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Investigating the relationship between word knowledge and cognitive ability

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INVESTIGATING THE RELATIONSHIP BETWEEN WORD KNOWLEDGE AND COGNITIVE ABILITY

by

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APPROVAL PAGE

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The purpose of this study was to explore the relationship among three areas of word knowledge: speed of word identification, accuracy of word identification, and spelling as well as the effect ability has on those three areas.

The subjects for this study were 102 second grade students. The students were divided into three ability groups based on the results of their scores on the Test of Cognitive Skills. The Qualitative Inventory of Word Knowledge was used to test for speed and accuracy in word identification and accuracy in spelling. First, means, standard deviations, and intercorrelations were generated for all variables. A one-way multivariate analysis of variance (MANOVA) with follow-up univariate analyses and three 3 X 2 ANOVAs were used to explore the relationship among the variables and groups.

The Wilks' Lambda statistic for the MANOVA indicated that there was a signifcant difference among the means of these three dependent variables across the three ability groups. The follow up univariate tests showed that significant differences were found for all three measures of word knowledge. The results of Neuman-Kuel post hoc tests indicated that the means of all three ability groups were significantly different from one another on all three measures of word knowledge. For all subjects, accuracy of word identification was greater than speed of word identification. All subjects could identify words as well as, or better than, they could spell the words on the lists. There was a strong

positive relationship between speed of word identifcation and spelling as well as accuracy of word identifcation and spelling. The strongest relationship was found to be between speed of word identification and accuracy of word identification.

The results confirmed the prediction that word knowledge (speed of word identification, accuracy of word identifcation, and accuracy of spelling) would differ among ability groups and that difference would depend on the ability of the students. When ability was partialed out of these correlations, intercorrelations for the three measures of word knowledge are similarly correlated regardless of ability.

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CHAPTER I

AN INTRODUCTION TO THE STUDY

Learning to read and spell are important parts of becoming literate. Traditionally word recognition and spelling have been treated as separate and distinct skills. They are usually taught at different times during the school day, and the materials used are often published by two different (frequently competitive) companies. Recently, several educators and psychologists have suggested that there is a common conceptual base in both word recognition skills and spelling ability, at least during the early stages of literacy learning (Henderson, 1981, 1985; Gentry, 1982; Beers, 1980; Ehri, 1987; and Morris, 1981). Word identification and spelling appear to be related. Both rely on similar sources of knowledge--cipher knowledge (knowledge of the code) and lexical knowledge (knowledge of print) and both deal with the relationship between language and sound (Juel, Griffith, & Gough, 1986).

Reading is a complex process. Educators, linguists, and psychologists have proposed many definitions and explanations. Most perceive it as a two fold process which includes: (1) decoding or identifying the words, and (2) comprehension or obtaining meaning from the recognized symbols or words. The teaching of word identification skills is an important part of the beginning reading program, because identifying words rapidly and accurately and understanding what is written are closely linked (LaBerge & Samuels, 1974). Gough believes that word identification is the foundation of the reading process (1984).

Spelling, or encoding, is important to the writing process. To spell, a student must be able to place the graphemes (letters) of a word in the conventional order. Spelling is also a complex process. Learning to spell is not simply a matter of memorizing words but, to a large extent, a consequence of developing cognitive strategies for dealing with English orthography (Henderson, 1985).

When teachers work with students consideration is often given to the students' cognitive ability. Ability is defined as "the power to perform" (Harris & Hodges, 1981, p.2). Students' ability is often influenced by their experiental background, personal attitudes, motivation, cultural background, and the test or task they are asked to perform. Cognitive ability involves memory, thinking, intelligence, and scholastic aptitude.

Word knowledge is knowledge that underlies both word recognition and spelling. This knowledge enables children to both read and write words. In this study word knowledge will subsume speed of word identification, accuracy of word identification, and spelling. The purpose of this study is to further explore the relationship among three areas of word knowledge: speed of word identification, accuracy of word identification, and spelling as well as the effect ability has on those three areas.

Need for the Study

Recently authors in the fields of education and psychology have become increasingly interested in studying cognitive development during the reading and writing processes. Squires (1983) describes the two activities as two sides of the same process; and Morris (1981) says that they are cyclical, mutually-facilitative entities that support one another. Henderson (1985) states that children must know what a word is before

formal reading and spelling instruction can begin. Some researchers (Cramer, 1978; Morris, 1981) view spelling as lagging behind the development of word identification. Children's writing is viewed as an excellent source of pertinent information about spelling and word recognition skills (Cramer, 1976). The complexity of the relationship, however, has only begun to be explained. Ehri, a researcher whose current work is investigating the psycholinguistic processes involved in learning to read and spell words, states, "We do not understand the relationship between reading instruction and spelling instruction" (Ehri, 1987, p. 6). What we do know instructionally is that spelling and reading are developmental skills, and that there is a systematic growth of word knowledge across the elementary grades (Morris, 1989).

The correlational evidence from the word identification and spelling research suggests that they are highly related but not identical skills. Moreover, to date no one has looked at how academic ability enters into the relationship between word identification and spelling. In a recent study, Hall (1989) noted that above-average students were able to read and spell words on lists, that students of average ability had more success in reading the words on lists than they did in spelling words, and that students of low ability had a problem with both reading and spelling the words on the lists, although not investigating the role that ability played in the relationship.

Research findings, which confirm or deny a connection between word identification and spelling, have important instructional implications--they would argue for integrated word study programs or separate spelling and reading activities. When we look at subjects' abilities (high, average,

or low) in relation to their scores on these two measures, we may have additional information so that reading and spelling instruction might be adapted best to meet the needs of all students, regardless of their ability. The answer to this question may be valuable information for teachers who are faced with the daily task of teaching students with a wide range of academic ability in the same classroom.

In this study second grade students are asked to read and to write the same list(s) of words. The purpose of the study is to investigate the relationship among three areas of word knowledge: speed of word identification, accuracy of word identification, and spelling as well as the effect ability has on those three areas.

Hypotheses

Based on the informal findings of Hall (1989), the following hypotheses are presented:

1. There will be a significant difference among the means of the word knowledge (speed of word identification, accuracy of word identification, and spelling) scores across ability groups.
2. There will be significant differences among the means of the speed of word identification scores for all three ability groups (High-Ability > Average-Ability > Low-Ability).
3. There will be significant differences among the means of the accuracy of word identification scores for for the three ability groups (High-Ability > Average-Ability > Low-Ability).
4. There will be significant differences among the means of the spelling scores for the three ability groups (High-Ability > Average-Ability > Low-Ability).

5. The students across three ability groups will score significantly higher on accuracy of word identification than speed of word identification.
6. The students across three ability groups will score significantly higher on speed of word identification than spelling.
7. The students across three ability groups will score significantly higher on accuracy of word indentification than spelling.

Definition of Terms

To insure a better understanding of this study selected terms that may be unfamiliar to the reader are defined.

Accuracy: To identify a word correctly.

Automaticity: Word identification that is quick and accurate.

Cipher Knowledge: General knowledge of how the spelling of a word helps generate pronunciation and speech sounds.

Decoding: To transfer an unfamiliar code of symbols (letters) to a familiar one (speech). In reading, the term is used to refer to word identification.

Encoding: To place the graphemes of a word in the conventional order.

Grapheme: A letter of the alphabet, or written orthographic representation of the phoneme.

Lexical Knowledge: Knowledge of print or written language.

Letter-Sound Correspondence: This describes the relationship between letters (graphemes) and sounds (phonemes).

Orthography: Spelling, the arrangement of letters in words.

Phonemes: One of about forty discriminating classes of significant, different speech sounds in English.

Phonics: The study of the sounds of the letters and letter combinations.
Sight word: A word that is immediately recognized as a whole.
Speed: Word identification that is quickly accomplished.
Word Identification: Refers to the process of determining the pronunciation and some degree of meaning with the printed word.
Word Knowledge: Knowledge that underlies both word recognition and spelling. This knowledge enables children to both read and write words.

Organization of Dissertation

Chapter One has presented an introduction, a statement of need, the hypotheses, and a list of terms with the definitions used for them in this study. The organization of the dissertation was presented.

Chapter Two contains a review of the literature. The relevant research in the three areas of word knowledge (speed of word identification, accuracy of word identification, and spelling) are presented. All correlational studies between the two skills of word identification and spelling are reviewed in this chapter, along with studies on ability. A brief summary of each area of the literature is included at the end of each section, with a full summary at the conclusion of this chapter.

Chapter Three decribes the methodology used in this investigation. The population is defined and descriptions of the instruments which were used to measure the students' ability and word knowledge are given. The research design and statistical proceedures used in the investigation are explained.

Chapter Four will present the results of the study and an interpretation of these results. In Chapter Five, the study will be

summarized, conclusions stated, and future instructional and research possibilities suggested.

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this study is to investigate the relationship among three areas of word knowledge: speed of word identification, accuracy of word identification, and spelling as well as the effect ability has on those three areas. The following literature review is divided into three sections. Each section considers empirical studies in one of these three areas: word knowledge (including automaticity and speed studies, accuracy studies, and spelling studies), correlational studies involving both word identification and spelling, and ability studies. For this study, automaticity is word identification that is quick and requires little effort. Accuracy is to identify a word correctly. Spelling is defined as the translation of oral words into graphic symbols. Ability is the power to perform academic tasks successfully. The development of word knowledge underlies both word identification and spelling (Henderson, 1985; Morris,1989).

Empirical studies in the area of word identification and spelling are extensive; therefore, this review looks only at those that are pertinent to this study and the development of word knowledge. The section on word knowledge includes studies about: the speed of word identification, accuracy of word identification, and spelling. Correlational studies found in the literature are included in this chapter. These researchers either used a variety of tasks to measure reading skill and a word list to measure spelling skill or used similar word lists to measure reading skill

and spelling skill. Zutell (1988) uses the term "global means" to subsume the variety of ways researchers measure reading skill when investigating the relationship between reading and spelling. Finally, ability studies are noted. A brief summary of each area of the literature is included at the end of each section, with a full summary at the conclusion.

Word Knowledge

This section on word knowledge is divided into three subsections: speed studies, accuracy studies, and spelling studies. The idea of word knowledge can be attributed to Henderson (1985), who wrote that there exists in the minds of beginning readers a developing conceptual knowledge of wordness that underlies their ability to both read and spell words. To describe how children learn to read and spell, Ehri (1980) has discussed how identities of words are learned and overlaid on each other such that one lexical feature, when detected, will reveal all of the other identities of the word including its phonetic elements, syntatical roles, contexual meaning, as well as its spelling. These identities produce a full picture which she calls an amalgam of the word and its function. Henderson (1985) has termed this composite aspect word knowledge. He posits that when students examine the similarities and differences among lexical properties of words, they acquire word knowledge. Through the experiences children have with words in new contexts, Henderson claims they build up these identities about words, and reading fluency and spelling proficiency should improve.

Although reading is a holistic act (Anderson, Hiebert, Scott, & Wilkerson, 1985), it is complex and has been described by most educators and pychologists as a two fold process, which includes word

identification, or decoding, and comprehension, or obtaining meaning from the printed page (Mason & Au,1986; Anderson et al.,1985; Stoodt,1989; Cunningham, Moore, Cunningham, & Moore, 1989; Adams,1990).

Word identification refers to the ability to associate pronunciation and meaning with the printed word (Gough,1984; Anderson et al.,1985). Gough (1984) states that word identification is the foundation of the reading process. He writes that how word identification is accomplished remains a mystery after more than one hundred years of research. One reason, Gough explains, is that word identification cannot be studied directly. It takes place in the eyes, the optic nerves, and the brain. The eyes look at the word(s), collect information for the brain which determines what the eyes see. Those who study reading, or word identification, ask readers to perform tasks which result in a response that can be measured. Gough (1984) states that there are two indexes of word recognition: accuracy and speed. He also claims that skilled readers are seldom inaccurate, and that speed aids their comprehension (LaBerge & Samuels, 1974; Samuels,1988).

Spelling is a complex process also. To spell a student must be able to place the graphemes (letters) of a word in their conventional order. Recent research (Read,1971; Beers,1978; Gentry,1979) shows that children's spelling strategies, when writing, reveal clear developmental stages. As young children mature their word knowledge increases and so do their spelling approximations (Henderson 1985,1990).

Speed of Word Identification

More often automaticity is treated as synonomous with speed (LaBerge & Samuels,1974; Samuels,1979). LaBerge and Samuels (1974),

define automaticity as word identification that is quick, effortless, and accurate. Thus, the reader's attention is free for understanding content. Following a study of fluent and poor readers, LaBerge and Samuels claimed that fluent readers decode text automatically, without expending effort to process the individual words. They noted that the reading speed of fluent readers approximates the same rate as speaking and their comprehension is good because their attention is available to process meaning. Poor readers, on the other hand, must expend processing effort, or attention, to decode each word.

