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COGNITIVE PROCESSES RELATED TO SPELLING DEVELOPMENT IN GRADES 5 AND 7

by

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ABSTRACT

This study explores the relationships between cognitive processes and spelling ability. The study consists of an instrumental component which involved testing 57 normal students in grades 5 and 7 on a survey of cognitive processes, and case studies on two good and two unexpectedly poor spellers. The cognitive processes assessed in this study include visual and auditory processes, reading by full or partial cues, learning by rote or by rule, and simultaneous and sequential processing. Spelling ability was assessed using phonologically irregular words. The relationships between subjects' spelling abilities and cognitive processing abilities and styles were analyzed using a Pearson product-moment correlation. Profiles of good and unexpectedly poor spellers at the grade 5 and grade 7 levels were developed using a multidimensional scaling procedure.

The correlational analysis was conducted using the scores of all subjects in grades 5 and 7. Spelling ability was found to be correlated with reading using full orthographic cues, learning by rote, visual and auditory processing and memory, and both simultaneous and sequential processing styles as tested in this study.

The multidimensional scaling procedure provided information which was used to develop profiles of idealized individual grade 5 and grade 7 good and poor spellers. The grade 5 good speller was found to be strong in rote learning, sequential processing, and reading using full cues. The grade 7 good speller was strong in rule learning, simultaneous processing and reading using full cues. The poor spellers at each grade differed from the good spellers primarily in reading style. These findings

support the the theory that a cognitive shift, which has a notable impact on spelling ability, occurs around age 10.

The case study data indicated a strong relationship between primary spelling strategy, reading style, and spelling ability. The two good spellers read using full cues and rely primarily on visual-orthographic strategies in spelling. The two poor spellers read using partial cues and reported primary reliance on phonologic strategies in spelling.

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DEDICATION

This work is dedicated to

Kathryn Pfliger
and
Harvey Pfliger

and

Arthur Kratzmann
and
Mary Kratzmann

Your belief in me carried me

until I could believe in myself.

CHAPTER 1

Introduction

The ability to spell in conventional ways is an aspect of language development which remains somewhat of a mystery. Schwartz (1983) and Venezky (1980) cited the lack of interest in and funding for spelling research, relative to research in other language areas, as major contributing factors to this lack of understanding. Others have described the problem in ways which are more fundamentally related to traditional perceptions of spelling as a simple dichotomous process, in which words were seen as being spelled correctly or incorrectly and the primary question was "how many" rather than "how." Spelling improvement in children was seen as a quantitative indication of increased speed and accuracy in the use of strategies which were the same as adult spelling strategies (Hall, 1984; Schwartz, 1983). Modern linguistic insights have altered this view of spelling, resulting in general recognition of developmental patterns in the acquisition of spelling ability, and the relationship of these patterns to general cognitive development and growing linguistic awareness. Templeton (1986) described the current view of spelling as involving "an interaction with reading, with writing, and with vocabulary development," and "...coming to understand the structure of words at progressively more abstract levels" (p.77). The knowledge and use of these various levels of English language structures in spelling develop gradually, and at differing rates among individuals (Read & Hodges, 1982).

Despite these differences, and differences in type and duration of spelling instruction, most people become proficient in the use of conventional spellings in day to day written production (Hamill, Larsen, & McNutt, 1977). Two to fifteen percent of the population of normal

language users do not become proficient spellers, however, although they exhibit average or above-average abilities in other areas of language function (Frith, 1980; Nolen, 1980). These spellers generally produce phonetically accurate, but unconventional representations of the words they are attempting to spell. This phenomenon of the "unexpectedly poor speller" (Frith, 1980) who is proficient in all language areas except spelling is not clearly understood, perhaps because the nature of the spelling process itself is not clearly understood in any holistic sense.

A growing body of literature speaks of the need for researchers to investigate spelling with the purpose of developing a comprehensive theory of spelling, rather than focusing on various factors independently and in isolation (Bruce & Cox, 1983; Harste, Burke, & Woodward, 1983; Read & Hodges, 1982; Templeton, 1986). There has also been a call for movement toward more qualitative research into the spelling process (Hall, 1984), and for serious study of individual subjects, as "Studies which collapse data across large numbers of subjects are unsuited by their nature to shed light on details of cognitive processes involved in spelling" (Sloboda, 1980, p. 234). Nolen and McCartin (1984) also cited the need for further work with spellers beyond age 10. This is seen as the age at which the transition from the phonological stage, wherein words are spelled largely by sounding out, to the final correct stage of spelling development, usually termed the visual-orthographic stage, occurs. The visual-orthographic stage is characterized by the use of stored visual and linguistic information when spelling words, a strategy which is more likely to produce conventional spellings than is the phonologic strategy.

Major changes have occurred in the perception of spelling as a process in the past decade, as researchers have investigated various factors related to spelling as a developmental, cognitive, language based, and symbolic communication code. There is, however, much work to be done in moving toward a comprehensive theory, as

researchers have tended to investigate individual factors with varying populations, and often with conflicting findings. Attempts to consolidate and clarify issues related to spelling through both qualitative and quantitative research would add greatly to the existing literature.

This study was designed with the issues noted above as a base. A group of students at two different grade levels, grade 5 and grade 7 was assessed on a survey of cognitive processes and on spelling ability, and this information was used to develop profiles of good and unexpectedly poor spellers at each grade level. The students who are not proficient spellers are designated as unexpectedly poor spellers throughout this study, because they are not deficient in general language ability, including reading, and are within average ranges in school achievement. Tests included in the survey of cognitive processes were selected based on a review and analysis of the literature on cognitive processes related to spelling ability. The grade levels, 5 and 7, were selected in order to investigate the cognitive shift which Frith (1980) and others have described as having an impact on spelling strategy and ability. Finally, case studies on individual students were conducted in order to gain greater insight into the spelling process of particular students in a particular setting, as well as to check test data against authentic qualitative data.

Purpose of the Study

The purpose of this study is to explore and describe the development of spelling proficiency in normal language users through comparisons of proficient spellers and unexpectedly poor, or non-proficient spellers at the grade 5 and grade 7 levels on a number of measures and factors. The focus of this research is the cognitive shifts that previous researchers have identified as occurring around age 10, and the effects of these shifts on spelling development. Students in grade 5 were selected as subjects,

as they are generally around age 10, and are in the process of making this shift. Grade 7 students were also included, in order to investigate the effects of this previously identified cognitive shift on spelling ability.

