix D

Pictures Used in the Word Recall Task

List A



dobson

gangrel

Pictures Used in the Word Recall Task (Continued)

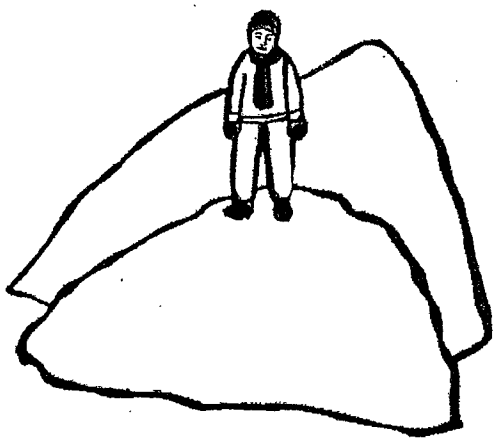
List A

potlatch

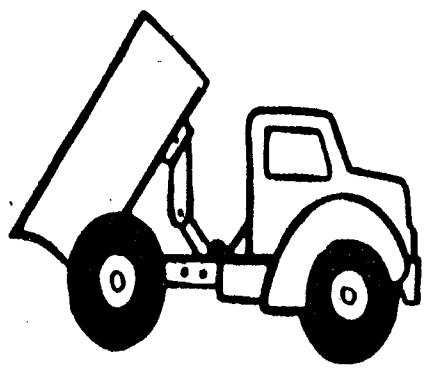
koomkie

Pictures Used in the Word Recall Task (Continued)

List A



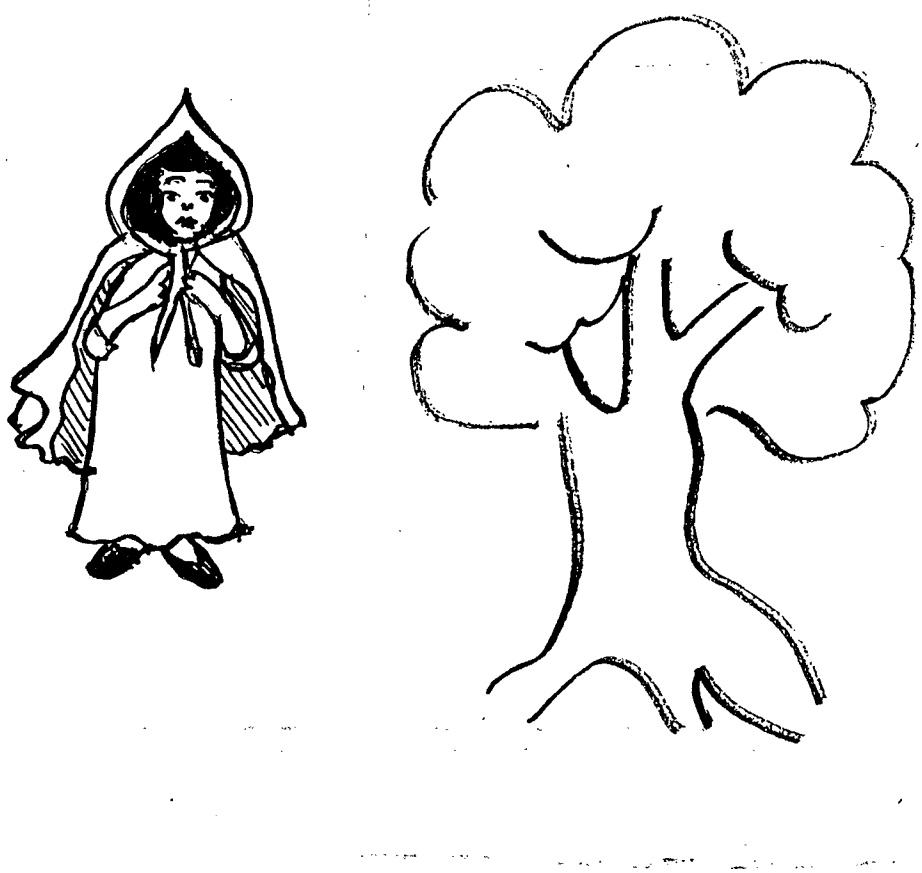
barrow



juggernaut

Pictures Used in the Word Recall Task (Continued)

List A



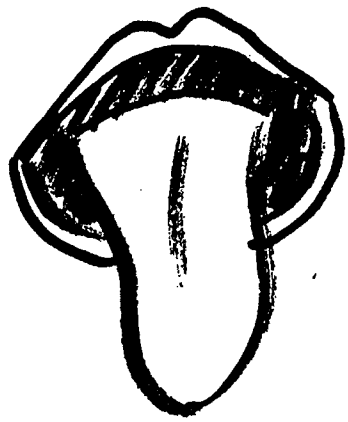
muleta

tamarack

Pictures Used in the Word Recall Task (Continued)