This section looks at experiments that have been conducted by Ehri (1976), Golinkoff and Rosinski (1976), Guttentag and Haith (1978), and Pace and Gollinkoff (1976) and which indicate that familiar words can be recognized automatically by normal readers as early as the end of the first grade and by less skilled readers as early as the third grade. Other experiments by Schadler and Thissen (1981), West and Stanovitch (1979), and Stanovitch, Cunningham, and West (1981) report that automatic recognition of words emerges midway through first grade in less skilled as well as skilled readers. Studies which support a difference between automaticity (speed and accuracy of word identification) and maximum speed of word identification conclude this subsection.

One method used by these researchers to explore when beginning readers become able to recognize words automatically is the Stroop task (Stroop,1935). Posner and Snyder (1975), using a typical Stroop task with their subjects, asked them to name the color of ink in which a string of letters was printed. They found that when the string of letters spelled the name of a conflicting word (e.g., the word "red" written in blue ink) the

printed word interfered with, or slowed down, the color-naming response. Since the subjects engaged in a Stroop task are attempting to attend only to the color of ink, color-word interference is presumed to be the result of the word having been read automatically. Posner and Synder predicted that if skilled readers process words more automatically than less skilled readers, a larger Stroop effect would be expected for the more skilled readers. The results failed to show the expected relationship between reading ability and automatic processing.

Similar results were noted by Golinkoff and Rosinski (1976). Using a picture-word interference task that is a variant of the Stroop, and working with skilled and unskilled third and fifth grade readers, they found that the picture naming times of unskilled readers were delayed by the presence of incongruent words just as long as the time of skilled readers of the same age. The results of their decoding tests indicated that unskilled comprehenders possess weak decoding skills compared to the skilled readers but did not suffer from extraction of meaning from single printed words. In another study Rosinski, Golinkoff, and Kukish (1975) required subjects to name pictures of common objects while ignoring words printed inside the pictures. They found no increase in the interference effect from second grade through adulthood.

West and Stanovitch (1978) offer three reasons why these studies failed to find the expected relationship between reading ability and automatic processing. The first two reasons are interrelated; they used highly familiar words, coupled with the fact that the subjects (even second graders and unskilled third graders) were well beyond the initial stage of reading acquisition. The third reason they gave was the studies

used a continuous-list procedure, whereby the subjects name a series of items and scores were the total time to name the entire list. Their opinion is supported by research where the expected relationship begins to become apparent with more difficult words (Pace & Golinkoff,1976) or poorer readers (Ehri,1976) are tested using the same picture-word interference tasks. Ehri (1976) found the picture-word interference task a useful tool for assessing whether beginners have reached a point in their reading where decoding proceeds automatically permitting direct access to semantic identities of words.

West and Stanovitch (1979) found the expected relationship between reading ability and automaticity when they asked kindergarten, first, and third graders to perform a Stroop task using the alphabet, high frequency words, and low frequency words. Kindergarteners had fully automated only the recognition of the letters and had just begun to automate the recognition of high frequency words. In contrast, the older children had automated the recognition of all the stimuli.

Guttentag and Haith (1978) were interested in determining the age at which normal children begin to extract meaning from printed words automatically and in the relationship between automaticity and the controlled processing ability of their youngest subjects. The subjects were early and late first-grade children, third-grade poor and good readers, and adults. These subjects were asked to name pictures under several interference conditions. From the results Guttentag and Haith (1978) concluded that even children who were young (first grade) or poor readers can extract meaning from familiar printed words automatically

and that good readers are automatic decoders, whereas poor and beginning readers decode unfamiliar letter strings much less automatically.

Ehri and Wice (1979) tested a different prediction of the automaticity theory, using a picture-word interference task with first and second graders. They found that as a result of practice, familiar words come to be recognized as wholes without deliberate processing of the component letter-sound relations. According to their theory practice at word recognition should lead to automaticity (speed and accuracy of word identification).

Schadler and Thissen (1981) tested one hundred and forty children in kindergarten, first, second, and third grade. Their reading skill level ranged from non-reader through sixth grade. Their tests involved three experiments using a Stroop task. They found that interference with color naming begins to emerge early in the process of learning to read, and then subsequently decreases. Strings of identical letters delayed color naming for children just beginning to learn to read. Interference from words, presumably reflecting semantic processing, began to develop early but did not peak until the second to fourth grade reading levels. They concluded skilled or automatic word recognition is a complex operation that develops as children acquire skill in reading; for skilled and unskilled readers this happens early in their schooling, usually during the first grade.

Stanovitch, Cunningham, and West (1981) conducted a longitudinal study of first graders to watch their automatic recognition skills develop. The first graders were asked to perform a Stroop task with letters, high frequency words, and low frequency words. Stanovitch and his colleagues

were able to trace the development of automaticity in some detail because the crucial first-grade period, identified from previous studies, was the focus of the study. Based on their research efforts, they concluded that a sharp increase in automaticity occurs during the first grade, but by the end of the year the development of automaticity has begun to level off. They noted that this was particularly true for skilled readers who have automatized the recognition of letters, high frequency words, and some low frequency words to an equal extent. They also found that word recognition speed continues to increase even after recognition has become automatized. Thus, a distinction between speed and automaticity is important. These results were consistent with Ehri and Wilce (1979) who argued that beginning readers need only a moderate amount of practice before recognition becomes automatized. Automaticity in decoding is a prerequisite for skilled reading, and for slow learners automaticity is the result of direct instruction in decoding skills and extended practice in comfortable reading materials (Samuels, 1988).

More often automaticity is treated as synonomous with speed (LaBerge & Samuels,1974; Samuels,1979). LaBerge and Samuels (1974) define automaticity as word identification that is quick, effortless, and accurate. However, Kaye, Brown, Post, and Plude (1981) and Ehri and Wilce's (1979,1983) findings, among others, support a distinction between automaticity and maximum speed. These researchers have concluded that automaticity (speed and accuracy) in word identification is attained prior to maximum speed of word identification.

In one study, Perfetti, Finger, and Hogaboam (1978) found that skilled third grade readers could identify printed words as fast as digits, whereas less-skilled readers were slower at words than digits. However, because the words that were used were nouns normed for the third grade, less-skilled readers may not have been sufficiently familiar with them. In another study, Hogaboam and Perfetti (1978) provided skilled and less-skilled third and fourth grade readers practice pronouncing nonsense syllables. Practice involved looking at the word and repeating the experimenter's pronunciation. They found that practice increased the speed of both groups. The skilled readers needed three exposures, on the average, to boost their speed to a maximum level. In contrast, the less-skilled readers needed six exposures to reach their maximum speed.

Perfetti and Lesgold state that speed is a distinguishing feature of skilled reading. They found, in a series of studies (1977, 1979), large consistent differences between skilled and less-skilled readers in third and fifth grade. Regardless of grade level, the less-skilled readers were slower than the skilled readers. Pseudowords took nearly twice as long as real words for less-skilled readers. They noted that both rapid phonological coding and rapid semantic coding are more characteristic of skilled readers than less-skilled readers. The reason they gave was that less-skilled readers were not as practiced in the skills of verbal encoding and decoding. Overlearning, such as drill and practice, was one means they suggested to overcome short term memory (STM) blocks. Less-skilled readers take longer to make simple semantic judgments of words than do skilled readers. From these studies they concluded that coding speed and achievement are highly related for young readers.

Kaye, Brown, Post, and Plude (1981), using a letter-search task, studied the development of efficiency in letter processing skills. Their subjects were students in kindergarten through third grade. In two experiments, subjects searched for a target letter displayed with items varying in their visual features. Accuracy and reaction time were evaluated. Results were discussed in terms of accuracy, automaticity, and efficiency of skill development and the relation of these to general reading and intellectual development. They concluded that letter processing skill (accuracy) was well developed at an early age and that automaticity (speed and accuracy) and efficiency (maximum speed) followed.

Ehri and Wilce (1979) have used performance in the picture-word interference task to distinguish between automaticity and maximum speed of printed word learning. They gave first and second graders practice reading the set of printed distractor words. The extent of interference created by these words in the picture-naming task was assessed both before and after word training. Results revealed two different patterns of performance depending on how well the subjects could read the words prior to training. Their findings showed that automaticity or quick word identification is attained prior to maximum speed of word identification.

This was the same conclusion that Kaye, Brown, Post, and Plude (1981) reached in their study of the development of letter processing efficiency. The attainment of speed in recognizing words has been studied by measuring readers' reaction times (RTs) to pronounce printed words. Stanovitch (1981) examined word recognition speed in much younger subjects. He divided end-of-the-year first graders into two ability groups

and measured their RTs to identify printed words, digits, line drawings of objects, letters, and colors. Neither groups could recognize words as quickly as digits or letters, suggesting that first graders have not attained unitized speeds with printed words.

According to Ehri (1978, 1980), learners could be said to have attained their maximum speed in identifying words when all the associative links between codes in the various memory and response systems are completely integrated or unitized. To assess when this point is reached with familiar printed words by beginning readers, Ehri and Wilce (1983) assessed how quickly these readers recognized letters and numerals they knew well. They then compared this baseline to the readers' word identification speed to determine whether the familiar words the beginning readers have learned are recognized as quickly as the highly familar stimuli. The results of their study showed how word recognition speed grows and, also, indicated the contribution that practice makes to the attainment of unitized speeds. They found practice to have a larger effect on skilled readers than on poor readers.

Research studies have provided support for LaBerge and Samuels' (1974) theory of automaticity. These studies have shown that fluent readers can and do decode text automatically. These studies have also shown that beginning and poor readers are not automatic decoders; therefore, they must concentrate on word identification when reading. Research efforts in this area indicate that familiar words are recognized automatically (with speed and accuracy) by many first graders and that even less skilled readers have become automatic with high frequency words by third grade. While automaticity and speed are synonomous to

most researchers, others have found a distinction. Those research studies that have noted a distinction have shown that word recognition speed continues to increase even after word identification is quick and accurate and that practice increases the speed at which both skilled and non-skilled readers recognize words until they reach their maximum speed.

Accuracy of Word Identification

This section contains empirical studies on how skilled readers become accurate at word identification. The studies noted include: phonics instruction, phonemic awareness, letter recognition, spelling patterns, and breaking words into syllables or chunks. The stages of word identification conclude this section.

Perfetti and Lesgold (1979) state that fast, accurate word identification is one of the cornerstones of skilled reading. When decoding can be executed rapidly, it provides an added source of redundancy that increases text-reading accuracy and efficiency (Perfetti, 1985), and it makes available memory for determining the meaning of the text (Perfetti & Lesgold, 1979). Ehri and Wilce (1983) noted that unfamiliar words become familiar and are recognized accurately by readers directing their attention to the component letters as they map sounds. It has been phoneme awareness, children's conscious awareness of the phonemic segments spoken in words, that has been the central issue in beginning reading research for the past three decades and the subject of many studies to find out how children learn to recognize words accurately. Laboratory research indicates that the most critical factor beneath accurate word reading is the ability to recognize letters, spelling patterns, and whole words. It is not simply the accuracy with which

children can name letters, that gives them an advantage in learning to read, it is the ease or fluency with which they can do so (Adams, 1990).

How do young children learn to recognize words accurately ? To become accurate readers, children must have strategies for mediating unfamiliar words, such as using context, structural clues, and knowledge of letter-sound relationships. Both Chall (1967, 1979) and Bond and Dykstra (1967) reported the best predictor of beginning reading achievement to be a child's knowledge of letter names.

Laboratory studies indicate that familiarity with the letters of the alphabet and phonemic awareness (awareness of the speech sounds, or phonemes, to which they correspond) are strong predictors of successful reading (Adams, 1990). One of the most notable of these studies was Bradley and Bryant's (1983) research involving oddity tasks. Oddity tasks are the simplest of any phonemic awareness tasks, they require only that a child be able to compare and contrast similarities and differences in the sound of syllables.

Bradley and Bryant (1983) presented beginning readers with a set of three or four spoken words and asked which of the words was different. They realized that even if children's differences on the oddity task proved to be a very strong predictor of reading achievement, it would not be quite enough to prove that differences with phonemic awareness caused differences in reading achievement. To do this, they divided sixty-five children, who had done poorly on the oddity test, into four groups. The first group received individual tutoring sessions on phonemic awareness (comparing the beginning, middle, and final sounds of words). Children in the second group were additionally taught how these sounds were

represented by letters of the alphabet (spelling the words). Children in the third group spent their tutoring sessions learning how to categorize words semantically, and children in the fourth group received no special training at all. Bradley and Bryant found that children in the first group, who had received training in phonemic awareness only, outscored their peers. The reading scores of the group that received both phonemic awareness and spelling were well ahead of the non-phonemic groups.

Rumelhart and McClellan (1986) from their research write that word identification depends upon recognition of the letters, and skilled readers are able to recognize the component letters of the fixated word automatically regardless of how it is printed. Skillful readers thoroughly process the individual letters of words, but they do not recognize the letters of a word independently of one another. Instead, within their memories, the units responsible for letter recognition have become linked to one another via an intermediate set of association units. The importance of the intermediate units is that they expand the processing capabilities of the cognitive network. When the reader fixates upon a word, the visual percepts of the letters stimulate its corresponding letter recognition units.