The subjects selected for this study were purposely drawn from a stable, upper middle class community. A majority of the subjects attended the same school from grade 1 on, and were average or above-average students throughout their elementary school years. Those subjects identified as poor spellers in this study are what Frith (1980) described as unexpectedly poor spellers, as their over-all school achievement and general language development were within normal ranges. Exploration of the cognitive processing abilities and styles of these children, as well as of those who are good spellers, provides some insight into the cognitive abilities and styles specific to spelling development. The use of a variety of measures and factors with a single group of subjects at two distinct places on the developmental continuum contributes information and data which will be useful in future attempts at producing a comprehensive theory of spelling development.

Methodological issues related to this type of inquiry are also explored, focusing on the use of qualitative and quantitative approaches, and ways in which these two approaches can be combined in a single study. In addition to providing information about spelling which may be useful to practitioners and future researchers, this study provides an example of the usefulness of combining qualitative and quantitative data in educational research, broadening the range of methodologies in the investigation of spelling development.

Theoretical Assumptions

Two sets of assumptions, theoretical and methodological, provide the foundation for this study.

The basic assumption underlying this study is that the acquisition of spelling competence is a developmental process, which has as its major impetus the human need to engage in the semiotic process of communication through the use of symbol systems (Harste et al., 1983).

A second assumption is that the stages of spelling development are reflected in the strategies employed by spellers, and that the visual-orthographic strategy is the primary strategy employed by spellers who have reached the mature, conventional stage of spelling development. While spellers continue to have access to, and use, all of the spelling strategies employed at each stage of spelling development, it is generally recognized that the visual-orthographic strategy is the most consistently reliable approach to spelling given the nature of English orthography (Barron, 1980; Frith, 1980, 1981).

The third theoretical assumption is that good spellers rely primarily on the use of visual-orthographic strategies, and that unexpectedly poor spellers, who are not generally language deficient, rely primarily on phonologic strategies (Gentry, 1984; Marsh, Friedman, Welch, & Desberg, 1980; Frith, 1980).

There are also three methodological assumptions, the first of which may seem obvious. However, it is an important consideration in light of current issues surrounding testing and the nature of tests. For the purposes of this study, it will be assumed that the testing devices used provide some indication of the abilities they were designed to assess (Das, Leong, & Williams, 1978; Kaufman & Kaufman, 1983; Narrett, 1984), and that these tests provide information which can be used to separate subjects into groups and to develop profiles of good and poor spellers.

Secondly, it is assumed that the use of a multidimensional scaling procedure, a form of cluster analysis, will map subjects in such a way as to provide information useful in the development of profiles of good and poor spellers in the total population, and of good and poor spellers at the grade 5 and grade 7 levels. It is further assumed that comparisons of test

results using correlational data will augment the descriptions of these groups of spellers.

Finally, this study rests on the assumption that insights into language use and other cognitive processes can be gained through the thoughtful analysis of a variety of qualitative and quantitative data, and that the merging of data collected through the use of these two approaches to research can provide greater insight into the problem than could either used alone (Hall, 1984; Sloboda, 1980).

Statement of the Problem

The questions to be addressed in this study are all centred around a single fundamental issue, the quest for understanding of the development of proficiency in spelling. The major question to be addressed is: Why are some people proficient spellers in grades 5 and 7, and others are not, despite similarities in school achievement and instructional experience?

It is generally accepted that phonologic strategies are not effective strategies for mature, conventional spelling and that visual-orthographic strategies are effective. Yet, little is known about how users of these strategies differ in areas other than spelling, or about how these strategies develop, or are learned or acquired. This study is designed to explore these issues, and to add to the growing understanding of spelling as a developmental process, through the investigation of a number of specific questions and the analysis of a variety of quantitative and qualitative data.

Research Questions

The specific questions addressed in the study are as follows:

1. What are the relationships between spelling ability and ability in using certain cognitive processes?

This question is exploratory in nature, designed to begin to sample the underlying cognitive processes which are related to spelling ability. The cognitive processes assessed in answering this question were selected for one of two reasons. Some were selected because of reports of differing findings with respect to their relationship to spelling ability in the existing literature. Others were selected based on a lack of information in the existing literature about the relationship of given cognitive processes to spelling ability for subjects at the upper elementary school level.

2. What are the relevant characteristics of good and unexpectedly poor spellers as determined by academic performance and performance on selected cognitive tests?

A statistical analysis, the multidimensional scaling procedure, was used to answer this question. This procedure grouped subjects based on their similarities when all available data were considered. From the actual scores of individual subjects in each group, group means were determined. These group means became the "scores" of the idealized individuals who represent good and unexpectedly poor spellers.

3. How do these relationships and characteristics differ between students in grade 5 and grade 7?

This is one of the key questions in this study, as it relates to the cognitive shift described in the literature. This shift is described as occurring around age 10, and as having an effect on ability to use visual-orthographic strategies in spelling, hence on general spelling ability. The information used to answer question 2, above, was also used in answering question 3, but the groups used to develop the profiles were further divided into grade level groups.

4. How do selected representatives of the good and unexpectedly poor spellers at the grade 5 level differ from each other?

Case studies of four individual subjects were conducted in order to gain greater insight into the actual processes and strategies employed by good and poor spellers at the grade 5 level. Information about these four individuals was compared to the instrumental data, in order to investigate areas in which the case study information converged with and diverged from the instrumental data.

Significance

This study grew out of the researcher's interest in spelling development, cognitive processes, and the relationship between the two. Existing research provided some insight, but there appeared to be gaps in the literature. Research reports on single, specific cognitive processing abilities, e.g. Bruce and Cox's (1983) work on the relationship between learning by rote or by rule and spelling ability, were found, but a lack of research on how a number of cognitive abilities taken together as a "profile" relate with spelling ability was noted. There are also few studies that investigate the same factors with subjects of varying ages. Given the general acceptance of the developmental nature of spelling ability, these gaps in the literature were most striking, particularly in light of existing research which indicates that the cognitive shift which occurs around age 10 is a critical turning point in spelling development. This study is designed to help fill these gaps in the understanding of spelling, by providing information on the relationships between a number of cognitive processes and spelling ability, and investigating and describing how these relationships differ between groups of subjects in grade 5 (approximately age 10) and in grade 7.