List A

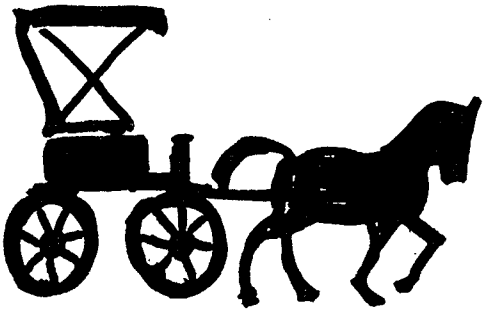
vibrissa



frenulum

Pictures Used in the Word Recall Task (Continued)

List B

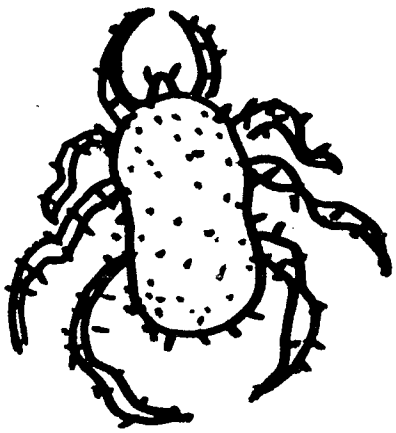


tandem

wimple

Pictures Used in the Word Recall Task (Continued)

List B

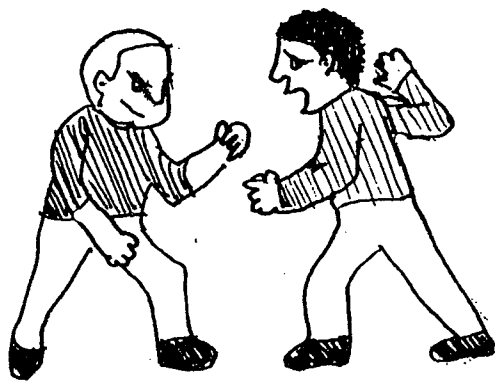


chigger

fribble

Pictures Used in the Word Recall Task (Continued)

List B



mullock

kerfuffle

Pictures Used in the Word Recall Task (Continued)

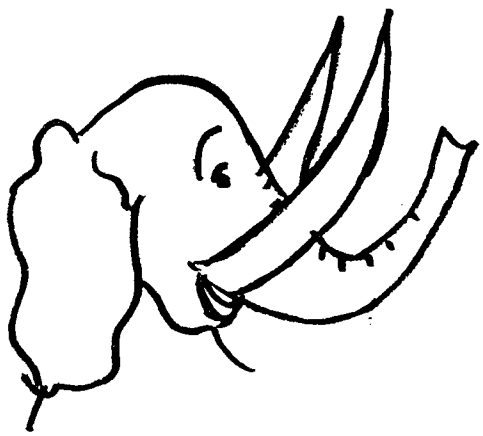
List B

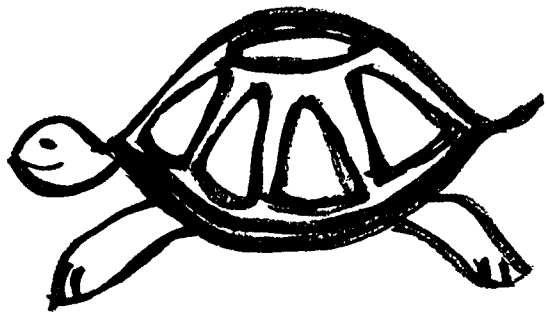
laburnum

proboscis

Pictures Used in the Word Recall Task (Continued)

List B





scrivello

hicatee

Appendix E

Script for Initial Training Trial

Practice trial/introduce word recall task :

"You will learn some new words. First, I will show you some pictures, and tell you the name and meaning of each picture. You will repeat the name and meaning for each picture. You need to remember the name and meaning of each picture, so you can tell me what they are later. Next, you will get just the word, and the meaning. You will repeat the word and meaning. You need to remember the meaning of each word so you can tell me later. We will practice so you get the idea. You already know these words, but I just want to show you HOW I will be teaching you the new words. Okay?"

(Display a picture of a fish.) "This is a fish. You say it." *(Ch: Fish.)*

"Good. A fish is an animal that lives in water. You say it." *(Ch repeats, feedback if necessary.)* "Fish." *(Point to child and indicate repeat. "You say it" if necessary.)*

(Display picture of a dog with spelling printed) "This is a dog. You say it." *(Ch: Dog.)*

"Good. A dog is an animal that barks and wags its tail. You say it." *(Ch repeats, feedback if necessary.)*

"Good. Now lets see if you can remember those words and meanings."

(Display test picture of fish. Give child 5 seconds to produce word and meaning. Prompt if necessary.) (Display training card.) (if correct: Yes) "This is a fish, an animal that lives in water." *(If response was incorrect:* You say it. *Ch responds.* Fish. *Ch repeats.)*

"Good."

*Script for Initial Training Trial_* (Continued)

(Display test picture of dog. Give child 5 seconds to produce word and meaning. Prompt if necessary.) (Display training card.) (*if correct:* Yes) "This is a dog, an animal that barks and wags its tail." *(If response was incorrect:* You say it. *Ch responds.*

Practice trial/introduce task WM:

"Next I will give you the word, and I want you to tell me the meaning of the word. Lets see if you can remember the meaning of those words."

"Fish, fish." *(Child responds.)* (*if correct*: Yes), "a fish is an animal that lives in the water."