Skillful, accurate word identification is held to depend, not just on the appearance or spelling of words, but also on their meanings and pronunciations. The ways in which these three types of information are processed or mediated by the reader are important, for they are not processed independently of one another. Instead, skillful reading is the product of the coordinated and interactive processes of all three (Seidenberg, 1987; Rumelhart and McClelland, 1986).

Adams (1979) studied skillful and less skilled readers. She found skillful readers could always remember the order of letters in words they read, whether real or regularly spelled nonwords, with perfect accuracy. The unskilled readers, in contrast, often remembered the order of letters in real words, but frequently misreported the order of the letters of pseudowords. She concluded that these less skilled readers had learned the whole spellings of real words, but their knowledge of spelling patterns that are smaller than words was weak. Adams (1981) argued that for reading, the most important function of the vowel was that of promoting the syllable as a perceptual unit. Skilled readers know how to break long words down into syllables. Moreover, they do so automatically and in the very course of perceiving them.

Mewhort and Campbell (1981) have investigated syllables for a number of years. Their results indicate that skilled readers break long words into syllable units during visual scanning, not afterwards. They do so for pseudowords as well as real words. Seidenberg (1987) presented evidence that skilled readers' ability to recognize words depended upon their ability to chunk words into syllables in the course of perceiving it. For skilled readers, the perception of words and syllables is effortless and automatic as they make connections among letters in their memories.

Empirical studies in the area of word identification show that readers first strive for accuracy, then automaticity. When immediate word recognition fails, good readers have mediated strategies for figuring out unfamiliar words. They use context, structural clues, and knowledge of letter-sound relationships to get to an accurate pronunciation and meaning of the word. Reading programs which include systematic

instruction in letter-to-sound correspondence lead to higher achievement in word recognition.

Stages of Word Indentification

Gough and Hillinger (1980) list two stages of word identification. Gough calls beginning readers cue readers. Cue readers remember words by selecting some distinctive visual aspect and associating it with pronunciation and meaning. They speculate that childen use visual cues to read their first forty or so words. In attempting to use this method with more and more words, children run into trouble. As confusion and frustration mount because it becomes harder and harder to find a unique visual cue, they shift to the second stage of development. Next, they become cipher readers. Cipher readers develop from knowledge of the alphabet, acquisition of phonemic segmentation skill, and an awareness of orthographic rules. Cipher reading enables readers to decode spellings they have not seen before and to read words accurately.

Ehri and Wilce (1983) write that beginning readers go through three successive "phases" of identifying words. During the first phase, unfamiliar words become familiar and are recognized accurately by readers as they direct their attention to component letters and map their sounds. As a result of practice, the second phase develops: familiar words come to be recognized as wholes without attention and without deliberate processing of the component letter-sound relationships. During the third phase, the speed of processing familiar words increases to a maximum as the components involved in the stimulus recognition and response production become consolidated or "unitized" in memory.

Ehri and Wilce (1985,1987) later elaborated on Gough's two stages and described a phonetic-cue reading stage. Phonetic-cue reading, which develops after visual cue reading but before deciphering, involves reading words by storing and retrieving associations between some of the letters in words' spellings and some of the sounds in their pronunciations. The phonetic cues selected are based on readers' knowledge of letter names, sounds, or both. They also documented the importance of moving beginning readers beyond cue reading and phonetic-cue reading to cipher reading. Cipher reading entails learning not only letter-sound relations but also how the phonemes are blended for forming pronunciations.

After years of careful and thorough investigation into the development of word identification skills, research shows that the ability to recognize letters, spelling patterns, and whole words accurately is critical to fluent word reading. As students' reading develops, their strategies become more complex. Word identification seems automatic and effortless as they concentrate more on learning from the printed page than on decoding print. First readers are visual cue readers, then they become phonetic-cue readers who depend on letter sound associations. The final stage is cipher reading--when the reader can decipher the written code accurately, automatically, and effortlessly.

Spelling

This section is divided into three subsections: spelling-to-sound correspondence, developmental spelling, and invented spelling versus traditional spelling. Spelling is defined as the translation of oral words into graphic symbols by visual memory and phonetic and motor clues (Hildreth, 1955). English orthography is an alphabetically based

orthography. It employs graphic symbols to represent the speech sound, or phonemes, of the language. In school, spelling is usually taught from a textbook because teachers do not have the time or resources to devise their own instruction (Henderson, 1985, 1990). Recent research shows that children's spelling strategies, when writing, reveal clear developmental stages. This review of literature on spelling begins with research about the letter-sound relationship, goes on to discuss the developmental nature of the spelling, the differences between invented (developmental) and traditional spelling instruction, and ends with the stages of spelling development.

Spelling-to-Sound Correspondence

There is not a perfect one-to-one correspondence between sound and letters. However, there is a more consistent relationship than was once thought (Hanna, Hanna, Hodges, & Rudolf, 1966). Hanna et al. (1966) undertook a study for the U. S. Office of Education at Stanford University using the aid of computer technology. They devised a set of rules for spelling 17,000 words in terms of letter-sound patterns. The results of the Stanford Study were that 49 % or half of the words were spelled correctly, and 37 % were spelled with just one error. Hanna et al. (1966) argue that even a limited knowledge of phonological relationships between sound and letters of the orthography can provide the power to spell literally thousands of words.

A significant factor of English orthography, however, eluded the Stanford researchers, namely that the appropriate unit of analysis in looking at English spelling is not the phoneme-grapheme correspondence

by themselves, but how these correspondences are governed by the words in which they occur (Venezky, 1967).

Hodges (1982) agrees that words, not letter-sound correspondence, are the appropiate unit of orthographic analysis. He writes that both phonological and morphological relationships play a fundamental role in establishing the spelling patterns in English spellings within words. Hodges reported that learning to spell is integrally related to learning underlying concepts about words and their structural and semantic relationships, and that the underlying cognitive processes involved in learning to spell are developmental in nature.

Developmental Spelling Studies

Studies in the area of developmental spelling began with Read (1971). He analyzed twenty preschool children's attempts to spell common and uncommon short and long vowel words. He found that the children seemed to rely on letter names for they often encoded the initial consonants and long vowel sounds correctly (e.g., "day" was DA and "lady" was LADE). These attempts to spell, when parents had given no instruction in letter sounds or how to spell, suggest that the children applied their knowledge of letter names. They figured out how the sounds in words might be segmented based on information contained in letter names. Read found that young children's spellings were often incorrect by conventional standards, but they were using their knowledge of letter names and sounds to spell words.

Read (1975) studied preschool children's effort to spell on the basis of their phonetic knowledge of language and familiarity with letter names. He showed that children as young as four years can identify and name

alphabet letters and represent word sounds quite accurately and consistently in their efforts. Read's analysis of children's "invented spellings" reveals that, even at an early age, children are able to detect phonetics represented in English orthography.

These observations extended to children in school settings. Paul (1976), who taught kindergarten children and gave them many opportunities to write, noted four stages of spelling development which fit with Read's interpretation. The stages noted were: recognition of words by their initial sound and letter (e.g., T for toy), recognition of initial and final sounds - consonants and some front vowels (e.g., wz for was, bot for boat), using vowels to mark a place for vowels (e.g., wotar for water), and acknowledgement of the correct spelling of sight words. By this classification, most of Read's subjects were at the second stage of development.

Henderson and his students at the University of Virginia followed up on Read's work. Beers and Henderson (1977) and Beers' study (1978) of first and second grade children showed the developmental nature of learning to spell held true even after children entered school. They noticed that many high frequency words were spelled correctly which they attributed to reading and spelling instruction. These same children failed to spell low frequency words correctly. They concluded that children can memorize words but may not understand the orthographic principles underlying those words. Children must internalize what they know about language before they can apply it to spelling.

The research of Beers and Henderson established that children move through stages of spelling development. When children first write, they

depend heavily on the sound system and spell words phonetically. In the second stage, they showed an awareness of letters representing sounds rather than being sounds themselves. In the third stage they recognize common structural features. For example, they see the influence of silent e on vowel sounds, and they consistently spell inflected endings correctly.

Gentry's research (1979) shows that development in spelling is continuous, going from simple to complex. Children pass from the phonemic to semi-phonemic to the transitional stage in spelling development. During the transitional stage of spelling most sight words are spelled correctly and invented spellings have short vowels correct and long vowel markers. Invented spelling errors occur when doubling consonants to mark the short English vowel and in the schwa position (Henderson, 1985). The final stage is correct spelling. Correct spellers show an extended knowledge of word structures including accurate spelling of prefixes, suffixes, contractions, and compound words. Correct spellers demonstrate growing accuracy in using silent consonants and dealing with consonants appropriately. As students grow in their spelling development, they continue to master alternative patterns. In describing the children's growth in spelling, Gentry and Henderson (1978) argue children test their theories of how the alphabet works by contrasting their productions with standard orthography. They encourage teachers to have students write daily, saying that purposeful writing is the key to cognitive growth in spelling.

In studying children's spelling strategies and their cognitive development Zutell (1982) pointed out that children seemed to use more sophisticated spelling strategies as grade level increased and children

matured. Considering the developmental nature of children's spelling mistakes and the cognitive factors, Zutell concluded that the development of spelling proficiency seemed to require both cognitive and linguistic processes. Zutell wrote that children need opportunities to compare and contrast words on a variety of levels (sound, syntax, semantics) so that they might systematically discover and utilize both intraword and interword patterns of organization.

Stages of Spelling Development

Gentry (1982) analyzed children's writing from age 4 to 10 and found distinct stages in spelling strategies. Gentry (1985) writes that knowledge of the developmental stages of spelling enables a teacher to assess where the child is developmentally. Emphasis is placed on what a child knows about words rather than on what they miss. Knowledge of development also helps a teacher know when to introduce formal spelling instruction. Gentry (1982, 1985) and Henderson (1985,1990) list the stages of spelling development. Gentry's list includes: precommunicative spellings, semiphonemic spellings, phonemic spellings, transitional spellings, and finally correct spellings. He explains the stages as follows:

Stage 1- Precommunicative. This stage embraces the understanding of written language that children attain before they learn to read. Children at this stage use letters or marks for writing words but the letters are strung together randomly. The letters in precommunicative spelling do not correspond to sounds (random letters = MONSTER).

Stage 2 - Semiphonemic. In this stage of spelling the child knows that letters represent sounds. It is sometimes called the

"letter-name" period and begins after children have achieved some concept of a word. Children's spelling at this stage is often abbreviated and represents the beginning and/or ending sound they hear (MTR = MONSTER).

Stage 3 - Phonemic. During this stage children spell words like they sound. The spelling may be unconventional because children at this stage represent the phonemes they hear in a word (MOSTR = MONSTER). At this stage they are ready to look for and learn about "within- word" vowel patterns.

Stage 4 - Transitional. Students in this stage of spelling think about how words appear visually. The spellings exhibit conventions of English orthography, like a vowel being present in every syllable (MONSTUR = MONSTER).

Stage 5 - Correct spelling. Correct spelling is the final stage. Correct spelling occurs after children develop an awareness of underlying spelling rules. Correct spellers develop over years of word study and writing and show an extended knowledge of word structures, including accurate spelling of prefixes, suffixes, contractions, and compound words. Correct spellers demonstrate accuracy in using silent consonants and dealing with consonants and vowels appropriately. Correct spellers also recognize when words don't look right and continue to master alternative spellings.

Invented Spelling Versus Traditional Spelling

Children use letters to invent words long before they have any explicit knowledge of written words (Templeton, 1980). Children as young as three or four seem to understand that writing represents more than

just some marks on paper and that it indeed "says something" (Goodman, 1986, p.12). An analysis of children's linguistic "errors" when teachers allow students to use invented spelling during writing reveals a great deal of information about the onset of language development (Hodges,1982). Children's misspellings are seldom random or haphazard, but instead fall into predictable categories. Research has shown that errors made by poor spellers indicate at what point that development has broken down (K. Anderson, 1985).

Ehri (1988) argued that developmental spelling is quite gradual. Carefully observing one student, she noticed that phonemically complete spellings were not in the majority until the child had been experimenting with the system for a whole year. Soon after the student's phonemic spelling came correct spellings. Ehri concluded, as Chompsky had in 1979, that once the child understood and learned the principles of our spelling system, dealing with standard spelling came easy. The evidence from research is that invented spelling activity simultaneously develops phonemic awareness and promotes an understanding of the alphabetic principle (Treiman,1985; Clarke,1989; Ehri,1988; Adams,1990).

Clarke (1989) observed two types of classrooms. She called one type the traditional classroom, where correct spelling was expected and children used word lists and dictionaries to obtain correct spelling during writing activities. The other type of classroom she called the invented spelling classroom. In these classrooms children were asked to spell unknown words as best they could. Clarke compared these first grade children who were encouraged to use invented spelling with those who were encouraged to use traditional spelling in their creative writing.

Overall, not much difference was noted among the two groups when looking at all students. Findings indicated that children using invented spelling were able to write on their own in the early months. Children encouraged to use invented spelling wrote more, and had more errors than children encouraged to use traditional spelling. Those using traditional spelling wrote with more sophisticated vocabulary, more complex syntax, and committed fewer spelling errors than those using invented spellings. On the other hand, children using traditional spelling tended to write much shorter stories.