This is a descriptive study and will provide information which has potential usefulness in four areas of concern to educators and theorists.

First, it will consolidate, clarify, and add new information to the literature concerning the cognitive aspects of spelling development, and move the field somewhat closer to the development of a comprehensive theory of spelling. Unlike many existing studies, in which a single aspect of cognitive processing and its relationship to spelling for a group of same age subjects is reported, a broad survey of cognitive processes was used with subjects in two different age groups. The resulting profiles of good and unexpectedly poor spellers, cross grade level sampling, and triangulation of test data with authentic data collected during the case studies will assist theorists and future researchers as they continue to move toward a comprehensive theory of spelling development.

This study will broaden the range of methodologies in spelling research by providing an example of the consolidation of quantitative and qualitative data in a single inquiry. While educational research has traditionally been either qualitative or quantitative, the melding of methodologies produces a model in which information of one type can be used to illuminate information of the other type. The quantitative data provide an overview of the findings, while the case studies provide concrete examples of the findings.

The descriptive information resulting from the analysis of these data will be useful as other researchers generate hypotheses and questions for further research, particularly with respect to the later stages of spelling development and the cognitive underpinnings of mature spelling.

Finally, and perhaps most importantly, the study will illuminate issues to be considered in the development and implementation of curricular approaches related to spelling instruction for students in the transitional and mature stages of spelling development. Early spelling development and the role of emergent writing and invented spelling are well documented in the literature. There has been a dramatic change in spelling instruction in the primary grades in recent years, based on this information about spelling development. Similar changes have not occurred in the upper elementary grades. This study will provide

information on the cognitive aspects of the later stages of spelling development which can be used in the development of instructional methodologies for students in the upper elementary grades.

Limitations of the Study

The limitations inherent in this type of educational research occur primarily in the area of generalization. The small, non-randomly selected number of participants, and the relatively large number of measures in relation to the number of participants, preclude statistical generalization to other populations.

Definition of Terms

Cognitive process - A specific aspect of perception and mental operation on information from the environment.

Cognitive strategy - Perceptions and mental operations on information from the environment which entails the use of more than one cognitive process.

Legal orthographic patterns - Letter strings which do not violate the conventions of the English spelling system, even though they may produce unconventional spellings, e.g. GOAST for ghost and CLIME for climb.

Orthography - The study of spelling and the conventions of correct spelling.

Phonologically opaque words - Those words which cannot be spelled correctly through the application of phoneme-grapheme correspondence rules, (phonics, or "sounding out"), e.g. canoe and business.

Phonologically transparent words - Those words which can be spelled through the application of phoneme-grapheme correspondence rules, e.g. smoke and dividend.

Semiotics - That field of study concerned with the identification and investigation of a variety of sign systems, or codes, and the conventions and operations through which these sign systems produce meaning.

Sequential processing - Cognitive processing style which entails the ability to organize separate elements of information into a series which involves order and/or time factors. Sequential processing is linear in nature.

Simultaneous processing - Cognitive processing style in which separate elements of information are integrated into gestalts. Simultaneous processing is holistic in nature.

Strategies:

analogy - Spelling using known words as models for determining the spelling of unknown words.

articulation - Spelling by matching points of articulation in a given word to points of articulation in known letter names.

phonologic - Spelling strategies based on the use of phoneme-grapheme correspondence rules; spelling by "sounding out."

visual-orthographic - Spelling strategies which involve the use of a mental visual representation of the word to be spelled, and implicit knowledge of underlying linguistic factors such as etymology, morphemic bases, and "legal" orthographic patterns.

CHAPTER 2

Literature Review

In this chapter, literature from a number of areas of study related to the development of proficiency in spelling is discussed. The areas of research which have been identified as important to this study are (a) developmental aspects of spelling, (b) spelling strategies, (c) cognitive factors related to the transition from phonologic to visual-orthographic strategies in spelling, (d) cognitive and orthographic considerations in spelling instruction, and (e) spelling as a semiotic process.

Developmental Aspects of Spelling

Spelling acquisition has been generally recognized as a developmental process for the past two decades (Anderson, 1985; J. Beers, 1980; Gentry, 1984; Henderson, 1980; Hodges, 1982; Johnson, Quorn, & Langford, 1981; Read & Hodges, 1982). Numerous studies conducted to explore the nature of this developmental process and to identify the steps along the continuum from non-speller to speller have resulted in a variety of descriptive terms for these stages. Gentry (1984) described five stages (a) precommunicative, (b) semiphonetic, (c) phonetic, (d) transitional, and (e) correct, or mature. The precommunicative stage is characterized by random representations, including the use of letters, numerals, and scribbles. The semiphonetic stage is the one in which young spellers combine use of letter name analogies, point of articulation, and some knowledge of letter-sound correspondences in their attempts to communicate in writing. Charles Read (1975) described this stage in detail in his study *Children's Categorization of Speech Sounds in English.*

The phonetic stage is the stage at which young spellers develop and use knowledge of letter-sound correspondence rules in their spelling attempts. This ability develops throughout the primary grades and is evidenced by spellings which are often unconventional, but nearly always understandable if one "sounds out" the letters in sequence.

The transitional stage, as described by Gentry, is that in which spellings provide evidence of a growing visual memory of spelling patterns. Although many words are still spelled in unconventional ways, these spellings do exhibit conventions of English orthography, for example, vowels in every syllable, and are often more visually similar to the conventional spelling than phonetically similar.

The final stage, that which most but not all spellers attain, is the mature stage. This stage is also referred to as the conventional or correct stage. At this point on the developmental continuum, the speller is able to spell most words conventionally through the use of visual, orthographic, morphemic, analogic, and other sources of information about language at multiple levels of abstraction (Beers & Beers, 1981; Bookman, 1984; Ehri, 1980, 1988; Fehring, 1983; Frith, 1980; Simon, 1976; Templeton, 1986; Thomas, 1982; Venezky, 1967).