(Display printed word "dog" for one second. Say word simultaneously.) "Dog." *(Child responds.)* (*if correct*: Yes), "a dog is an animal that barks and wags its tail.

Now we will learn some new words. Do you understand what I want you to do? Good."

Appendix F

Sample Test-Feedback Script for Word Recall and Definition Recall Tasks

(All text in regular print represents what the experimenter says.)

PICTURE –WORD Trial 2 & Trial 7

Let's see if you can remember those words.

Display stimulus picture for child for each word. Allow 5 seconds for child to respond. If no response is given, ask "What is the name of this?" **.)**

1. **Child responds. Display training card.** (*If response was correct:* Yes), this is a gangrel. A gangrel is a homeless person. (*if response was incorrect:* You say it. **Child repeats word and defining sentence.**) Life is very hard for a gangrel, especially during the winter. *(Spellings absent:* Gangrel. You say it. **Child repeats word.)**
2. **Child responds. Display training card.** (*if correct:* Yes), this is a koomkie. A koomkie is a female elephant that attracts male elephants. (*if incorrect:* You say it. **Child repeats word and defining sentence.**) To a male elephant, a koomkie is the most beautiful creature alive! *(Spellings absent:* Koomkie. You say it. **Child repeats word.)**
3. **Child responds. Display training card.** (*if correct:* Yes) this is a juggernaut. A juggernaut is a large truck. (*if incorrect:* You say it. **Child repeats word and defining sentence.**) A juggernaut is much bigger than a car. *(Spellings absent*: Juggernaut. You say it. **Child repeats word.***)*
4. **Child responds. Display training card.** (*if correct:* Yes), this is a tamarack. A tamarack is a big tree found all over America. (*if incorrect:* You say it.) A

Sample Test-Feedback Script for Word Recall and Definition Recall Tasks (Continued)

tamarack has leaves that turn red in the fall and then fall off. *(Spellings absent:* Tamarack. You say it. **Child repeats word.**)

5. **Display training card.** (*if correct:* Yes) this is a frenulum. A frenulum is a tongue. (*if incorrect:* You say it. **Child repeats word and defining sentence.**) You use your frenulum to lick an ice cream cone. *(Spellings absent:* Frenulum. You say it. **Child repeats word.**)
6. **Display training card.** (*if correct:* Yes) this is a Dobson. A Dobson is a bug that is a kind of beetle. (*if incorrect:* You say it. **Child repeats word and defining sentence.**) A Dobson lives in plants and will eat the plant it lives on. *(Spellings absent:* Dobson. You say it. **Child repeats word.**)
7. **Display training card.** (*if correct:* Yes) this is a potlatch. A potlatch is a big party, or festival, where people give each other gifts. (*if incorrect:* You say it. **Child repeats word and defining sentence.**) You might have a potlatch for your birthday. *(Spellings absent:* Potlatch. You say it. **Child repeats word.**)
8. **Display training card.** (*if correct:* Yes), this is a barrow. A barrow is a small hill. (*if incorrect:* You say it. **Child repeats word and defining sentence.**) You could walk up to the top of a barrow quite easily. *(Spellings absent:* Barrow. You say it. **Child repeats word.**)
9. **Display training card.** (*if correct:* Yes), this is a muleta. A muleta is a red cape. (*if incorrect:* You say it. **Child repeats word and defining sentence.**) For some Halloween costumes, you might wear a muleta – like a vampire, or a devil. *(Spellings absent:* Muleta. You say it. **Child repeats word.**)

Sample test-feedback script for word recall and definition recall tasks (Continued)

10. **Display training card.** (*if correct:* Yes), these are vibrissa. Vibrissa are the whiskers on a cat. (*if incorrect:* You say it. **Child repeats word and defining sentence.**) A cat uses her vibrissa as feelers to let her know how large a space is. *(Spellings absent:* Vibrissa. You say it. **Child repeats word.**)

Good job remembering those words. Now lets see if you can remember the meanings when I give you the words.

WORD-DEFINITION Trial 2 & 7 Say word. Give child 5 seconds to give definition. If no answer is given, give definition.

1. (*spellings present:* **Display printed word for 1 second. Simultaneously say:** Gangrel.) (*Spellings absent:* Gangrel, gangrel.) (*If correct:*Yes,) A gangrel is a homeless person.
2. (*spellings present:* **Display printed word for 1 second. Simultaneously say:** Koomkie.) (*Spellings absent:* Koomkie, koomkie.) (*If correct:* Yes,) A koomkie is a female elephant that attracts male elephants.
3. (*spellings present:* **Display printed word for 1 second. Simultaneously say:** Juggernaut.) (*Spellings absent:* Juggernaut, juggernaut.) (*If correct:* Yes) A juggernaut is a large truck.
4. (*spellings present:* **Display printed word for 1 second. Simultaneously say:** Tamarack.) (*Spellings absent*: Tamarack, tamarack.) (*if correct:* Yes), A tamarack is a big tree found all over America.