However, it is important to note that Clarke's results did show a clear advantage for low readiness students in invented spelling classrooms. Low readiness students accounted for most of the gain in spelling and reading that resulted from using invented spelling. They outperformed their traditionally instructed peers of the low readiness group on the majority of spelling and word recognition post-tests.

This section reviewed the literature in the area of developmental spelling beginning with Read (1971, 1975). Studying young children's invented spelling reveals much about their cognitive and linguistic development. Looking at spelling developmentally places the focus on what a child knows about words, not what a child does not know. As young children mature, they learn more about the orthographic principles underlying spelling, and they develop more sophisticated strategies for spelling words. As their knowledge increases, so do their spelling approximations. As teachers observe spelling skills unfold in their classrooms, they must engage students in the kinds of cognitive activities

that will help them, regardless of individual differences in ability, and lead them to spelling competence (Gentry, 1985).

Relationship Between Word Identification and Spelling

The strongest link between reading and writing abilities tends to cluster at the level of spelling and word identification skills. Two lines of research in the areas of word identification and spelling were identified: (1) correlational studies of the relationship between spelling and word recognition using global measures (Morris,1981; Morris & Perney,1984; Shanahan,1984; Zutell & Rasminski,1986, 1989), and (2) correlational studies of the relationship between spelling and word recognition using similar word lists (Gill,1989; Zutell,1988). Thus, this section is divided into two subsections: global measures and similar word lists.

Global Measures

Morris (1981) explored the beginning reading-writing relationship using global measures. He used two diagnostic tasks to assess children's knowledge of reading and spelling words. The first task was to read a known rhyme to children as they pointed to the words, in order to assess their concept of a word. The second task was a fourteen word spelling test. Morris found a high correlation ($r = .79$) between the beginning first graders' performance on the concept of a word-rhyme reading and their ability to represent phonemic segments in their invented spellings. Morris stated in his work that reading and spelling are cyclical, mutually-facilitative entities that support one another.

Morris with the help of Perney (1980) replicated this study with end of the year kindergarten students, again a significant correlation was reported (r = .67). A second study by Morris and Perney (1984) explored in some depth the developmental relationship existing between early reading and spelling ability. The question they asked was whether children's spelling at the beginning of first grade was a good predictor of their reading achievement at the end of the year. The children were tested at three points during the school year on an eighteen word spelling test. The scoring system was based on the developmental spelling patterns identified by Read (1975) and Beers (1980). An illustration of their scoring system follows. 0 points--words which were spelled with a random letter string or a spelling in which the beginning consonant was inappropriate. 1 point--words with only the beginning consonant correctly represented. 2 points--words with the beginning and ending consonants correctly represented. 3 points--phonetic spelling of a word.
4 points--transitional spelling (which was usually beginning and ending consonants plus correct short vowel or attempts to mark the long vowel).
5 points--correct spelling of the word.

Morris and Perney (1984) found that the eighteen-word spelling test at the beginning and in the middle of first grade strongly predicts word recognition scores in the spring or the end of first grade (r = .68 in September and r = .82 in January). They concluded that reading and writing experiences serve to advance young children's written word knowledge through progressively more complex conceptual stages. Over time, students gained a growing power to read and spell, and moved away from reliance upon spoken language for spelling because they began

learning the orthographic regularities of the written language.

Shanahan (1984) conducted a study using multiple reading and writing measures with second and fifth graders. The purpose of the study was to conduct an exploratory analysis of the relationship between learning to read to learning to write at elementary school level. For the reading measures Shanahan used vocabulary, word recognition, sentence comprehension, and passage comprehension. For the writing measures he used vocabulary diversity, syntactic complexity, qualitative and quantitative measures of spelling and organization. An exploratory analysis of these variables was made using canonical correlational analysis. At both grade levels word recognition factors drawn from the reading set were most related to the spelling variables of the writing set. Shanahan stated that the nature of the reading writing relationship appears stable across grade levels. The only major difference in the reading contributions across the grade levels is the substantial increase in the importance of vocabulary to the relationship. Shanahan concluded that these results suggested that a knowledge of word meanings becomes more important to the reading process as children get older.

Shanahan looked at the nature of the reading-writing relationship between grade levels (second and fifth) and achievement levels (beginning readers and advanced readers). Beginning readers ($\underline{N}$ = 69) were second and fifth grade students whose standard scores on phonics and reading comprehension tests placed them in the bottom 25 % of the sampling distribution. Proficient readers ($\underline{N}$ =137) performed in the top 35% of the sampling distribution on both the phonics and the reading comprehension tests. Shanahan concluded that phonics knowledge is the most important

aspect of reading that relates to the writing performance for beginning readers. He indicated that the reading comprehension and writing skills of young children are influenced primarily by word-level skills (decoding and spelling). As the students become more proficient readers, the nature of the reading-writing relationship changes and vocabulary begins to play a more important role than phonics knowledge. Shanahan suggested that writing could be integrated into the teaching of reading, and that research which explores the possibility of exploiting this relationship instructionally is also needed.

Shanahan and Lomax (1986) used the data collected by Shanahan (1984) to compare and evaluate three alternative theoretical models of the reading-writing relationship. The three models they investigated were: the reading-to-writing model, the writing-to-reading model, and the interactive model. The reading measures Shanahan included were word analysis, vocabulary, and sentence and passage comprehension. The writing measures included spelling, vocabulary, sentence structure, and story organization. Of the three models, the interactive model, in which reading knowledge could be used in writing, and writing knowledge could be used in reading, provided the best description of the data, particularly at the second grade level.

Shanahan and Lomax concluded that the traditional approach to curriculum design and instruction (reading instruction proceding writing instruction) is unnecessarily inefficient. Such an approach fails to take advantage of the knowledge-sharing opportunities in both directions. They also suggested that these relationships might be increased even more by

taking reading and writing measurements during the performance of identical or related tasks.

Juel, Griffith, and Gough (1986) conducted a longitudinal study using first and second grade students and focused on the development of word recognition, spelling, reading comprehension, writing, and the interrelations of the growth in these skills. Their investigation compared the word recognition and spelling subtests of the Wide Range Achievement Test (WRAT, 1977) to phonemic awareness and exposure to print along with several other tasks. Two subtests (vocabulary and block design) of the Weschsler Intelligence Scale for Children-Revised (WISC-R) were given to the students and an estimated IQ was formed. Some data were analyzed with hierarchical multiple regression and some with analysis of variance. A path analysis was also performed.

These researchers found that IQ contributed to phonemic awareness, and phonemic awareness had a powerful influence on learning to read and write. They also found the correlation between word recognition and spelling was high (r = .84 in first grade and r = .77 in second grade). Their results strongly suggest that without phonemic awareness, exposure to print does little to foster spelling-sound knowledge. They claimed that phonemic awareness combined with exposure to print contributes to cipher knowledge. (Cipher knowledge is the basic component of decoding which is one of the two components of reading.) Cipher knowledge is also the basic component of spelling, which is a necessary component of writing. They reported that the relationship between word recognition and spelling was especially strong because development of both skills appears to rely on similar sources of knowledge: cipher knowledge--

knowledge of code (letters and letter patterns) and lexical knowledge--knowledge of words.

Juel and her colleagues wrote that the influence of cipher knowledge appeared to shift between first and second grade. In first grade they found a predominance on cipher knowledge. By second grade lexical knowledge predominated, suggesting that more automatic processsing predominates. In both first and second grade they noted that spelling and ideas contributed to writing. In first grade they found that spelling dominated, whereas in second grade they found that ideas dominated.

Juel (1988) reported on these same subjects as they learned to read, write, and progress in school. She followed them from the first grade to fourth grade. She stated that poor readers remained poor readers (probability =.88), and a primary factor that kept poor readers from improving was their poor decoding skills. She noted that poor readers appear to become poor writers. Her study showed results similar to Clay (1979) in New Zealand and Lundberg (1984) in Sweden.

Zutell and Rasminski (1986, 1989) began to explore this relationship further by looking at students' reading and spelling at the third and fifth grade levels. Each student was asked to do three things: (1) read aloud a carefully selected passage, (2) take a brief spelling test, and (3) take the appropriate level of the Gates-MacGinitie Reading Test. Zutell and Rasminski were looking at the relationship between spelling and oral reading performance--specifically, rate, accuracy, and phrasing--and found, as expected, that all the reading and spelling variables were highly correlated. The results indicated a connection between reading fluency and spelling ability is strong, at least through third grade. They found the

connection between reading accuracy of words in context and phonetic quality particularly noteworthy (r = .73). This suggested to the researchers that the ability to move across a word to get general phonetic match is an important aspect of word knowledge in the primary grades. This ability was found to vary among students.

Similar Word Lists

Zutell (1988), aware of limitations in the global aspects of the reading and spelling tasks in his previous study, examined the reading-spelling relationship more closely by using the same words at the third grade level. He chose the Qualitative Inventory of Word Knowledge, developed and refined by Schalgal (1982), for the list of words he used to have the third grade children read and spell. Zutell had forty third grade students read the list of words individually. For quick identification (Q) the students received 2 points, for words that were inspected (I) before they were identified the students received 1 point. When words could not be identified no points were given. The reading scores were the total of the Q and I points. The spelling lists were given in small groups. The words were scored correct or incorrect. The spelling score was the total number of words correctly spelled.

Zutell found that a closer relationship existed (r = .82) than when more global comparisons have been used (r = .70, Zutell & Rasminski, 1986). A second finding was the slightly closer connection between spelling and quick identification than between spelling and untimed word identification. Zutell concluded that the relationship between the areas of spelling and word recognition is an area that needs further investigation.

The purpose of Zutell's latest study (Zutell & Fresch,1990) was to add a longitiudinal dimension to understanding spelling and oral reading fluency and the word knowledge connections between the two. Zutell used twenty-eight of the thirty-nine third grade students from his 1988 third grade study. The Qualitative Inventory of Word Knowledge was used to assess the students' spelling ability and to test the students on both quick and untimed word identification. Students were also asked to read two oral reading selections. A correlation matrix indicated very strong relationships between all variables both within and across collection times. In addition, the study revealed clear stability within measures and a remarkable consistency in patterns of relationships across measures over an extended period of time. Zutell concluded that word identification and spelling are two skills which are strongly related and that this relationship remains stable, at least through the fifth grade.

Gill (1989) conducted a study using the same lists of words for spelling and reading. His purpose was to examine how well children could read words printed in their own invented (incorrect) spelling and to compare this performance to how well they could read the same words when correctly spelled. Forty-one words were used. These words came from the research of Beer (1978), Gentry (1979), and Zutell (1975) and were selected because the spelling of the words changes developmentally across the primary years. He also compared the responses by first, second, and third graders in order to determine if there were any developmental changes in the relationship examined. In reporting proportionally correct responses across grade levels, Gill found the following: Grade 1 = .88, Grade 2 = .81, and Grade 3 = .81. These numbers

suggest word recognition and spelling are closely related processes and that a healthy and steady relationship exists across the primary grades. As children became older, they recognized more correctly spelled words than invented spelling words.

Gill claimed that these findings lend support to a current theory that children's invented spellings reveal their present knowledge of the orthographic system and that children use this knowledge base for both word recognition and spelling.

The correlational literature reviewed shows work occurred in the investigation of word identification and spelling in the elementary grades during the 1980's. The first measures used by the researchers were rather global, but recently two investigators began to use the same word lists for both word recognition and spelling. Although, they found the correlation even closer, Gill (1989) stated that, "The actual nature of the relationship between spelling and word recognition knowledge has not been determined" (p. 118).

Ability

When teachers work with students, consideration is often given to the students' cognitive ability. Ability is defined as "the power to perform" (Harris & Hodges, 1981, p.2). Cognitive ability involves thinking, intelligence, and scholastic aptitude. Students' ability is often influenced by their experiental backgound, personal attitudes, motivation, cultural background, and the test or task they are asked to perform (Harris & Sipay, 1985; Spiro & Myers, 1984). Reading ability is "skill in processing text accurately and rapidly, in interpreting it and in using it (Harris & Hodges, 1981, p.266). Research has given us some ideas of the individual

differences in ability among students. This section on ability is divided into two subsections: skilled and unskilled readers and good spellers versus poor spellers.

Skilled and Unskilled Readers

The single most striking characteristic of skillful readers is the speed and effortlessness with which they can decode text, recognize whole words at a glance and understand their meanings at once (Rozin & Gleitman, 1977). Skillful readers appear to recognize words at a glance. Rumelhart and McClellan (1986) believe that word identification depends upon recognition of the letters, and skilled readers are able to recognize the component letters of the fixated word automatically regardless of how it is printed. They do not depend upon shape information for their rapid recognition of familar words and letter patterns (Adams, 1979). When visual recognition fails, skillful readers can apply some spelling-to-sound rules to translate print into its spoken equivalent (Adams,1990). Skillful readers have knowledge of words--their spellings, meanings, and pronunciations.