Henderson and Templeton (1986) described four stages of spelling development which differ slightly from Gentry's descriptions. The four stages relate to the development of awareness of and ability to use various language structures and concepts. These are described as (a) concept of word, at which point children become capable of inventing spellings, (b) letter-sound correspondences, which is equivalent to Gentry's phonetic stage, (c) syllables and affixes, the stage at which young spellers become aware of these linguistic structures and incorporate use of rules related to them in their spellings, and (d) the fourth stage, which involves the use of derivational patterns in the spelling of morphologically related words. Henderson and Templeton identify grades 5 and 6 as the level in which the final stage becomes cognitively possible and encourage instructional support for transition to

this stage. Other researchers have also described grade 5 or approximately age 10 as an important point on the developmental continuum, as it appears to be the point at which transition to the final stage of spelling ability begins. Most children at this age are developmentally prepared to move from the phonologic stage to the visual-orthographic stage (Frith, 1980).

Developmental issues have provided the main thrust in spelling research since 1970. It is now known that knowledge of ways in which words are composed, and the permanent mental storage of representations of both phonologically transparent and opaque words has to be constructed over time (Ehri, 1982, 1988; Seymour, & Porpodas, 1980; Templeton, 1986). Further evidence supporting the view of spelling as a developmental process is provided in studies which assessed spelling abilities and found that the same patterns occur at various ages, across groups, and regardless of type or duration of spelling instruction (Beers & Beers, 1980; Beers, Beers, & Grant, 1977; Hamill et al., 1977).

Despite general acceptance of spelling as a developmental process, there are dissenting views with respect to the role of instruction in the development of spelling ability. Ehri (1988) and Groff (1986) discussed the value of phonologic knowledge in spelling and suggested that instruction in phoneme-grapheme correspondences at the beginning stages of literacy learning produces greater proficiency in spelling. Groff promoted the use of direct instruction in phonics and spelling as part of a traditional approach to spelling instruction. He suggested that the use of word lists for study and testing and the requirement of correct spelling in all written work throughout the elementary school years are critical to acquiring spelling ability. Ehri described phonological awareness as being important in the amalgamation of word identities, which involves the integration of word knowledge based on lexical (semantic and syntactic), auditory-verbal (pronunciation) and visual aspects of the word. She suggested that phonological awareness grows through knowledge

of English orthography as a speech mapping system. Unlike Groff, Ehri stated that children should be encouraged to invent phonetic spellings in the primary years, and that teachers should in fact teach phonics by teaching children how to invent phonetic spellings. This exploration and invention is, in Ehri's view, important in children's development of both phonological awareness and orthographic knowledge, and is more effective than traditional approaches to spelling and phonics instruction in helping children become proficient spellers.

The developmental aspects of spelling investigated in the present study focus on the later stages of spelling development, with particular attention to the cognitive shift which occurs around age 10. The effects of this shift on spelling development, and the cognitive processes which are related to this development are described for subjects in grades 5 and 7.

Spelling Strategies

Developmental researchers have relied primarily on error analysis in their determination of the strategies employed at various stages of spelling development (Anderson, 1985; Hodges, 1982; Read, 1975). Other researchers have investigated various spelling strategies in terms of their efficacy in the spelling process (Drake & Ehri, 1984; Fehring, 1983; Henderson & Templeton, 1986; Ormrod & Jenkins, 1988; Simon & Simon, 1973; Venezky, 1967). These issues are closely related, as it is apparent that spellers employ different strategies in each of the developmental stages, and that these strategies increase in complexity and usefulness. The following discussion will focus on the research which has been primarily concerned with the usefulness of various strategies in attempts to spell correctly, but there will be some overlap with the preceding discussion of developmental aspects of spelling.

Read (1975) described the earliest spelling strategies as being based on articulatory features rather than phonologic features. The invented spellings of young children, ages 4 to 7, were collected and categorized, resulting in Read's finding that these spellers often used the letter whose name shared points of articulation with the sound they wanted to represent. For example, the word "bed" might be spelled BAD, as the articulatory features of the E as sounded in "bed" are quite similar to those for the letter name A. Read concluded that speech sounds are categorized by young children in ways that lead to systematic and logical invented spellings and that early invented spellings provide evidence of the use of a logical strategy based on points of articulation -- how the word "feels" when it is being pronounced -- although they may appear fairly random when approached from a phonological or orthographic perspective.

The articulatory strategy gives way to a phonologic strategy during the primary years of schooling. This major strategy shift appears to be related to early reading instruction; as children acquire greater knowledge of letter-sound correspondences, they begin to use this knowledge in their attempts to spell words (Ehri, 1978; Marsh, Friedman, Welch, & Desberg, 1980). Ehri (1978) proposes that learning to read may produce change in the organization of the internal lexicon by providing visual entries. The organization of the visual entries in conjunction with existing phonologic entries assists in the matching of letters to sounds and supports development of the phonologic strategy. This strategy is augmented by the use of analogy strategies, in which the child uses stored information about known words in attempts to spell unknown words.

The phonologic strategy is effective in spelling phonologically transparent words, commonly called regular or phonetically regular words. It is also effective in producing phonologically accurate but often unconventional spellings. The effectiveness of this sound-based strategy breaks down when it is applied to phonologically opaque words, those

which do not have one to one letter-sound correspondences. This breakdown is demonstrated in the findings of the Hanna, Hanna, Hodges, and Rudorf (1966) study in which a computer was programmed with approximately 300 phoneme-grapheme correspondence rules which the computer then applied to the spelling of 17,000 commonly used English words. Although the rules were derived specifically from and for the list of 17,000 words, the computer was able to spell only slightly less than half of the words correctly (Hanna, et al., 1966; Hanna, Hodges, & Hanna, 1971). The researchers found that most of the errors could be traced to morphologic and orthographic levels of word structure, homophones, foreign words, and a few seemingly unpredictable spellings, such as colonel, of, one.

A second major strategy shift occurs at approximately age 10. Most spellers begin to rely primarily on visual-orthographic strategies which involve the use of visual, analogic, orthographic, and morphemic information, rather than phonologic strategies (Barron, 1980; Evans & Smith, 1989; Frith, 1980; Henderson & Templeton, 1986; Marino, 1978; Marsh et al., 1980; Templeton, 1979, 1986). Children who do not make this shift continue to rely primarily on phonologic strategies and fall behind in spelling achievement, even though they may make normal progress in reading and general language development. Several researchers have investigated the strategies employed by these children, whom Frith (1980) described as unexpectedly poor spellers, in studies comparing subjects who are good readers and good spellers, good readers and poor spellers, and poor readers and poor spellers (Frith, 1980; Jorm, 1981; Nelson & Warrington, 1974). The findings of these researchers showed that the unexpectedly poor spellers produced spelling errors which were phonologically accurate but unconventional, indicating continued reliance on phonologic strategies beyond the age at which most children shift to greater reliance on visual-orthographic strategies.