Sample test-feedback script for word recall and definition recall tasks (Continued)

5. (*spellings present:* **Display printed word for 1 second. Simultaneously say:** Frenulum.) (*Spellings absent:* Frenulum, frenulum.) (*If correct,* Yes,) A frenulum is a tongue.
6. (*spellings present:* **Display printed word for 1 second. Simultaneously say:** Dobson.) (*Spellings absent:* Dobson, Dobson.) (*if correct:* Yes,) A Dobson is a bug that is a kind of beetle.
7. (*spellings present:* **Display printed word for 1 second. Simultaneously say:** Potlatch.) (*Spellings absent:* Potlatch, potlatch.) (*If correct:* Yes,) A potlatch is a big party, where people give each other gifts.
8. (*spellings present:* **Display printed word for 1 second. Simultaneously say:** Barrow.) (*Spellings absent*: Barrow, barrow.) (*If correct,* Yes,) A barrow is a small hill.
9. (*spellings present:* **Display printed word for 1 second. Simultaneously say:** Muleta.) (*Spellings absent*: Muleta, muleta.) (*If correct:* Yes,) A muleta is a red cape.
10. (*spellings present:* **Display printed word for 1 second. Simultaneously say:** Vibrissa.) (*Spellings absent:* Vibrissa, vibrissa.) (*If correct,* Yes,) Vibrissa are the whiskers on a cat.

Appendix G

Oral Cloze Posttest

List A

1. I do not like bugs in my back yard; a _____ for example might eat my whole garden.
2. When I see a _____ on the street, I feel bad for him, especially when it is winter.
3. It must be fun to go to a _____ and have the Indian chief give you presents.
4. What is so pretty about a _____ to make all of the boy elephants like her?
5. If I climb to the top of a _____ I could roll down it.
6. A _____ is huge and makes too much noise when it is driving on the road.
7. Little red riding hood wore a _____.
8. I love to sit under the shade of a _____ when it is hot out.
9. What would happen to a cat if you cut off her _____?
10. If you eat very hot food, you might burn your _____.

Oral Cloze Posttest

List B

1. Before there were cars, you could ride around in a _____ - if you had a horse to pull it.
2. I wonder if a nun gets hot wearing a _____ on her head.
3. I don't know which is worse, being bitten by a _____ or by a mosquito.
4. That girl is so full of herself, she is nothing but a _____.
5. America makes so much garbage, you would not believe how big a _____ could be.
6. When I get really mad at someone, I might want to have a _____ with them.
7. I love the springtime, when flowers begin to bloom on a _____.
8. He has big ears, big eyes, big lips, and a _____.
9. I wonder if an elephant's _____ are very heavy.
10. Sometimes, when I am embarrassed, I wish I could hide inside my shell like a _____.

Appendix H

Script and Order of Administration of Items on the Picture Identification Posttest

"Every page has four pictures, and they are numbered, see? One, two, three, four. I am going to say a word. I want you to tell me which picture best tells the meaning of the word. Just tell me the number of the picture you choose. Okay?"

List A

1. Dobson (4)
2. Frenulum (2)
3. Barrow (2)
4. Koomkie (1)
5. Muleta (3)
6. Tamarack (2)
7. Juggernaut (3)
8. Vibrissa (3)
9. Potlatch (4)
10. Gangrel (2)

List B

1. Kerfuffle (3)
2. Laburnum (1)
3. Fribble (4)
4. Wimple (3)

Script and Order of Administration of Items on the Picture Identification Posttest

(Continued)

5. Scrivello (4)
6. Hicatee (1)
7. Chigger (4)
8. Proboscis (1)
9. Mullock (2)
10. Tandem (1)

References

Anderson, R. C., & Nagy, W. (1992). The vocabulary conundrum. *American Educator,* 16, 14-18, 44-47.

Atkinson, R. C. (1975). Mnemotechnics in second-language learning. *American Psychologist, 30,* 821-828.

Bast, J. & Reitsma, P. (1998). Analyzing the development of individual differences in terms of Matthew effects in reading: Results from a Dutch longitudinal study. *Developmental Psychology, 34,* 1373-1399.

Baumann, J. F. & Kameenui, E. J. (1991). Research on vocabulary instructions: Ode to Voltaire. In J. F. Baumann and E. J. Kameenui (Eds.), *Handbook of research on the teaching of Language Arts,* (604-632). New York: MacMillian Publishing.

Beck, I. L. & McKeown, M. G. (1991). Conditions of vocabulary acquisition. In R. Barr, M. L. Kamil, P. B. Mosenthal, & P. D. Pearson (Eds.), *Handbook of reading research* (Vol. II, pp. 789-814). New York: Longman.

Beck, I. L. & McKeown, M. G. (1999). Comprehension: The sine qua non of reading. *Teaching & Change, 6*(2), 197-212.

Beck, I. L., McKeown, M. G., & McCaslin, E. S. (1983). Vocabulary development: All contexts are not created equal. *Elementary School Journal, 83,* 177-181.

Biemiller, A. (2001). Teaching vocabulary: Early, direct, and sequential. *American Educator,* 24-47.

Biemiller, A. & Slonin, N. (2001). Estimating root word vocabulary growth in normative and advantaged populations: Evidence for a common sequence of vocabulary acquisition. *Journal of Educational Psychology, 93,* 498-520.