Unskilled readers, in contrast, are often unable to recognize individual letters and spelling patterns quickly, effortlessly, and automatically and transform them into words. Poor readers read far fewer words, stories, and books (Allington, 1983). Therefore, they do not get the practice they need with letters and letter patterns to become more skillful readers (Adams, 1990). Weak decoding skills are the cause of many of the poor readers' difficulties. Poor readers expend much effort decoding word by word and characteristically cannot decode polysyllabic words. When younger and poorer readers have insufficient knowledge of

spelling patterns, they often rely on context and often overuse it (Adams, 1990). Poor readers get further and further behind. Indeed, the gap between good and poor readers grows wider each year.

Good Versus Poor Spellers

Research has given us some ideas of these individual differences among students. Early in the course of spelling development, all children tend to spell words in ways that are neither correct, phonologically acceptable, nor stable. Individual differences are noticed among students as their spelling develops. Good spellers tend to use their knowledge of letter patterns. Poor spellers, in contrast, use letter by letter sound translation. Good spellers have a sense of what "looks right" but their ability to spell reflects more than just visual imagery. Poor spellers do not have a sense of what "looks right." Poor spellers rely on grapheme-phoneme correspondence in spelling (Radebaugh, 1985). Both the reading and spelling of poor spellers reflect an incompleteness in the knowledge they have acquired about spelling patterns and an incompleteness in their basic orthographic knowledge. Successful spelling improvement depends on getting children to attend to unfamiliar patterns. Seeing a word in print is superior to hearing it spelled (Adams, 1990).

Research has shown that the ability to read and spell words depends on the students' word knowledge. This knowledge enables children to both read and write words. Skillful, accurate word identification is held to depend, not just on the appearance or spelling of words, but also on their meanings and pronunciations. The ways in which these three types of information are processed or mediated by the reader are important, for they are not processed independently of one another. Instead, skillful

reading is the product of the coordinated and interactive processes of all three (Seidenberg, 1987; McClelland and Rumelhart, 1986). When children attend to print and spelling patterns, they become good readers and better spellers.

Summary

Studies pertinent to this investigation have been included in the literature review. (The studies reviewed that pertain to reading focus on the area of word identification during the last twenty-five years.) The studies on spelling focus on invented spelling and began in 1971. All correlational studies of word identification and spelling have been included and have all occurred during the last decade.

Learning to read is a complex process. During the beginning stages of reading development children focus on print as they try to decode words. Studies in the area of reading instruction show that programs, which include systematic instruction on letter-to-sound correspondence (phonics), lead to higher achievement in word recognition, especially in the early grades and by students who are experiencing difficulties in beginning reading. Skilled readers recognize words quicky and accurately.

Learning to spell is a complex process also. Read's work (1971) in the area of developmental spelling made educators and psychologists aware of how word knowledge develops. Research that followed began to focus more closely on the areas of spelling and reading, and how they relate to one another. During spelling development, educators have found that children's invented spelling errors evolve toward correctness as the child gains more experience with written language. The process of inventing spelling right from the beginning is firmly endorsed. Spelling

encourages children to practice and experiment with letter-sound relationships, it sharpens their phonemic awareness and their interest in words.

Noticing that an important relationship exists between children's early spelling and reading efforts, researchers began to ask the question: "What is the nature of the relationship between reading and spelling?" Researchers found a strong correlation when using global measures for reading, and the correlation was even higher when students were asked to read and spell the same word list(s). This investigation further explores the relationship and investigates the relationship among three areas of word knowledge: speed of word identification, accuracy of word identification, and spelling as well as the effect ability has on those three areas.

CHAPTER III

METHODOLOGY

Several studies have demonstrated important relationships between children's word knowledge, as measured by spelling development, and the easy, automatic processing involved in fluent reading (Morris, 1981; Zutell & Rasminski,1986,1989; Zutell & Fresch, 1990). The purpose of this study is to investigate the relationship among three areas of word knowledge: speed of word identification, accuracy of word identification, and spelling as well as the effect ability has on those three areas.

Subjects

Initially, 108 students were the subjects of this study. Four students in this population who were identified by the local school system as "Learning Disabled" were not included because of their inability to perform like the other students in the population. Two other students who did not have scores for the Test of Cognitive Skills were not included. Thus, the subjects for this study were 102 second grade students in a large elementary school in northwest North Carolina who spend their entire school day in self-contained, grade-level classrooms. Eighty-four of the subjects (82%) have been students at this school since kindergarten. While in kindergarten and first grade these students were encouraged to use invented spelling when writing. They have also used a basal reading program which includes phonics instruction. In second grade, these students received separate instruction in both word

identification (reading) and spelling daily. During the writing process the students used invented spelling with some modifications.

Seventy-seven of these students (75%) are white children and come from upper middle-class neighborhoods surrounding the school. The twenty-six black students (25%) are inner-city children who are bussed outside the city limits to the school to achieve racial integration. The population was balanced, having 51 boys and 51 girls.

All students were given a letter which explained the study to take home, and parents were asked to sign an attached consent form (See Appendix A for a copy of the letter and the consent form). All students who returned the parental consent form were included in the study. The students were divided into three ability groups based on the results of their score on the Test of Cognitive Skills (Publisher CTB/McGraw-Hill, 1981).

Materials

Test of Cognitive Skills

The Test of Cognitive Skills is a multiple-item paper and pencil test consisting of four subtests (Sequence, Analogies, Memory, Verbal Reasoning) assessing cognitive skills. The purpose of this test is to assess skills important for success in school. This test was administered by classroom teachers in October 1989 when the students were in second grade.

The Test of Cognitive Skills was sent to the Administrative Center where it was machine-scored and returned to the school. The test scores yielded the following: number of correct responses, age or grade

percentile rank, stanine, scaled score, and cognitive skills index (CSI). The CSI is an age-normed measure of general academic aptitude and indicates the students' overall level of ability relative to chronological age. The CSI scores were standardized for this population by first arranging the raw scores from highest to lowest. The top 4% were assigned a stanine score of 9. The next 7% received a stanine score of 8, the next 12% received a stanine score of 7, the next 17% were placed in stanine 6, the next 20% in stanine 5, the next 17% in stanine 4, the next 12% in stanine 3, the next 8% in stanine 2, and the remaining 4% in stanine 1. Students who scored in the seventh, eighth, and ninth stanines were designated as the High-Ability Group; students who scored in the fourth, fifth, and sixth stanines were designated as the Average-Ability Group; and students who score in the first, second, or third stanine were designated as the Low-Ability Group.

Qualitative Inventory of Word Knowledge

The Qualitative Inventory of Word Knowledge, standardized by Schlagal in1982, consists of six word lists graded in difficulty and was used to test speed and accuracy in word identification and accuracy in spelling. The words on Level I, Level II, and Level III of the Inventory were used (See Appendix B). Level I was used with all the students. Words on Level I were chosen to include such features as consonant nasals (bump), consonant blends (trip, drive), vowel-markers for simple long vowels (plane), and r-controlled vowels (girl).

Level II was used with those students who were successful in spelling a minimum of fourteen words (70 percent) at Level I. Level II words

include those with inflected endings (traded), doubled consonants (shopping), and varied long vowel patterns (train). When using the Inventory, a score of 69 percent or below signifies Frustrational Level (Schlagal, 1989).

Level III was used with those students who were successful in spelling eighteen of the twenty-five words at Level II. The words chosen for Level III include further examples of consonant doublets (stepping), as well as various silent letters (knee), further vowel patterns (count), r-controlled vowels (nerve), and ambiguous consonants (circus).

The investigator scored the Qualitative Inventory of Word Knowledge for speed and accuracy in word identification and for accuracy in spelling the words on the list(s). To score for speed the student was given one second to recognize each word. A response after one second was not considered for the speed count but was considered accurate if it was correct. Self-corrected responses were considered correct. The count for words identified with speed and accuracy was noted on each student's score sheet.

The spelling of the word list(s) was scored for accuracy. The spelling test(s) were hand scored later, and the number of words spelled correctly was noted at the top of the spelling score sheet(s).

Procedure

Children were tested individually on speed and accuracy of word identification and in a small group for spelling. All testing was done in a small room adjacent to the school library (which is centrally located). The students were told that the purpose of the testing was to evaluate

their reading and spelling, and the results would neither be used to grade them nor be placed in their permanent folders. The tests, administered in the mornings, varied in length from five to fifteen minutes. The time for each individual student depended on his/her speed of word identification and the number of lists he/she were required to read. Each level of the spelling test(s) took approximately fifteen minutes. All testing was completed during a two week period in May.

The research design was counter balanced to control for the practice effect (Campbell & Stanley, 1966). Students in the three ability groups were given a number using Table B Random Digits (Glass and Hopkins,1984, p.528) and were then randomly assigned to one of two groups: Group A or Group B. Those students in Group A were asked to read (identify) the words first and then to spell the words on Level I. Students who received a score of 70% or greater on the spelling measure of Level I went on to Level II to read then spell the words. Students who received a score of 70% or greater on the spelling measure of Level II went on to Level III to read then spell the words.

Those students in Group B were asked to spell the words first and then to read (identify) the words on Level I. Students who received a score of 70 % or greater on the spelling measure of Level I went on to Level II to spell then read the words. Students who received a score of 70% or greater on the spelling measure of Level II went on to Level III to spell then read the words. Level I testing for all students was completed before Level II testing was started. Level II testing for all students who

qualified was completed before Level III testing was started. The research design for each level looked like this:

High Ability	Group A:	Read words	Spell words
	Group B:	Spell words	Read words
Average Ability	Group A:	Read words	Spell words
	Group B:	Spell words	Read words
Low Ability	Group A:	Read words	Spell words
	Group B:	Spell words	Read words

Students in Group A were first asked to identify the words. The testing was done individually. Student reponses were audiotaped. The words were printed on index cards. The students were shown the words one at a time and asked to read (identify) the individual words. After one second, the examiner made a noise with a metal object. A teacher's aide at the school checked the audiotape to be sure that the one second timing for speed was consistent. Words identified after one second were no longer considered for the speed count but were counted as accurate if the response was correct. After 5 seconds of no response the students were encouraged to try the word and give any response they thought appropriate. The count for speed and accuracy was noted on the students' score sheet.

Students assigned to Group B were asked to spell the words first. The spelling test was administered in small groups. Students were given a sheet of paper, with a place for their name on the top of it, and numbered from one to twenty or twenty-five. Each word was pronounced first in isolation, then the word was used in the context of a simple sentence, and finally it was repeated again in isolation. The spelling tests were later scored, and the number correct was noted on the sheet.

Analysis

The focus of this study was on word knowledge (speed, accuracy, spelling). Three dependent variables were the number of correct responses on three measures of word knowledge: speed of word identification, accuracy of word identification, and spelling. These dependent variables were believed to be correlated; thus a one-way multivariate analysis of variance (MANOVA) was planned. First means, standard deviations, and intercorrelations were generated for all the variables. A MANOVA with follow-up univariate analyses and ANOVAS were used to explore the relationships among variables and groups. The MANOVA had two factors: word knowledge and ability. The results of the MANOVA indicate differences in the three measures of word knowledge. A test of homogeneity was run after the MANOVA to tell if the ability groups had equal variance.

Three univariate F-tests after the MANOVA identified significant differences in means for word knowledge scores. Neuman-Keul post hoc tests were computed for each univariate analysis that followed-up the MANOVA. The Newman-Keul post hoc tests indicate differences in ability groups on each measure of word knowledge.

Three 3 X 2 ANOVAs were also computed. The first 3 X 2 ANOVA indicated if the students across three abilty groups scored significantly higher on two measures of word knowlege: accuracy of word identification and speed of word identification. The second 3 X 2 ANOVA indicated if the students across three ability groups scored significantly higher on two measures of word knowledge: speed of word identification

and spelling. A third 3 X 2 ANOVA indicated if students across three ability groups scored significantly higher on two measures of word knowledge: accuracy of word identification and spelling.

Summary

Methodology used to investigate the relationship between word knowledge and cognitive ability was described in this chapter. Included were descriptions of the subjects, the instruments used for ability and word knowledge, as well as the scoring, procedure, and research design used in this study. An overview of the data analysis was given. Information regarding the analysis of this data and the results are in Chapter IV.

CHAPTER IV

RESULTS OF THE STUDY

The purpose of this study was to investigate the relationship among three areas of word knowledge as well as the effect ability has on those three areas. One hundred and two second grade students were tested on the three measures of word knowledge: speed of word identification, accuracy of word identification, and spelling. The results of this study are presented in this chapter and are divided into three sections: descriptive statistics, correlations among the three measures of word knowledge, and inferential statistics. A summary of the results concluded this chapter.

Descriptive Statistics

One hundred and two second grade students were tested on three measures of word knowledge. For the first measure, accuracy of word identification or total number of words recognized correctly, the mean for the total group was 54.19. For the second measure, speed of word identification, the mean score was 52.59. A mean of 42.86 was obtained for the third measure or the number of words spelled correctly (See Table 1). For all subjects, accuracy of word identification was greater than speed of word identification. All subjects could identify the words, as well as, or better than they could spell the words on the list(s).