Frith's (1980) study of students in grade 7 who were either good readers/good spellers, good readers/poor spellers (unexpectedly poor spellers), or poor readers/poor spellers indicated that students who are poor at both reading and spelling lack knowledge of phoneme-grapheme correspondence rules. Frith found that about half of their spelling errors were not phonetically consistent with the sounds of the words given, an indication that these subjects were proficient in using a phonologic spelling strategy. Jorm (1981) and Nelson and Warrington (1974), in similar studies with students in grades 4 - 6, also concluded that the subjects they identified as poor readers/poor spellers were deficient in their knowledge of or ability to use phoneme-grapheme correspondence rules. These subjects appeared to be attempting to employ a phonologic strategy, but with little success.

Subjects Frith (1980) identified as good readers/poor spellers tended to produce phonologically intact misspellings, as did the good reader/good speller group. The major difference among these two groups was in number rather than type of errors, with the good reader/poor spellers producing significantly more errors than the good reader/good spellers. Frith describes this difference as a breakdown at the level of correct grapheme selection. While both groups produced phonologically intact spellings, the unexpectedly poor spellers appear to lack the mental store of visual representations of words which the good spellers call upon in order select the correct letter when more than one letter could be used to represent a given sound. Consequently, these unexpectedly poor spellers relied on phonologic strategies, which resulted in phonologically intact, but not necessarily conventional spellings. Jorm (1981) also found that unexpectedly poor spellers produced spellings which were more phonologically accurate than the spellings produced by poor readers/poor spellers, and concluded that the unexpectedly poor spellers were able to use phoneme-grapheme correspondence rules, but had difficulty at the grapheme selection stage. The findings of these studies are consistent with Cahen, Craun, &

Johnson's (1971) review of the literature related to spelling difficulties, in which they noted that most poor spellers produce phonologically intact but unconventional spellings. This indicates that these spellers have not shifted to the use of visual-orthographic information, and continue to rely primarily on phonologic strategies when spelling.

The findings of Frith (1980), Jorm (1981), and Nelson and Warrington (1974) indicate that different spelling strategies are employed by children with differing configurations of abilities in reading and spelling. A similar study of children in grade 3 by Waters, Bruck, and Seidenberg (1985) produced different results. Waters et al. found that the good reader/poor speller group did not differ from the poor reader/poor speller group in the phonetic accuracy of their spellings. Waters et al. suggested that the difficulty faced by their subjects who were poor spellers, regardless of reading ability, was a lack of knowledge of phoneme-grapheme correspondences. In discussing the possible reasons that their findings disagree with those of other similar studies, Waters et al. noted that the subjects in their study were younger than the subjects in Frith's, Jorm's, and Nelson and Warrington's studies and stated that "...it is possible that the characteristic of good readers-poor spellers changes as a function of age" (p. 529). This is in keeping with a developmental view of spelling, and with the findings of other researchers that a cognitive shift occurs around age 10, (grade 4 or 5), which supports the transition to greater reliance on visual-orthographic strategies.

Essentially, then, strategies employed by spellers beyond the preliterate/prephonetic stage can be described as being either phonologic or visual-orthographic. Both strategies can be used, often in parallel, in the spelling process. Either strategy is effective for spelling phonologically transparent, "regular", words, but only the visual-orthographic strategy is useful in the spelling of phonologically opaque, "irregular", words and homophones (Barron, 1980). Most children who do not have general language deficits move to the use of visual-orthographic strategies in a seemingly natural developmental

progression, with the shift from primary reliance on phonologic strategies to greater reliance on visual-orthographic strategies occurring around age 10. Yet, some normally functioning children do not move beyond the phonologic stage and some take longer than expected to do so (Frith, 1980; Gerber, 1984; Henderson, 1980; Marcel, 1980; Schwartz, 1983). This is the population which Frith (1980) and others call unexpectedly poor spellers.

This study proposes to further explain the role of a number of cognitive factors and styles in the progression from primary reliance on phonologic strategies to primary reliance on visual-orthographic strategies. In addition this study will entail an investigation of the role of these factors in spelling development and in the breakdown of spelling development which results in unexpectedly poor spellers.

Strategies employed by good and unexpectedly poor spellers in this study were determined in a number of ways. Writing samples were collected from the four subjects in the case study portion of this study. Analysis of the errors produced in these writing samples provided an indication of the strategies employed. The same type of error analysis was conducted on the spellings produced during the self-report spelling activity. During this activity, the subjects provided information on the strategies they used to spell, as they described their thought processes while spelling the various words on the test. The words on the self-report spelling activity test were clearly divided into two groups, words which could be spelled using phonologic strategies and those which required use of visual-orthographic strategies, e.g. "canoe". Information collected in the above ways was used to determine which strategies each of the four subjects used, and the spelling situations in which they used given strategies.

Factors Related to the Transition from Phonologic to Visual-Orthographic Strategies in Spelling

In light of the importance of visual-orthographic strategies in the development of spelling proficiency and the variation in the development and use of such strategies, many researchers have attempted to identify factors related to the transition from use of phonologic strategies to use of visual-orthographic strategies. Some of these researchers have investigated the relationships of spelling ability and other language abilities, while others have investigated more general cognitive processes. Although the studies of general cognitive factors are of more relevance to this study, a brief review of both types of studies will provide some needed background information and will also serve to demonstrate the general lack of consensus among researchers in this area of investigation.

Reading and Spelling

One area which has received a great deal of attention is the relationship between reading and spelling. While the correlation between the two has long been recognized, it is clear that skill in one does not imply skill in the other (Read & Hodges, 1982). There are enough exceptions, good readers who are poor spellers, to warrant attention. The studies by Frith (1980), Jorm (1981), and Nelson and Warrington (1974), discussed above, indicate that the spelling strategies employed by good readers who are also good spellers differ from the strategies employed by good readers who are not good spellers. Frith (1980) suggested in the conclusions of her study that some of the spelling difficulties encountered by the good readers/poor spellers may result from an "elegant and efficient" reading style which involves the use of partial orthographic cues, thereby interfering with the development of orthographic awareness and visual store of complete word images.