Blachowicz, C. L. Z. & Fisher, P. (2000). Vocabulary instruction. In M. L. Kamil, P. B. Mosenthal, & P. D. Pearson (Eds,), *Handbook of reading research* (Vol. III, pp.503-523). Mahwah, NJ: Lawrence Erlbaum Associates.

Boder, E. & Jarrico, S. (1982). *Boder Test of Reading and Spelling Patterns.* San Antonio, TX: Harcourt Brace.

Bowey, J., & Hansen, J. (1994). The development of orthographic rimes as units of word recognition. *Journal of Experimental Child Psychology, 58,* 465 – 488.

Brooks, L. (1977). Visual pattern in fluent word identification. In A. S. Reber & D. L. Scarborough (Eds.), *Towards a psychology of reading.* Hilsdale, NJ: Erlbaum.

Brett, A., Rothlein, L., & Hurley, M. (1996). Vocabulary acquisition from listening to stories and explanation of target words. *The Elementary School Journal, 96,* 415-422.

Cain, K. & Oakhill, J. V. (1999). Inference making ability and its relation to comprehension failure in young children. *Reading and Writing: An Interdisciplinary Journal, 11,* 489-503.

Cain, K., Oakhill, J. V. & Elbro, C. (2003). The ability to learn new word meanings from context by school-age children with and without language comprehension difficulties. *Journal of Child Language*, 30, 681-694.

Cain, K., Oakhill, J. V., & Lemmon, K. (2004). Individual differences in the inference of word meanings from context: The influence of reading comprehension, vocabulary knowledge, and memory capacity. *Journal of Educational Psychology, 96,* 671-682.

Carning, D., Kameenui, E. J., & Coyle, G. (1984). Utilization of contextual information in determining the meaning of unfamiliar words. *Reading Research Quarterly, 19*, 188-203.

Chall, J. S. (1983). *Stages of reading development.* New York: McGraw Hill.

Chall, J. S., Jacobs, V. A., &Baldwin, L. E. (1990). *The reading crisis.* Cambridge, MA: Harvard University Press.

Cobb, T. (1999). Breadth and depth of lexical acquisition with hands-on concordancing. *Computer Assisted Language Learning, 12*, 345-360.

Curtis, M. E. (1987). Vocabulary testing and vocabulary instruction. In M. G. McKeown & M. E. Curtis (Eds.), *The nature of vocabulary acquisition* (37-52). Hillsdale, NJ: Erlbaum.

D'Anna, C. A., Zechmeister, E. B., & Hall, J. W. (1991). Toward a meaningful definition of vocabulary size. *Journal of Reading Behavior, 23,* 109-122.

Dale, E. (1965). Vocabulary measurement: Techniques and major findings. *Elementary English, 42,* 82-88.

Daneman, M., & Green, I. (1986). Individual differences in comprehending and producing words in context. *Journal of Memory and Language, 25,* 1-18.

Drake, D., & Ehri, L. (1984). Spelling acquisition: Effects of pronouncing words on memory for their spellings. *Cognition and Instruction, 1,* 297 – 320.

Drum, P. A. & Konopak, B. C. (1987). Learning word meanings from written context. In M. G. McKeown & M. E. Curtis (Eds.), *The nature of vocabulary acquisition* (73-88). Hillsdale, NJ: Erlbaum.

Duin, A. H., & Graves, M. F. (1987). Intensive vocabulary instruction as a prewriting technique. *Reading Research Quarterly, 22*, 311-330.

Dunn, L. M. & Dunn, L. M. (1997). *Peabody picture vocabulary test, 3rd edition.* Circle Pines, MN: American Guidance Service.

Durso, F. T., & Shore, W. J. (1991). Partial knowledge of word meanings. *Journal of Experimental Psychology: General, 120,* 190 – 202.

Ehri, L. C. (1978). Beginning reading from a psycholinguistic perspective: Amalgamation of word identities. In F. B. Murray (Ed.), *The recognition of words* (pp. 1-33). Newark, Del.: International Reading Association.

Ehri, L. C. (1980). The development of orthographic images. In U. Frith (Ed.), *Cognitive processes in spelling* (pp. 311-338). London: Academic.

Ehri, L. C. (1984). How orthography alters spoken language competencies in children learning to read and spell. In J. Downing & R. Valtin (Eds.), *Language awareness and learning to read* (pp. 119-147). New York: Springer-Verlag.

Ehri, L. (1987). Effects of printed language acquisition on speech. In D. Olson, N. Torrence, & A. Hildyard (Eds.), *Literacy, language and learning* (pp. 333-367). Cambridge, MA: Cambridge University Press.

Ehri, L. C. (1997). Learning to read and learning to spell are one and the same, almost. In C. Perfetti, L. Rieben, & M. Fayol (Eds.), *Learning to spell* (pp. 237-269). Hilsdale, NJ: Lawrence Erlbaum Associates.

Ehri, L. C. (1998). Grapheme-phoneme knowledge is essential for learning to read words in English. In J. L. Metsala & L. C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 3 – 40). Mahwah, NJ: Lawrence Erlbaum Associates.

Ehri, L. C. (1999). Phases of development in learning to read words. In J. Oakhill & R. Bard, (Eds.), *Reading development and the teaching of reading: A psychological perspective* (pp. 79-108). Oxford, UK: Blackwell Publishers.