Table 1

Subjects' Scores on Three Measures of Words Knowledge (N = 102)

MEASURE	MEAN	SD	VARIANCE	RANGE
Accuracy	54.19	20.20	408.13	09-70
Speed	52.59	21.14	446.90	03-70
Spelling	42.86	20.01	400.52	05-69

The subjects were divided into three ability groups: High-Ability, Average-Ability, and Low-Ability. Students in the High-Ability group had mean scores on the three measures of word knowledge superior to the Average-Ability group. Students in the Average-Ability group had mean scores on the three measures of word knowledge superior to the Low-Ability group (See Table 2).

Table 2

Subjects' Scores on the Three Measures of Words Knowledge by Groups

MEASURE	MEAN	SD	VARIANCE	RANGE
		High-Ability Group (n =24)		
Accuracy	66.46	8.70	75.74	43-70
Speed	65.83	8.92	79.54	41-70
Spelling	53.04	11.03	121.61	27-67
		Average-Ability Group (n = 55)		
Accuracy	54.40	19.04	362.50	15-70
Speed	52.69	19.97	398.59	10-70
Spelling	43.96	20.00	400.04	08-69
		Low-Ability Group (n = 23)		
Accuracy	40.87	23.56	429.98	09-70
Speed	38.52	24.33	591.90	03-70
Spelling	29.61	20.74	429.98	05-62

Correlations

A correlation describes a relationship between two variables. Pearson Product-Moment correlations were performed on scores from the three measures of word knowledge with the following results. There was a strong positive relationship between speed of word identification and spelling (r= .947) as well as the accuracy of word identification and spelling (r= .947). The strongest relationship among the three measures of word knowledge was found between speed of word identification and accuracy of word identification (r= .997). Table 3 presents the Pearson Product-Moment correlations for the three measures of word knowledge for the total population. Scattergrams for these correlations (Figures 1, 2, 3) follow.

Table 3

Correlations for Word Knowledge (N =102)

VARIABLES	Covariance	Correlation	R-squared
Accuracy and Speed	425.701	.9969	.994
Accuracy and Spelling	383.026	.9474	.898
Speed and Spelling	400.715	.9472	.897

Figure 1. Scattergram for the correlation between speed of word identification (Column 1) and accuracy of word identification (Column 2).

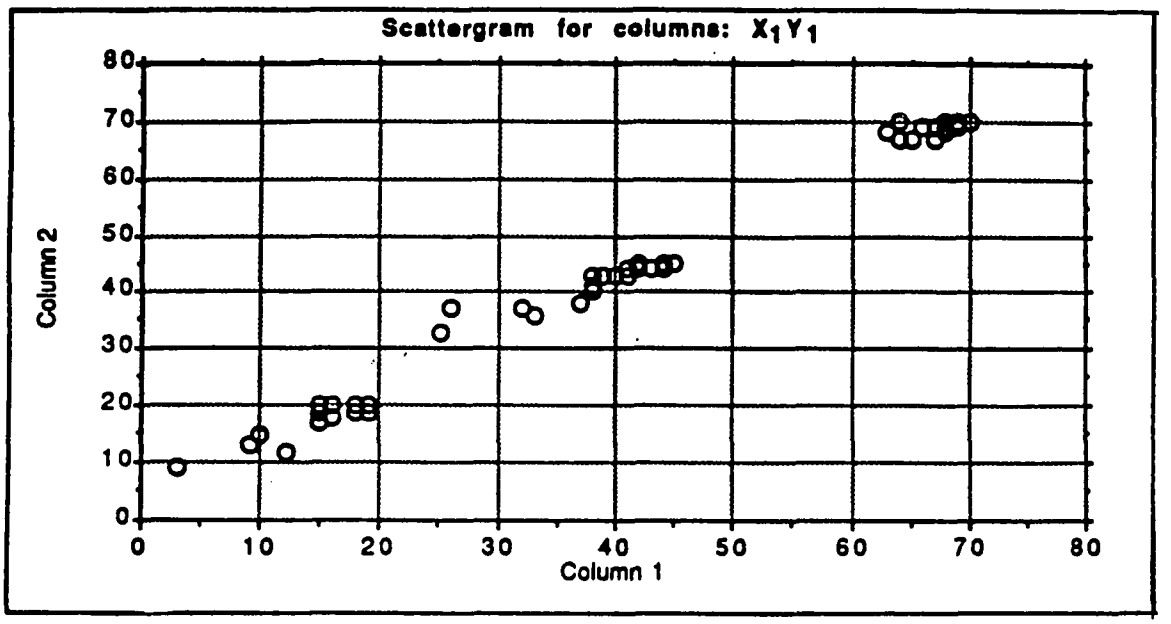


Figure 2. Scattergram for the correlation between speed of word identification (Column 1) and spelling (Column 3).

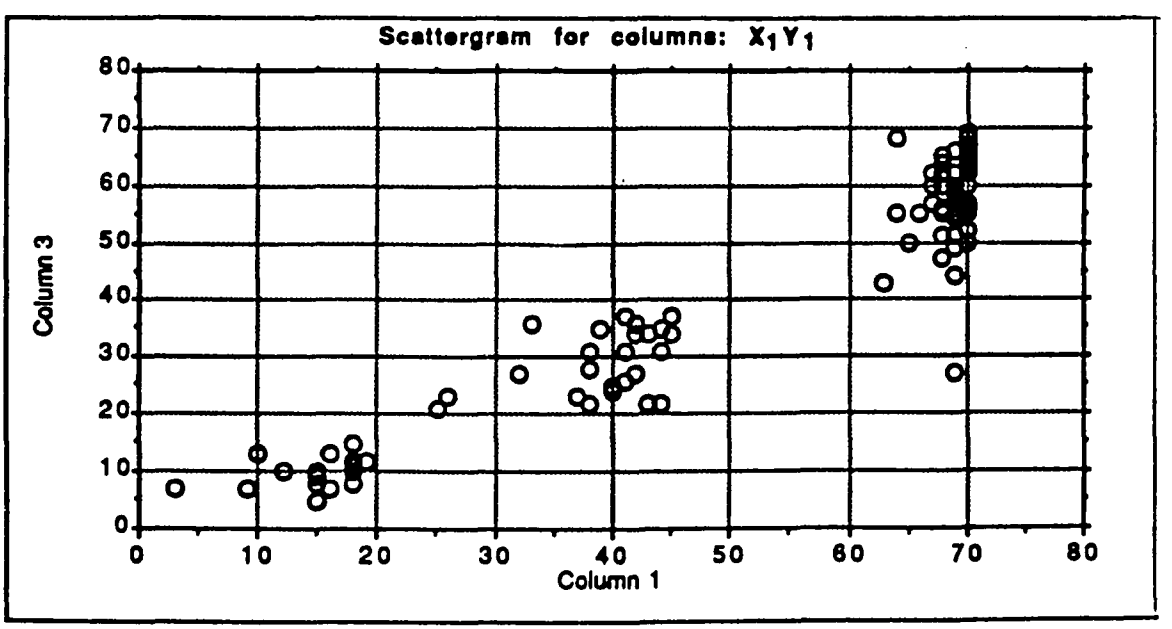
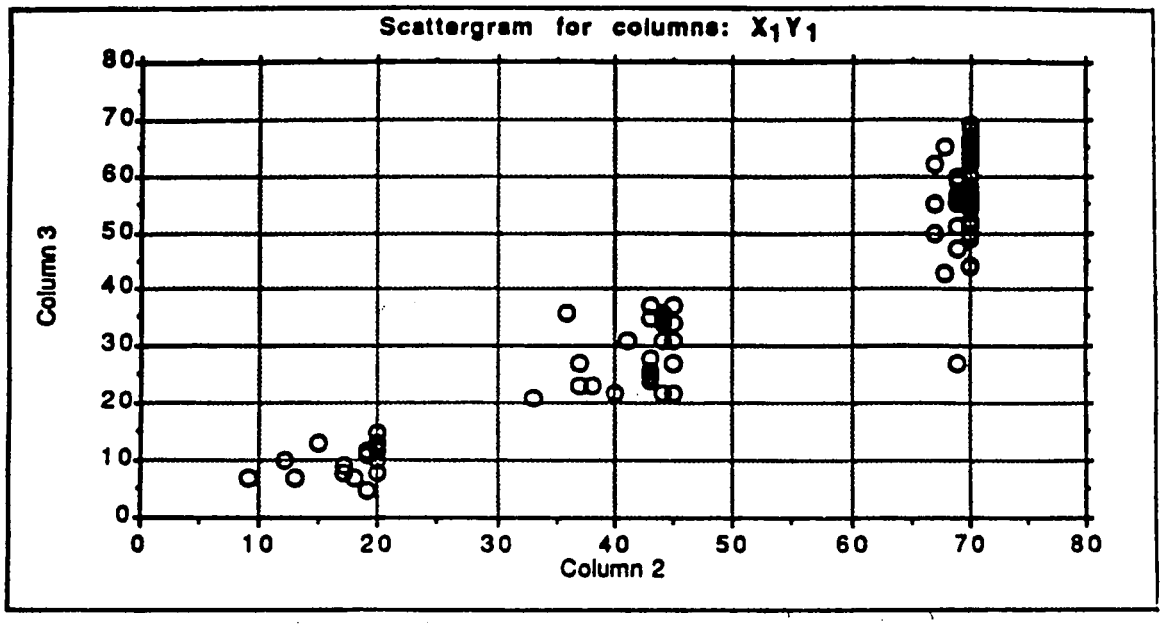


Figure 3. Scattergram for the correlation between accuracy of word identifcation (Column 2) and spelling (Column 3).



The correlations were also run by ability groups. For the High-Ability Group the correlation between accuracy and speed of word identification was found to be a strong positive relationship (r = .996). The relationship between accuracy of word identification and spelling (r = .67) was not found to be as as strong, nor was the relationship between speed of word identification and spelling (r = .665). The results for the correlations run for the High-Ability group differed from the correlations run for the total population (See Table 4).

Table 4

Correlations for the High-Ability Group (n = 24).

VARIABLES	COVARIANCE	CORRELATION	R-SQUARED
Accuracy and Speed	77.297	.996	.992
Accuracy and Spelling	64.284	.670	.449
Speed and Spelling	65.442	.665	.443

The next set of correlations run was for the Average-Ability group. The Average-Ability group had strong positive relationships between accuracy and speed of word identification (r = .996), accuracy of word identification and spelling (r = .955), and speed of word identification and spelling (r = .956). These correlations were similar to the total population (See Table 5).

Table 5

Correlations for the Average-Ability Group ($n = 55$).

VARIABLES	COVARIANCE	CORRELATION	R-SQUARED
Accuracy and Speed	378.57	.996	.992
Accuracy and Spelling	363.625	.955	.912
Speed and Spelling	381.933	.956	.915

The last set of correlations run was for the Low-Ability group. The Low-Ability group showed a strong relationship ($r = .997$) between speed and accuracy of word identification. The relationships between accuracy of word identification and spelling ($r = .977$) and speed of word identification and spelling ($r = .974$) were also strong and positive. These results were similar to the correlations for the Average-Ability group and the population as a whole (See Table 6).

Table 6

Correlations for the Low-Ability Group (n = 23).

VARIABLE	COVARIANCE	CORRELATION	R-SQUARED
Accuracy and Speed	571.117	.997	.993
Accuracy and Spelling	477.310	.977	.955
Speed and Spelling	491.486	.974	.949

Inferential Statistics

The purpose of the study was to investigate three areas of word knowledge and to see what effect the students' ability plays in this relationship. The subjects were divided into three ability groups by their scores on the Test of Cognitive Skills: High-Ability, Average-Ability, and Low-Ability. Seven hypotheses were generated in order to investigate the relationship between the students' word knowledge and their ability.

The assumption of equal variance was tested with homogeneity of variance tests (Bartlett-Box F and Cochran's C). This assumption was not met, primarily because of the restricted range (i.e. ceiling effect) of the High-Ability group. Nonetheless, both the MANOVA mutivariate F test (Lamba) as well all univariate tests were statistically significant.

Because the focus of the study was on word knowledge, a one-way multivariate analysis of variance (MANOVA) was computed with follow-up univariate tests for each dependent variable: speed of word identification, accuracy of word identification, and spelling. The Wilks' Lambda statistic indicated that there was a significant differences among the means of these three dependent variables ($p < .001$) across the three ability groups. The three follow-up univariate F-tests with (2, 99) D. F. showed that significant differences ($p < .001$) were found for all three measures of word knowledge (See Table 7).

Table 7

Univariate F-Tests with (2,99) D. F. that Follow the MANOVA

VARIABLE	HYPOTH. SS	ERROR SS	HYPOTH. MS	ERROR MS	F
Speed	8761.89	36374.82	4380.94	367.42	11.92*
Accuracy	7695.69	33525.77	3847.85	338.64	11.36*
Spelling	6593.72	33858.36	3296.86	342.00	9.64*

* $p < .001$

Neuman-Keul multiple comparison, or post-hoc tests, for the univariate tests used to follow-up the MANOVA were performed to determine exactly where the significant differences lie. The results of the Newman-Keul comparisons indicated that the means of all three

ability groups were significantly different ($p = .05$) from one another (High-Ability > Average-Ability > Low-Ability) on all three measures of word knowledge when broken down into pairs-wise comparisons (See Table 8, 9, and 10).