Ormrod (1985) investigated this possibility using a proofreading test with grade 9 and 10 students matched for sex and I.Q., but differing in spelling ability. Her findings supported Frith's "partial cues" hypothesis, as good spellers were superior to poor spellers in identifying misspelled segments of the text. Zutell and Rasinski (1986) reported related findings in their study of the oral reading fluency and spelling abilities of grade 3 students. They found these two abilities to be strongly correlated, and suggested that:

> The ability to move systematically across a word and get a general phonetic match, even if the spelling is incorrect, is an important and varying aspect of word knowledge through the primary grades. Children who are unable to work their way across a word are likely to have a minimal sight vocabulary and a very weak understanding of how words work." (p. 111)

Zutell and Rasinski's description of systematically working one's way across a word appears to refer to the same sort of process Frith and Ormrod described as reading using full cues. In an earlier study, Gould (1976) described the use of prediction and hypothesis testing using minimal print cues as an efficient method or style of reading. However, Gould noted that phonemic, graphemic, orthographic and semantic information are needed in the hypothesis testing involved in spelling, and that efficient readers who do not attend to print at these levels may have difficulty producing conventional spellings.

While Frith questioned "...how input processes (reading) and output processes (spelling) can be divorced to such an extent that one functions well, the other poorly" (1978, p. 43), Ehri (1980) spoke of them as being highly related. Underlying both is the "...child's growing knowledge of print as a means of representing all the words in his language" (p.312). This relationship, which is essentially semiotic, was described by Ehri (1978) in her word amalgamation identity theory. This theoretical construct details the way in which conventional orthographic identities of

individual words become established in lexical memory by becoming matched and assimilated with the known phonological forms, and the semantic and syntactic identities of these words. The result of this assimilation is automaticity, as all four identities of the word are amalgamated, and a fairly exact, but not photographic, visual representation of the word has been stored in memory. These visual images provide a level of automaticity in spelling as well as in reading, and involve an integration of the sounds of the word and graphemic representation of those sounds.

Bryant and Bradley (1980, 1985) also investigated the relationship between reading and spelling, and the use of visual and phonologic strategies in these processes. The subjects of their studies ranged from 5 years of age to 13 years of age, but were approximately equal in reading ability and general intelligence. Their findings related to children's ability to organize sounds suggest that difficulties in this area are related to difficulties in reading and spelling (Bradley and Bryant, 1978). This is consistent with other researchers' findings that poor readers/poor spellers are unable to use grapheme-phoneme correspondence rules effectively (Frith, 1980; Jorm, 1981). Bryant and Bradley's work is also consistent with Ehri's (1978) word identity amalgamation theory. They noted that children in the early stages of learning to read and spell use different strategies for each process. Children try to read a word using visual chunks, but try to spell the same word using phonological segments. They concluded that, with experience in these processes, children come to use both strategies for both processes, and that the disconnection between spelling and reading "might be a temporary phenomenon confined in most children to the early stages of their reading and writing" (p. 365). In later stages of literacy development, children are more able to use phonological and visual strategies, as these identities of words become associated in the children's mental lexicons.

In a study of adult university students who had been identified as learning disabled, Bookman (1984) reported that these students were not deficient in their perceptions of sounds, their knowledge of grapheme-phoneme correspondence rules, nor basic orthographic rules. Rather, she found that the spelling difficulties of these students resulted from, ". . . an inability to relate to words as units of a language system having an 'orthographic identity' which is part of a total identity based on many sources of information about particular words" (p. 24). Her findings are based on and support Ehri's word amalgamation theory.

Ehri's view of the relationship between reading and spelling is also supported, in part, by Tenney (1980) who stated that good spellers must rely on a process of visual recognition which is dependent on some visual store of words developed through visual exposure to them during the reading process, and on visual memory. Ormrod (1986) supported this view, suggesting that short term visual memory may be better for good spellers, but Day and Wedell (1972) found no significant difference in the number of errors produced by subjects having better visual memory than among those having better auditory memory. It should be noted, however, that Day and Wedell did indicate that there were differences in the types of spelling errors made by the two groups.

While Ehri (1982, 1988) stated that spellings are stored as visual representations for the pronunciations of words, and that the two identities are amalgamated rather than stored as separate codes, neurological research provides a dissenting view. Studies relating differences in proficiency for spelling words and non-words among victims of cerebral damage in varying areas of the brain seem to indicate that there are separate neurological codes for the visual representation of words and the sounds of words (Margolin, 1984). Margolin cited case histories of patients who, following a stroke, could spell common words, including phonetically irregular words, but could not produce phonetically accurate representations of nonwords, indicating separate neurological channels for visual and phonologic strategies in word

spellings. He also cited postmortem studies for patients who could spell either words or nonwords, but not both. These groups of patients were found to have lesions in different but closely situated areas of the brain. Margolin cautioned that these sites are located very near each other, and that the results need further research before a definitive statement can be made with respect to the neurological "location" of phonologically and visually based abilities. These findings do not seem inconsistent with the findings of educational researchers, Frith (1978) for example, who seem somewhat baffled by the apparent dissociation of reading and spelling which appear to be closely related language processes.

The findings of various researchers with respect to the relationships among visual, auditory/phonologic, orthographic, and other aspects of word knowledge and reading appear to provide different views of these relationships and their effects on spelling ability. It is possible that deeper analysis and further research will provide information on the missing links among the various views. Certainly, developmental factors play a role, as subjects of various ages exhibit differing use of the various strategies. It is also possible that in subjects with normal brain function information about the sounds of words, and about the visual aspects of words may be stored or processed in separate areas of the brain, but that the neurological connections between the two areas function efficiently enough to allow the two areas to work in concert. This is one possible explanation of how word identities could be amalgamated, even though the various identities of a given word were stored in separate areas of the brain.