Ehri, L. C. & Roberts, K. T. (1979). Do beginners learn printed words better in context or in isolation? *Child Development, 50*, 675-685.

Ehri, L. C. & Wilce, L. S. (1979). The mnemonic value of orthography among beginning readers. *Journal of Educational Psychology, 71*, 26-40.

Ehri, L. C. & Wilce, L. S. (1980a). The influence of orthography on readers conceptualizatuion of the phonemic structure of words. *Applied Psycholinguistics, 1,* 371–385.

Ehri, L. C. & Wilce, L. S. (1980b). Do beginners learn to read function words better in sentences or in lists? *Reading Research Quarterly, 15,* 451-476.

Ehri, L. C. & Wilce, L. S. (1982). The salience of silent letters in children's memory for word spellings. *Memory & Cognition, 10,* 155-166.

Ehri, L. C. & Wilce, L. S. (1985). Movement into reading: Is the first stage of printed word learning visual or phonetic? *Reading Research Quarterly, 20,* 163-179.

Ehri, L. C. & Wilce, L. S. (1986). The influence of spellings on speech: Are alvelor flaps /d/ or /t/? In D. Yaden & S. Templeton (Eds.), *Metalinguistic awareness and beginning literacy* (pp. 101-114). Portsmouth, NH: Heinemann.

Ehri, L. C., Wilce, L. S., & Taylor, B. B. (1987). Children's categorization of short vowels in words and the influence of spellings. *Merrill-Palmer Quarterly, 33,* 393-421.

Elley, W. B. (1989). Vocabulary acquisition from listening to stories. *Reading Research Quarterly, 24*(2), 174-188.

Eller, R. G., Pappas, C. C., & Brown, E. (1988). The lexical development of kindergarteners learning from written context. *Journal of Reading Behavior, 20*(1), 5-23.

Frith, U. (1978). From print to meaning and from meaning to sound, or How to read without knowing how to spell. *Visible Language, 12,* 43 –54.

Gathercole, S. E. & Baddeley, A. D. (1989). Evaluation of the role of phonological STM in the development of vocabulary in children: A longitudinal study. *Journal of Memory and Language, 28,* 200-213.

Ganske, K. (2000). *Word Journeys: Assessment-Guided Phonics, Spelling, and Vocabulary Instruction.* New York: Guilford Publications.

Gates, A. I. (1962). The word recognition ability and the reading vocabulary of second and third grade children. *Reading Teacher, 15,* 443 – 338.

Gipe, J. P. (1979-1980). Investigating techniques for teaching word meanings. *Reading Research Quarterly, 14,* 624-645.

Glushko, R. J. (1981). Principles for pronouncing print: The psychology of phonology. In A. M. Lesgold & C. A. Perfetti (Eds.), *Interactive processes in reading* (pp. 61 – 84). Hillsdale, NJ: Lawrence Erlbaum Associates.

Goswami, U. (1988). Orthographic analogies and reading development. *Quarterly Journal of Experimental Psychology, 40,* 239-268.

Graves, M. (1986). Vocabulary learning and instruction. In E. Z. Rothkopf (Ed.), *Review of Research in Education (*Vol. 13, pp. 49 – 89). Washington, DC: American Educational Research Association.

Hart, B., & Risley, T. R. (1995). *Meaningful differences in the everyday experiences of young American children.* Baltimore: Brookes.

Hatch, E. & Brown, C. (1995). *Vocabulary, semantics, and language education.* Cambridge: Cambridge University Press.

Henriksen, B. (1999). Three dimensions of vocabulary development. *Studies in Second Language Acquisition,* 21, 303 – 317.

Herman, P. A., Anderson, R. C., Pearson, P. D., & Nagy, W. E. (1987). Incidental acquisition of word meaning from expositions with varied text features. *Reading Research Quarterly, 22*, 263-284.

Jenkins, J., & Dixon, R. (1983). Vocabulary learning. *Contemporary Educational Psychology, 8,* 237-260.

Johnson, D. D., & Baumann, J. F. (1984). Word identification. In P. D. Pearson (Ed.), *Handbook of reading research* (pp. 583-608). New York: Longman.

Johnson-Laird, P. N. (1987). The mental representation of the meanings of words. *Cognition, 25,* 189-211

Jose de la Fuente, M. (2002). Negotiation and oral acquisition of L2 vocabulary: The roles of input and output in the receptive and productive acquisition of words. *Studies in Second Language Acquisition, 24*, 81-112.

Juel, C. (1988). Learning to read and write: A longitudinal study of 54 children from first through fourth grades. *Journal of Educational Psychology, 80*, 437-447.

Kame'enui, E. J., Dixon, R. C., & Carnine, D. W. (1987). Issues in the design of vocabulary instruction. In M. G. McKeown & M. E. Curtis (Eds.), *The nature of vocabulary acquisition* (129-146). Hillsdale, NJ: Erlbaum.

Krashen, S. (1989). We acquire vocabulary and spelling by reading: Additional evidence for the input hypothesis. *The Modern Language Journal, 73,* 440-464.