Table 8

Neuman Kuels for Speed of Word Identification by Groups

	MEAN	Group H-A	Group A-A	Group L-A
Group H-A	65.83		*	*
Group A-A	52.69			*
Group L-A	38.52			

* Denotes pairs of groups significant different at the .05 level.

Table 9

Neuman-Kuels for Accuracy of Word Identification by Groups

	MEAN	Group H-A	Group A-A	Group L-A
Group H-A	66.46		*	*
Group A-A	54.40			*
Group L-A	40.87			

* Denotes pairs of groups significantly differently at the .05 level.

Table 10

Neuman-Kuels for Spelling by Groups

	MEAN	Group H-A	Group A-A	Group L-A
Group H-A	53.04		*	*
Group A-A	43.96			*
Group L-A	29.61			

* Denotes pairs of groups significantly different at the .05 level.

Three 3 X 2 ANOVAs were run to determine relationships among ability levels and kinds of word knowledge. The first ANOVA with three levels of ability (High-Ability, Average-Ability, Low-Ability) and two levels of word knowledge was designed to investigate whether speed of word identification and accuracy of word identification differs significantly by ability. Three Es were generated by this ANOVA. The first, the main effect (11.67) for the three ability groups was significant ($p < .001$) as was the second the main effect (63.61) for the three types of word knowledge ($p < .001$). The third E generated was for the interaction. The interaction (5.45) was found to be significant for the three ability groups (2,99) D. F. ($p < .01$) on these two measures of word knowledge (See Table 11).

Table 11

Summary of the 3 x 2 ANOVA for Speed and Accuracy

SOURCE	DF	SS	MS	F
Main Effect for Group				
Between Subjects	2	16439.42	8219.71	11.67*
Within Subjects	99	69735.49	704.40	
Main Effect For Type				
Between Subjects	1	106.07	106.07	63.61*
Within Subjects	99	165.09	63.65	
Interaction	2	18.17	9.08	5.45*

* $p < .001$ ** $p < .01$

The second ANOVA with three levels of ability (High-Ability, Average-Ability, Low-Ability) and two levels of word knowledge was designed to see whether accuracy of word identification and spelling differs significantly by ability. Three Fs were generated by this ANOVA. The first, the main effect (10.77) for the three ability groups was significant ($p < .001$), as was the second the main effect (284.40) for the two types of word knowledge ($p < .001$). The third F generated was for the interaction. The interaction (1.77) was found not to be significant [F(2,99) = 1.77,ns] (See Table 12).

Table 12

Summary of 3 X 2 ANOVA for Accuracy and Spelling

SOURCE	DF	SS	MS	E
Main Effect for Group				
Between Subjects	2	14215.14	7107.57	10.77*
Within Subjects	99	65307.23	659.67	
Main Effect for Type				
Between Subjects	1	5966.44	5966.44	284.40*
Within Subjects	99	2076.44	20.98	
Interaction	2	74.26	37.13	1.77**

* $p < .001$ **NS

The third ANOVA with three levels of ability (High-Ability, Average-Ability, Low-Ability) and two levels of word knowledge was designed to investigate whether speed of word identification and spelling differs significantly by ability. Three Es were generated by this ANOVA. The first, the main effect (11.06) for the three ability groups was significant ($p < .001$) as was the second, the main effect (204.04) for the three levels of word knowledge ($p < .001$). The third E generated was for the interaction. A significant interaction (3.36) was found for all three ability groups (2,99) D.F. ($p = .039$) on these two measures of word knowledge (See Table 13).

Table 13

Summary of 3 x 2 ANOVA for Speed and Spelling

SOURCE	DF	SS	MS	F
Main Effect for Group				
Between Subjects	2	15207.79	7603.90	11.06*
Within Subjects	99	68058.84	687.46	
Main Effect for Type				
Between Subjects	1	4481.44	4481.44	204.04*
Within Subjects	99	2174.35	21.96	
Interaction	2	147.81	73.91	3.36**

*p < .001 ** p <.05

Summary

One hundred and two second grade students were tested on three types of word knowledge. For all subjects, accuracy of word identification was greater than speed of word identification. All subjects had more success with word identification than spelling. The correlations between the three measures of word knowledge showed strong positive (almost perfect) relationships. Three sets of correlations were also computed for each ability group. The correlations for the Average-Ability group and

the Low-Ability group were similar to the total population. The High-Ability group was not as highly correlated as the population as a whole on two sets of variables (the correlations for accuracy of word identification with spelling and speed of word identification with spelling).

A MANOVA indicated that the means of the three measures of word knowledge differed significantly from one another. The univariate F-tests followed by post hoc multiple comparison tests yielded significant differences among the means of the three ability groups on the three measures of word knowledge. Students in the High-Ability group could identify words with speed and accuracy as well as spell the words on the list(s) significantly better than the Average-Ability group or Low-Ability group. The students in the Average-Ability group could identify words with speed and accuracy as well as spell the words on the list(s) significantly better than the students in the Low-Ability group.

The results confirmed the prediction that word knowledge (speed of word identification, accuracy of word identification, and spelling) would differ among ability groups and that the difference would depend on the ability of the students. Thus, the seven hypotheses which were generated were found to be tenable.

CHAPTER V

DISCUSSION

This chapter reviews and discusses the investigation into word knowledge and cognitive ability. Research has shown that the ability to read and spell words depends on the students' word knowledge. When teachers work with students, consideration is often given to the students' cognitive ability. How cognitive ability affects the students' attempts at identifying words (with speed and accuracy) and spelling the same words was the focus of this investigation. Correlations and the hypotheses generated for this study are discussed in this chapter, as are the developmental spelling stages for these students and other classroom implications. Finally, limitations of this study are stated and future research is discussed.

It was hypothesized that the three measures of word knowledge would be significantly different (accuracy > speed > spelling). The raw data, the descriptive, and the inferential statistics for the three measures of word knowledge used in this study indicate that the differences among the measures are not great, but are statistically significant. Specifically the mean score for accuracy of word identification (54 words) does not look different from the mean score for speed of word identification (53 word), but the mean scores for accuracy and speed do look considerably different than mean of the spelling scores

(43 words). Nevertheless the means were significantly different even though there was little practical significance.

Correlations

Correlations for these variables were important because they show the relationship among the three measures of word knowledge: speed of word identification, accuracy of word identification, and spelling. The correlations for these three measures of word knowledge were high (nearly perfect). One reason for these high correlations may be the methodology used. Students were asked to read and spell the same words. Studies that have children use the same word lists to read and spell words have accounted for higher correlations before (Zutell 1988; Zutell & Fresch, 1990). However, the high correlations suggest that speed of word identification, accuracy of word identification, and spelling are very similar tasks. In any event, the correlations were so much higher than expected, and, thus, did not show differences in the three measures of word knowledge that would be expected for three different but correlated tasks. The results of this study support Zutell's conclusions from his studies (1988, 1990) that a single factor--conceptual word knowledge--common to a variety of reading and spelling tasks may explain the high relationships.

Because the correlations for the population were so high, three sets of correlations were run for each ability group. If the three groups had equal variance, then the correlations for these groups should similiar to the correlations for the population as a whole. As expected, the three correlations for the Average-Ability group and the Low-Ability group were similar to the population as a whole. The correlation for speed and

accuracy of word identification for the High-Ability group was also similar to the correlation for the total population. Surprisingly different were the two correlations for speed of word identification with spelling for the High-Ability group (r = .665) and accuracy of word identification with spelling for the High-Ability group (r = .67). The difference might be attributed to the fact that some students in the High-Ability group topped out on the two measures of word identification and spelled more than 70% of the word correctly but did not go on to a higher level list of words. Because of this ceiling effect, these students did not perform to their maximum and this affected the correlation of word identification with spelling for the High-Ability group only. The variance of this one group was limited by the ceiling effect. If High-Ability students who spelled 70% of the words on Level III of the Qualitative Inventory of Word Knowledge had been given an additional list (Level IV) to read and spell, the results might have been similar to the correlations for the total population.

However, the unusually high correlations can not be attributed to ability alone. When correlations were computed for the three measures of word knowledge with the subjects' scores on the Test of Cognitive Skills then partialed out of the intercorrelations to hold ability constant, these correlations were still very high (speed and accuracy, r=.996; speed and spelling, r=.935; accuracy and spelling, r=.934). Although statistically ability did make a difference, the correlations remained unusually high even when ability is partialed out of the relationship. In other words, as measured in this study and reflected by the correlations, these components of word knowledge are one and the same.

Hypotheses

Regardless of the correlational evidence, a MANOVA was performed and is robust. Subjects were divided into three ability groups by their scores on the Test of Cognitive Skills: High-Ability, Average-Ability, and Low-Ability. The variance in the High-Ability group was found to be limited by the ceiling effect. Seven hypotheses were generated in order to investigate the relationships between the students' word knowledge and their ability. The hypotheses examined in this study were:

1. There will be a significant difference among the means of the word knowledge (speed of word identification, accuracy of word identification, and spelling) scores across the three ability groups.
2. There will be significant differences among the means of the speed of word identification scores for the three ability groups (High-Ability > Average-Ability > Low-Ability).
3. There will be significant differences among the means of the accuracy of word identification scores for the three ability groups (High-Ability > Average-Ability > Low-Ability).
4. There will be significant differences among the spelling scores for the three ability groups (High-Ability > Average-Ability > Low-Ability).
5. The students across three ability groups will score significantly higher on the accuracy of word identification than speed of word identification.
6. The students across three ability groups will score significantly higher on accuracy of word identification than on spelling.

7. The students across three ability groups will score significantly higher on speed of word identification than on spelling.

For the first hypothesis the MANOVA indicated significant differences among the means of the word knowledge scores across ability groups. The results confirmed the prediction that word knowledge does differ among students across ability groups.

The second, third and fourth hypotheses investigated the effect ability played in these relationships. Ability was found to make a significant difference. As expected, students of High-Ability can read and spell words with greater speed and accuracy than students of Average-Ability or Low-Ability. Students of Average-Ability could read and spell words with greater speed and accuracy than those in the Low-Ability group. Ability does play a part in this relationship.

This data was consistent with what was expected, both from teacher observations and the literature. Although the teachers did not have their students grouped exactly as their Tests of Cognitive Skills would have grouped them, the results were remarkably close. Skilled readers recognized words rapidly and accurately and spelled these same words correctly. These same skilled readers were in the High-Ability group. Students who received average scores on the three measures of word knowledge were for the most part in the Average-Ability group. Also as expected, the students who had the lowest scores on the three measures of word knowledge were in the Low-Ability group. This pattern was also noted on the students' responses to the three measures of word knowledge.

The effects of ability on word knowledge has already been investigated in the second, third, and fourth hypotheses. The reason ability was in the 3 X 2 ANOVAs that investigated the fifth, sixth, and seventh hypotheses was to look at the interaction between ability and the three measures of word knowledge. Technically the three 3 X 2 ANOVAs are superfluous and one ANOVA could have been done because of the high correlations. Although they were not needed, they were performed as planned.

Once again as expected, the mean scores for accuracy of word identification was significantly different than the mean scores for speed of word identification across the three ability groups. Raw scores indicated that students in the three ability groups could correctly identify more words when given additional time to inspect the words than they were able to identify automatically. It may be that students had internalized word knowledge that they could apply to unknown words which allowed identification of the words. Students identified more words correctly than they spelled. Word identification was an easier task than spelling for most students. When spelling a word, students must be letter perfect in the placement of the graphemes. Students must be knowledgable about the sounds they hear in spoken words and be able to represent those sounds accurately. This is a difficult task for many children unless they have some idea of how English orthography works, and have been exposed to print. As expected, when given the same list(s) of words, the students could identify more words accurately than they could spell correctly.

The words used in this study are familiar words. The results of this study are similar to studies noted in the literature review (Ehri, 1976; Golinkoff & Rosinski, 1976; Guttentag and Haith, 1978; Pace & Golinkoff, 1976; Schadler & Thissen, 1981; Ehri & Wilce, 1979; and Stanovitch, Cunningham, & West, 1981) on automaticity. These studies indicated that familiar words can be recognized automatically (with speed and accuracy) by skilled and unskilled readers early in their schooling--by normal readers as early as the end of first grade and by unskilled readers as early as the third grade.

Previous studies have measured speed of word recognition in two ways: (1) measuring the exact time with an electronic clock, accurate to the millisecond (e.g., Stanovitch & Cunningham, 1981) or (2) asking the students to "name (the stimuli) as rapidly as possible" and responses within a certain amount of time are considered automatic (e.g., Ehri & Wilce, 1987). The methodlogy used in this study was similar to Zutell (1988) and Zutell and Fresch (1990) where the Qualitative Inventory of Word Knowledge was used to have students read and spell the same words. Rapid responses were considered for the speed count and words that had to be inspected before being named were added to the speed count for a count of word identified accurately. Results of this study reaffirm a statement made by Perfetti and Lesgold concerning speed and accuracy, "Current methods of testing do not make these distinctions very well (Perfetti & Lesgold, 1979, p.78)."