General Cognitive Factors and Spelling

A number of cognitive factors have been investigated in relationship to spelling. Visual imaging ability is one factor which would seem, form a common sense perspective, to be related to spelling ability. Yet, findings of studies using adult subjects do not indicate that good visualizers are

good spellers and poor visualizers are poor spellers. Visualizing ability does, however, seem to correlate with error type (Sloboda, 1980; Walker, 1974). Studies conducted by Caban, Hambleton, Coffing, Conway and Swaminathan (1978), Radaker (1963), and Sears and Johnson (1986), each of which involved training school children in the use of visual imaging techniques, differ from the above findings in that each of these researchers reported that imagery training resulted in long term improvement in spelling ability. There are at least two possible explanations for these differences. The studies by Sloboda (1980) and Walker (1974) were conducted using adult subjects, while the Caban et al. (1978), Radaker (1963), and Sears and Johnson (1986) studies were conducted with children. The differences may be an effect of the widely varying ages of the subjects. Also, the adult subjects in Walker's study were tested on general imaging ability, and Sloboda's groups were formed on the basis of subjects' descriptions of themselves as good or poor visualizers. The children were taught imaging techniques specific to developing visual memory for words and word spellings. It appears that while general imaging ability is not related to spelling ability, training in imaging procedures directly related to the development of visual images for words assists children in the spelling process.

Bruce and Cox (1983) investigated differences in learning by rote and learning by rule in undergraduate students who were good and poor spellers, in an attempt to discover whether spelling was more related to rote or rule learning. They reported that good spellers scored somewhat higher on rote learning than did poor spellers, but failed to meet significance levels. Citing conflicting evidence in studies conducted by McLeod and Greenough (1980), Schwartz and Doehring (1977), and their own work, Bruce and Cox suggested the need for further investigation of this area. McLeod and Greenough found that "gross memory", rather than sequential memory, or ability to discern patterns, was the key factor associated with spelling ability. Schwartz and Doehring concluded that "...spelling ability is associated with an orderly

acquisition of morphological and orthographic patterns, supporting the notion that an important aspect of spelling behavior is rule governed" (p. 420). As in studies discussed above, the conflicting findings may be attributable, at least in part, to variance in the ages of the subject groups in the various studies. McLeod and Greenough's subjects were in grades 1 and 4, Schwartz and Doehring's subjects were in grades 2 to 5, and Bruce and Cox's subjects were young adults.

Overall cognitive development has been suggested as a factor related to spelling ability by C. Beers (1980) and Zutell (1980, 1984). Both found positive correlations between level of cognitive development, as measured by Piagetian tasks, and spelling ability. Beers' subjects were grade 2 students, Zutell's were in grades 1 to 4. In contrast to these findings, Allen and Ager (1965) found spelling to be relatively independent of other abilities. Their factor analytic study of spelling ability, personality traits, spatial ability, clerical aptitude, and I.Q. for subjects in grade 12 indicated that a factor deemed "general spelling ability" explained all of the common spelling variance. Two things should be noted here. First, none of the above cited researchers suggest that cognitive development and I.Q. are the same thing. Second, given the developmental nature of spelling, the different findings may be an artifact of the ages of the subjects. Other similar studies with older children were not found in the literature, which is interesting given the major developmental shifts which occur in the upper elementary years.

There are many cognitive factors which have been, or could be, assessed in relation to spelling ability. The general cognitive factors investigated in this study were selected because they are consistent with a developmental view of spelling, and because they are factors for which varying findings were noted in the literature. Visual, auditory, and spatial processing and memory, visual imaging and closure, and rote and rule learning styles were selected on this basis. In each case, research reports were found which provided evidence of the relationship between the particular cognitive process in question and spelling, and reports

were found which did not support the relationship. This is also true of the existing research on simultaneous and sequential processing styles, which became a major focus of this study.

Sequential and Simultaneous Processing and Spelling

In addition to distinct and overall cognitive abilities, a few references to the role of sequential (also referred to as successive) and simultaneous cognitive abilities in literacy development appear in the literature (Bayliss & Livesy, 1985; Das, Leong, & Williams, 1978; Leasak, Hunt, & Randhawa, 1982).

Luria (1966) described simultaneous processing as the integration of separate elements into simultaneous groups, or gestalts, and successive processing as the ability of the brain to integrate external influences, or stimuli, into a successive or sequential series which involves order and/or time factors. He cited anatomical evidence for the separate locations of these two abilities in the brain. Cerebral accidents which affect the occipital (visual) areas of the brain affect simultaneous processing. Disturbances in the frontotemporal (motor and acoustic) areas of the brain affect sequential processing ability. This seems plausible from an experiential perspective, as listening seems largely sequential, while seeing is more often a simultaneous event.

Leasak, Hunt, and Randhawa (1982) investigated simultaneous processing in an intervention study aimed at determining whether cognitive strategies could be altered through instruction. Grade 4 students were given an instructional program designed to improve simultaneous processing, which earlier research had shown to be correlated with academic achievement. Using a pretest-posttest design, Leasak et al. found that significant increases had been achieved on some of the tests used in the study but over-all changes in scores were not significant. An interesting finding of the study, however, was that

spelling achievement, as measured on the Wide Range Achievement Test, did increase significantly following the intervention. This suggests a possible relationship between spelling ability and cognitive strategies based on simultaneous processing.

Bayliss and Livesy (1985) investigated the relationship of simultaneous and sequential processing abilities and spelling ability in boys aged 9 to 11. Each of the subjects had normal or above normal I.Q. scores and was identified as dyslexic. The subjects were placed into two groups: dysphonetic-dyslexic, characterized by a holistic reading style and nonphonetic spelling errors; and dyseidetic-dyslexic, characterized by an analytic reading style and phonetically accurate spelling errors. Testing indicated that the two groups differed in their cognitive approaches to literacy and other tasks. The dysphonetic group displayed a simultaneous processing style and relied on spatial information. The dyseidetic group used a sequential processing style and processed information serially. Bayliss and Livesy concluded that early literacy instruction should be matched to cognitive style and suggested that this capitalization on individual strengths would significantly reduce the incidence of the learning disability dyslexia, which affects reading and spelling.

Although it does not relate directly to the development of spelling ability, the work of Das, Leong, and Williams (1978) is important in that it was one of the first to explore the relationship between simultaneous and sequential processing ability and literacy skills. These researchers also demonstrated the ability to distinguish relative strength in simultaneous and sequential processing abilities using only a few easily administered tests.