Kreiner, D. S. & Gough, P. B. (1990). Two ideas about spelling: Rules and word-specific memory. *Journal of Memory and Language, 29*, 103-118.

Lee, S. H. (2003). ESL learners' vocabulary use in writing and the effects of explicit vocabulary instruction. *System, 31*, 537-561.

Levin, J. R. (1993). Mnemonic strategies and classroom learning: A twenty-year report card. *Elementary School Journal, 94,* 235-244.

Levin, J. R., Johnson, D. D. Pittelman, S. D., Hayes, B. L., Levin, K. M., Shriberg, L. K., & Toms-Bronowski, S. (1984). A comparison of semantic- and mnemonic-based vocabulary learning strategies. *Reading Psychology, 5,* 1-15.

Levin, J. R. & Pressley, M. (1985). Mnemonic vocabulary instruction: What's fact, what's fiction. In R. F. Dillon (Ed.), *Individual differences in cognition* (vol. 2, 145 – 172). Orlando, FL: Academic Press.

Levin, J. R., Pressley, M., McCormick, C. B., Miller, G. E., & Shriberg, L. K. (1979). Assessing the classroom potential of the keyword method. *Journal of Educational Psychology, 71,* 583-594.

Lotto, L. & deGroot, A. M. B. (1998). Effects of learning method and word type on acquiring vocabulary in an unfamiliar language. *Language Learning,48,* 31-70.

Lutz, K. A. & Lutz, R. J. (1977). Effects of interactive imagery on learning: Application to advertising. *Journal of Applied Psychology, 62,* 493-498.

McDaniel, M. A. & Pressley, M. (1989). Keyword and context instruction of new vocabulary meanings: Effects on text comprehension and memory. *Journal of Educational Psychology, 81,* 204-213.

McKeown, M. G. (1985). The acquisition of word meaning from context by children of high and low ability. *Reading Research Quarterly, 20*(4), 482-496.

McKeown (1993). Creating effective definitions for young word learners. *Reading Research Quarterly, 28,* 17-31.

McKeown, M., Beck, I., Omanson, R., & Pople, M. (1985). Some effects of the nature and frequency of vocabulary instruction on the knowledge and use of words. *Reading Research Quarterly, 20,* 522 – 535.

McKeown, M., Beck, I., Omanson, R., & Perfetti, C.(1983). The effects of long-term vocabulary instruction on reading comprehension: A replication. *Journal of Reading Behavior, 15,* 3-18.

McKeown, M. G. & Curtis M. E. (Eds.). (1987). *The nature of vocabulary acquisition.* Hillsdale, NJ: Erlbaum.

Miller, P. H. (2002). *Theories of developmental psychology.* New York: Worth Publishers.

Miller & Gildea (1987). How children learn words. *Scientific American, 25,* 94 – 99.

Nagy, W. E., & Anderson, R. C. (1984). How many words are there in printed school English? *Reading Research Quarterly, 19,* 303-330.

Nagy, W. E., Anderson, R. C., & Herman, P. A. (1987). Learning word meanings from context during normal reading. *American Educational Research Journal, 24*(2), 237-270.

Nagy, W. E. & Herman, P. A. (1987). Breadth and depth of vocabulary knowledge: Implications for acquisition and instruction. In M. G. McKeown & M. E. Curtis (Eds.), *The nature of vocabulary acquisition* (19-35). Hillsdale, NJ: Erlbaum.

Nagy, W. E., Herman, P. A., & Anderson, P. A. (1985). Learning words from context. *Reading Research Quarterly, 20*(2), 233-253.

Nassaji, H. (2004). The relationship between depth of vocabulary knowledge and L2 learners' lexical inferencing strategy use and success. *The Canadian Modern Language Review,* 61(1), 107-134.

NICHHD (2000). Report of the National Reading Panel. Teaching children to read: An evidence-based assessment of the scientific research on reading and its implications for reading instruction. (NIH publication No. 00-4769). Wash, DC: US Government Printing Office.

Nist, S. L., & Olejnik, S. (1995). The role of context and dictionary definitions on varying levels of word knowledge. *Reading Research Quarterly, 30,* 172-193

Penno, J. F., Wilkinson, I. A. G., & Moore, D. W. (2002). Vocabulary acquisition from teacher explanation and repeated listening to stories: Do they overcome the Matthew effect? *Journal of Educational Psychology, 94,* 23-34.

Pressley, M. & Levin, J. R. (1981). The keyword method and recall of vocabulary words from definitions. *Journal of Experimental Psychology: Human Learning and Memory, 7,* 72 – 76.

Pressley, M., Levin, J. R., & Delaney, H. D. (1982). The mnemonic keyword method. *Review of Educational Research, 52,* 6 – 91.

Pressley, M., Levin, J. R., & McDaniel, M. A., (1987). Remembering versus inferring what a word means: Mnemonic and contextual approaches. In M. G. McKeown & M. E. Curtis (Eds.), *The nature of vocabulary acquisition* (pp. 107 – 127). Hillsdale, NJ: Erlbaum.

Pressley, M., Levin, J. R., & Miller, G. E. (1981). How does the keyword method affect vocabulary comprehension and usage? *Reading Research Quarterly, 16,* 213 – 226.