Spelling Stages

The data was also analyzed by spelling stages and this section discusses the students' performance in terms Gentry's (1982, 1985) and

Henderson's (1985) stages of spelling development.

High-Ability Group

Students in the High-Ability group were found to be at later stages of spelling development than the Average-Ability group and the Low-Ability group. All students in the High-Ability group (N = 24) were found to be in Stage 4 of spelling development according to Gentry's (1982, 1985) and Henderson's (1985) stages. These students exhibited conventions of standard English orthography, such as a vowel being present in every syllable. The problems they had when spelling words on the lists were with double consonants (e.g. traped for trapped) and varied long vowel patterns (e.g. chane for chain).

Average-Ability Group

Students in the Average-Ability group (N = 55) had more variance and were divided between Stage 3 and Stage 4. The students in Stage 4 made the same types of spelling errors as the students in the High-Ability group. Those Average-Ability students in Stage 3 had problems with vowel sounds (e.g., "shep" for ship), the consonant nasal (e.g., "bup" for bump), consonant blends (e.g., brive for drive), vowel-markers for simple long vowels (e.g., plan for plane), and the r controlled vowel (e.g., gril for girl) as well as inflected endings (e.g., grabd for grabbed), doubled consonants (e.g., stoping for stopping) , and varied long vowel patterns (e.g., flote for float).

Low-Ability Group

Students in the Low-Ability group (N = 23) had the greatest variance and were divided among Stage 2, Stage 3, and Stage 4. Children in Stage 2 often abbreviate and represent the beginning and/or ending

sounds they hear. Only one second grade student in the Low-Ability group was found to be still at Stage 2. This student had problems with beginning and ending sounds (the child wrote "jrop" for drop, "g" for girl, and "jrep" for trip). In Stage 3 children represent the phonemes they hear in a word and in Stage 4 they are more conventional about their spelling and represent a vowel in every syllable. The low-ability group students in Stage 3 and Stage 4 had misspellings similar to the average-ability group, but, more words were spelled incorrectly and they were more phonetic in their misspellings (they wrote "nee" for knee, "wen" for when, and "flot" for float).

Summary of Spelling Development by Groups

As expected, students in the High-Ability group were found to be in a later stage of spelling development than the Average-Ability group or the Low-Ability group. Students in the Average-Ability group were found to be in a later stage of spelling development than the Low-Ability group. Students in the High-Ability group were all at the same stage of spelling development. The students in the Low-Ability group exibited more variance in their spelling ability than the High-Ability or Average-Ability group. This variance may account for the fact that some teachers have difficulty teaching Low-Ability groups. Although there were a small number of students in this group, they had a wide variety of instructional needs. Table 14 shows in which stages of spelling development students in each ability group were classified based on their performance.

Table 14

Students by Ability Group and Stages of Spelling Development (N = 102)

Group	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
High-Ability	0	0	0	24	0
Average-Ability	0	0	22	32	0
Low-Ability	0	1	15	08	0
Totals	0	1	37	64	0

Classroom Implications

Cognitive abilitly affected the students' scores on the three measures of word knowledge. So one could argue that good students are good at word identification and spelling, and poor students are poor at word identification and poor spelling. One could also argue because of the high correlations that regardless of ability if one is good (or poor) at word identification then one probably is also good (or poor) at spelling. There was a pattern in the data and correlation scattergrams-- students were ranked similarly on the three measures of word knowledge regardless of their ability. All students, regardless of ability, could, identify as many or more words accurately than they could identify with speed. All students, regardless of ability, could identify more words than they could spell. The pattern of responses was consistent regardless of the ability group.

Teachers working with students of varying ability in the same classroom may find the students word identification and spelling skills may vary also. Teachers might best spend their time not in "grouping" students but in finding instructional strategies (such as word sorts) that best meet the developmental needs of all students regardless of their varying abilities. The results of the correlations for these three measures of word knowledge would argue for an integrated word study program and not separate instruction in word identification and spelling.

Limitations

The following limitations must be considered when interpreting the results of this study:

1. The study was conducted with second grade students in a large elementary school in North Carolina. Different results may have been found if a different population or grade level was used.
2. The Test of Cognitive Skills used to place students in the ability groups may not be a true test of academic ability for all students.
3. The word list(s) were words in isolation, not words in context, and may not accurately measure the students' word identification skill under ecologically valid conditions.
4. Words that were identified and named in one second were considered to be identified with speed. The speed at which students identify words varies and this may just be an approximation of their speed of word identification.
5. Only words on the first three levels of Schlagel's Qualitative Inventory of Word Knowledge were used. Some students could read all seventy words and spell more than 70% of them. These students

needed another level (list of words) to adequately assess their skill in word identification and spelling. Not continuing to the additional levels created the ceiling effect.

6. The methodology used to measure the three types of word knowledge did not tap the three different processes although conceptually these are different processes.

Future Research

This investigation was a continuation of previous work. A replication of this study in a different school, with a different population, having a different socioeconomic setting, and students of different abilities might lead to different results. Certainly this should be tried. Future research in this area should include a replication of the study letting students who had 70% or more of the words on the third list spelled correctly spelled go on to the next level, thus avoiding the "ceiling effect" for any student. It would be interesting to see if the correlations for the High-Ability group would be as closely related as the Average-Ability and Low-Ability group. Another investigation should study the idea of letting all students continue with the word lists until they could not identify 70% of the words accurately. Data from students' scores on the three measures of word knowledge may not correlate so highly.

Research with older students using similar word lists could investigate the correlations among three areas of word knowledge as well as investigate whether ability continues to have a significant effect on the three measures of word knowledge. Also, it might be interesting to study students in the Low-Ability group, at later time in

their schooling, to see if they might be taught some word identification strategies that would improve their spelling scores as well as their word identification scores. How closely related are the areas of word knowledge and how word knowledge is acquired and improved are all topics that will continue to be investigated until more answers are found.

Summary

One hundred and two second grade students were tested on three kinds of word knowledge. The results of a multi-variate analysis of variance (MANOVA) and follow-up tests confirmed the prediction word knowledge (speed of word identification, accuracy of word identification, and spelling) would differ among ability groups and that the difference would depend on the ability of the students. The three measures of word knowledge were found to be highly correlated to one another. They are so highly correlated that even when ability is partialed out the correlations remain unusually high.

Students in the High-Ability group were in the later stages of spelling development, Stage 4. Students in the Average-Ability group had more variance than the High-Ability Group and were in Stage 3 or Stage 4. The students in the Low-Ability group had the greatest variance and were in Stage 2, Stage 3, or Stage 4. This variance might account for the problems some teachers have when working with the Low-Ability group.

A pattern was noted in the results of this study. All students, regardless of ability, could identify more words accurately than they could identify with speed and all students could identify more words

than they could spell. The results of the correlations for these three measures of word knowledge (speed of word identification, accuracy of word identification, and spelling) would argue for an integrated word study program and not separate instruction in word identification and spelling.

Future research in this area might include a replication with a different population to see if similar results were obtained. Also, future research should investigate allowing students who had 70% of the words spelled correctly to go on to another list, thus avoiding the ceiling effect. Finally, it might be interesting to see if students in the Low-Ability group, even at later time in their schooling, might be taught some word identification strategies that word improve their spelling scores as well as their reading ability.

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APPENDIX A

PARENT'S CONSENT FORM

May, 1990

Dear Parent:

I am a graduate student in Curriculum and Instruction, EdD. level, at the University of North Carolina at Greensboro. I am interested in conducting a study at your child's school. The study will examine the question of how your child's word identification and spelling scores are related.

Before I ask you to consider granting permission for your child to participate, I would like to outline the study's procedure and potential benefits of such a study for your child and your school. Each child who participates will be asked to read and spell a list of words. Your child will read one list of words orally; later, your child will be asked to spell the same list of words in a group setting. The amount of time for each test will be from10 to 15 minutes.

The practical benefits of the study for your child are related to the fact that the testing will help the teachers and principal at your child's school to further evaluate the strengths and weaknesses of their reading and spelling programs. In terms of my interests, the benefits of the study will be related to learning more about the correlation between word identification and spelling by second grade students and how their word

knowledge (reading and spelling of words) relates to their cognitive ability. The Test of Cognitive Skills, given at school in October, will be used to determine ability groups. My research will look at these groups and not individual students.

Additionally, several points need to be mentioned. First of all, if your child participates, his or her identity will be kept confidential. After the testing is completed and the results are evaluated by your child's teacher, your child's name will be removed from the testing form. At this point, the only identification that I will have is an identification number. Also, if you decide to grant permission and then change your mind you will be able to withdraw your child from the study.

If there are any further questions regarding any aspect of the study, please feel free to contact me. If you are willing to grant permission for your child to participate, please write your child's name on the form below, sign it, and return it to school.

Thank you for your help,

Dorothy P. Hall

My child _____ can participate in the reading/spelling study at Clemmons Elementary School.

(your signature) (today's date)

APPENDIX B

Qualitative Inventory of Word Knowledge*

LEVEL I	LEVEL II	Level III
girl	traded	send
want	cool	gift
plane	beaches	rule
drop	center	trust
when	short	soap
trap	trapped	batter
wish	thick	knee
cut	plant	mind
bike	dress	scream
trip	carry	sight
flat	stuff	chain
ship	try	count
drive	crop	knock
fill	year	caught
sister	chore	noise
bump	angry	careful
plate	chase	stepping
mud	queen	chasing
chop	wise	straw
bed	drove	nerve
	cloud	thirsty
	grabbed	baseball
	train	circus
	shopping	handle
	float	sudden

* The Qualitative Inventory of Word Knowledge has six levels. These three levels were used for this study.
Source: Mc Guffey Reading Center - University of Virginia

APPENDIX C

Subjects' Scores

Student	CSI	Group	Speed	Accuracy	Spelling
60	140	B	44	45	31
83	137	B	64	67	55
32	134	A	69	70	44
19	133	A	69	70	58
11	131	A	69	69	27
31	131	A	70	70	62
88	130	B	68	70	60
30	130	B	70	70	63
22	127	A	69	69	56
78	126	B	70	70	57
41	126	A	70	70	67
46	125	B	70	70	63
01	125	A	69	70	60
52	124	B	70	70	65
57	124	B	69	70	57
80	124	B	68	69	47
20	124	A	70	70	55
92	121	B	70	70	60
77	120	B	69	70	51
40	120	A	70	70	50

38	118	A	41	43	37
65	118	B	69	70	62
64	118	B	69	69	51
36	117	A	44	44	35
04	116	A	70	70	52
73	115	B	45	45	37
51	114	A	70	70	66
72	114	B	70	70	62
05	113	A	42	44	34
39	113	A	69	70	58
81	112	B	68	70	51
07	111	A	69	70	56
90	111	B	70	70	68
33	110	A	69	69	59
79	110	B	66	69	55
96	110	B	63	68	43
34	109	A	70	70	67
26	109	A	18	20	10
75	109	B	70	70	60
49	109	A	16	20	13
93	109	B	68	70	62
86	109	B	68	69	55
21	108	A	68	70	64
84	108	B	70	70	64
35	108	A	41	43	26
08	107	A	67	67	62

70	106	B	40	43	25
27	106	A	68	68	65
89	105	B	64	70	68
85	105	B	44	44	35
63	105	B	70	70	56
69	105	B	19	20	12
16	104	A	45	45	34
24	104	A	69	70	49
91	104	B	42	44	36
37	104	A	69	70	54
17	103	A	69	70	62
76	103	B	69	70	54
13	102	A	69	69	59
02	101	A	69	70	66
06	100	A	68	70	56
62	99	B	67	69	57
61	99	B	70	70	69
58	99	B	15	17	08
47	99	A	15	20	10
97	99	B	18	20	12
18	99	A	18	20	08
59	98	B	38	40	22
94	98	B	38	41	31
00	98	A	33	36	36
28	98	A	40	43	24

09	98	A	42	45	27
12	98	A	43	44	34
29	97	A	70	70	69
44	97	A	43	44	22
03	97	A	41	44	31
98	96	B	26	37	23
23	96	A	70	70	67
97	96	B	10	15	13
10	95	A	03	09	07
53	95	B	18	19	11
95	94	B	44	45	22
38	94	A	69	70	55
42	93	A	18	20	15
14	93	B	19	19	12
100	92	B	69	70	62
68	91	B	68	70	56
43	91	A	65	67	50
66	90	B	37	38	23
74	89	B	16	18	07
71	89	B	67	69	60
54	89	A	25	33	21
25	88	A	38	43	28
80	87	B	68	69	47
55	86	A	09	13	07
56	83	B	70	70	57
99	82	B	32	37	27

87	81	B	70	70	55
67	79	B	12	12	10
82	78	B	39	43	35
48	77	A	15	19	05
50	71	A	15	17	09