Pressley, M., Levin, J. R., & Miller, G. E. (1982 or 3) The keyword method compared to alternative vocabulary learning strategies. *Contemporary Educational Psychology.*

Pulido, D. (2003). The relationship between text comprehension and second language incidental vocabulary acquisition: A matter of topic familiarity? *Language Learning, 54,* 269-324.

Rack, J., Hulme, C., Snowling, M., & Wightman, J. (1994). The role of phonology in young children learning to read words: The direct mapping hypothesis. *Journal of Experimental Child Psychology, 57,* 42-71.

Reitsma, P. (1983). Printed word learning in beginning readers. *Journal of Experimental Child Psychology, 36,* 321-339.

Rice, M. L. & Woodsmall, L. (1988). Lessons from television: Children's word learning when viewing. *Child Development, 59,* 420-429.

Robbins, C. & Ehri, L. C. (1994). Reading storybooks to kindergarteners helps them learn new vocabulary words. *Journal of Educational Psychology, 86*(1), 54-55.

Roberts, T. A., (2003). Effects of alphabet-letter instruction on young children's word recognition. *Journal of Educational Psychology, 95,* 41-51.

Rodriguez, M. & Sadoski, M. (2000). Effects of rote, context, keyword, and context/keyword methods on retention of vocabulary in EFL classrooms. *Language Learning, 50,* 385-412.

Schmitt, N. (1998). Tracking the incremental acquisition of second language vocabulary: A longitudinal study. *Language Learning, 48*(2), 281-317.

Segers, E., Takke, L., & Verhoeven, L. (2004). Teacher-mediated versus computer-mediated storybook reading to children in native and multicultural kindergarten classrooms. *School Effectiveness and School Improvement,* 15(2), 215-226.

Senechal, M. (1997). The differential effect of storybook reading on preschoolers' acquisition of expressive and receptive vocabulary. *Journal of Child Language, 24,* 123-138.

Senechal, M. & Cornell, E. H. (1993). Vocabulary acquisition through shared reading experiences. *Reading Research Quarterly, 28*(4), 361-374.

Senechal, M., Thomas, E., & Monker, J. A. (1995). Individual differences in 4-year-old children's acquisition of vocabulary during storybook reading. *Journal of Educational Psychology, 87*(2), 218-229.

Scarborough, H. S. & Parker, J. D. (2003). Matthew effects in children with learning disabilities: Development of reading, IQ, and psychosocial problems from Grade 2 to Grade 8. *Annals of Dyslexia, 53,* 47-71.

Shaywitz, B. A., Holford, T. R., Holahan, J. M., Fletcher, J. M., Stuebing, K. K., Francis, D. J., & Shaywitz, S. E. (1995). A Matthew effect for IQ but not for reading: Results from a longitudinal study. *Reading Research Quarterly, 30,* 894-906.

Shu, H., Anderson, R. C., & Zhang, H. (1995). Incidental learning of word meanings while reading: A Chinese and American Cross-cultural study. *Reading Research Quarterly, 30*(1), 76-95.

Sparks, R. L. & Artzer, M. (1995). Prediction of foreign language proficiency. *Journal of Educational Psychology, 89,* 549-562.

Snow, C., Burns, M. S. & Griffin, P. (Eds.), (1998). *Preventing reading difficulties in young children.* Washington, D. C.: National Academic Press.

Stahl, S. A. (1986). Three principles of effective vocabulary instruction. *Journal of Reading, 29,* 662-668.

Stahl, S. A., & Fairbanks, M. M. (1986). The effects of vocabulary instruction: A model-based meta-analysis. *Review of Educational Research, 56,* 72 – 110.

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly, 21,* 360-407.

Sternberg, R. J. (1987). Most vocabulary is learned from context. In M. G. McKeown & M. E. Curtis (Eds.), *The nature of vocabulary acquisition* (89-105). Hillsdale, NJ: Erlbaum.

Sternberg, R. J. & Powell, J. S. (1983). Comprehending verbal discourse. *American Psychologist,* 878-892.

Swanborn, M. S. L., & deGlopper, K. (1999). Incidental word learning while reading: A meta-analysis. *Review of Educational Research, 69,* 261-285.

Thomas, M. H., & Wang, A. Y. (1996). Learning by the keyword mnemonic: Looking for long-term benefits. *Journal of Experimental Psychology: Applied, 2,* 330-342.

Torgesen, J., Wagner, R., & Rashotte, C. (1999). *Test of Word Reading Efficiency (TOWRE).* Austin, TX: PRO-ED Inc.

Van Daalen-Kapteijns, M, & Elshout-Mohr, M (1981). The acquisition of word meanings as a cognitive learning process. *Journal of Verbal Learning and Verbal Behavior, 20,* 386-399.

Watts, S. M. (1995). Vocabulary instruction during reading lessons in six classrooms. *Journal of Reading Behavior, 27,* 484-489.

White, T. G., Graves, M. F., & Slater, W. H. (1990). Growth of reading vocabulary in diverse elementary classrooms: Decoding and word meaning. *Journal of Educational Psychology, 67,* 484 – 489.

Woodcock Reading Mastery Test – Revised (1988). Circle Pines, MN; American Guidance Service.