Simultaneous and sequential processing styles and their relationships to spelling development and ability constitute a major focus of this study. In reviewing the literature, varying findings were noted with respect to these relationships, and it was noted that some of the differences in findings might be related to the ages of the subjects involved in the

studies. This study is designed to address this possibility through the inclusion of subjects in grades 5 and 7.

Cognitive and Orthographic Considerations in Spelling Instruction

A number of researchers and theorists have noted that traditional spelling instruction, consisting of rote memorization of word lists, does not reflect the actual processes involved in learning to spell conventionally. There are simply too many words in the English language to memorize in a systematic and formalized manner. Spelling instruction based on phoneme-grapheme correspondences and rules, commonly called the phonics approach, has also been called into question. The orthography of the English language is such that use of phonetic information results in phonetically accurate, but often unconventional spellings, as vividly demonstrated in the computer spelling study conducted by Hanna, Hanna, Hodges, and Rudorf (1966), described above. Frith (1981), Henderson and Templeton (1986) and Hodges (1982) pointed out the role of meaning in some spellings which are phonetically incomprehensible, and suggested that spelling instruction should focus on morphological factors as well as phonetic factors involved in spelling.

Frith (1981) discussed the arguments for and against regularizing the English spelling system so that it would be phonetically consistent. She discounted the value of regularization, noting that reading would suffer at the loss of morphemic cues which exist in current orthography. She suggested that a "black box" -- a sort of computer assisted translating device which could change sequentially produced, sound-based spellings produced by writers into simultaneously processed, conventional spellings which add richness and depth of meaning for readers -- would effectively end the on-going debate over the regularization of English orthography. (It is interesting to note that now,

ten years later, a device much like Frith's "black box" is in constant use by all who have access to a word processing program equipped with a spelling checker.)

Cognitive processes and related instructional and learning strategies which help children become proficient spellers were the focus of a number of studies in the 1980's. The debate over whether spelling is primarily a visual or an auditory process is represented in these studies. The role of auditory, phonologic strategies is stressed in the research reported by Drake and Ehri (1984) and Ormrod and Jenkins (1988). Both found over-enunciation of words, even to the point of mispronunciation, to be an effective strategy for learning to spell words and suggested that this strategy be incorporated into spelling instruction. Sears and Johnson (1986) found that normal pronunciation of words is not an effective strategy, but that the use of visual imagery is. Mihail (1986) recommended that spelling instruction be expanded to include skills in problem-solving, self-correction, spelling patterns and regularities, proofreading, and dictionary skills. Mihail also noted that the emphasis on spelling should be that it is a skill which is learned, ". . . for the convenience of all the language arts. . . ." and strongly recommended that, ". . .opportunities to use this skill in writing. . ." should also be emphasized (p. 32).

The developmental aspects of spelling and the impact of this attribute of spelling on the teaching and learning of spelling were discussed by many researchers and theorists (Beers & Beers, 1981; Harste, Burke, & Woodward, 1983; Hodges, 1982; James, 1983; Johnson, Quorn, & Langford, 1981; Yellin, 1986). The overarching message from each of these studies or literature syntheses is that spelling is a developmentally acquired language process, and that the learning of spelling demands interaction with both reading and writing on a regular basis. This is not to imply that there is no place for spelling instruction in the curriculum, but rather that the nature of spelling instruction should be reassessed and altered to match the developmental aspects of learning to spell as an

integral part of general language development. James (1983) cautioned that, "An instructional system that dictates to children that they parrot adult language is disrespectful of a child's natural curiosity to explore his language" (p. 18). Beers and Beers (1981) noted that "Children need to be encouraged to write often using the spelling strategies they have. It is during the act of writing that the rationale and function of spelling becomes most clear to primary children" (p. 578). Hodges (1982) extended this view to include all spellers, noting that spelling is learned throughout life through interaction with written language in many different contexts. These studies provide evidence of the important role inventing spellings plays in young children's growing awareness of English orthography.

This study will provide information on cognitive factors underlying spelling development and ability which will be useful to educators designing instructional programs in spelling. It will address the needs of students in the upper elementary years, as they approach and move through the transition to the mature stage of spelling development. This transition is characterized by increasing reliance on visual and orthographic information, and decreasing reliance on phonologic information, hence the focus of this research on visual and auditory processing and memory.

Spelling as a Semiotic Process

As can be seen from the review of the literature on developmental aspects, strategies, and cognitive processes related to spelling, the representation of words in print is a complex process. At its most fundamental level spelling is but one aspect of an even more complex process, that of communicating meaning through the use of a symbol system -- language (Hodges, 1982). All language processes are semiotic, in that the word is not the thing, but merely represents that to

which it refers. This representation is symbolic. It is conventionalized and operationalized through historical usage and societal agreement (Scholes, 1981). The semiotician attempts to identify and investigate the nature of a variety of sign systems, or codes, which make literary communication possible (Culler, 1981). Spelling can be seen as one of these codes. It has a system of conventions which assists in communication of meaning among literate individuals. These are the conventions related to orthographic representations of words (Anderson, 1985; Yellin, 1986).

Semioticians are also concerned with societal codes which affect the symbolic communication of meaning and the systematic and societal conventions related to the communication and interpretation of symbolic codes. Similarly, much of the attention in spelling research has focused on the orthographic conventions and the importance of visual-orthographic strategies in the ability to produce conventional spellings. This is understandable when viewed from a semiotic perspective, as conventionalization of symbol systems plays an important role in communication. However, little has been done in the way of investigating spelling as part of the larger semiotic process. One possible reason for this is that an issue as complex and context dependent as this appears to be would best be approached through phenomenological and other qualitative methods. These approaches to research are only currently gaining general acceptance in the field of educational research.

The research team headed by Jerome Harste at the University of Indiana has attempted to look at the relationships among the development of receptive and productive language abilities and the larger issues which impinge upon and are affected by this development (Harste, Burke, & Woodward, 1983). This is a major undertaking, and few others have attempted it. There is a great need for further research, particularly of a broad qualititative nature, in this area in order to illuminate methodological as well as theoretical issues. The design of this study is such that some of these issues can be addressed on a fairly

small scale, and includes investigation of individual cases, as recommended by Sloboda (1980).

Summary of the Literature and Rationale for the Present Study

Several independent lines of theory are brought together for this study. First, spelling is a semiotic process, part of the larger semiotic of language, in which meaning is communicated through the use of words represented in conventionalized ways. Second, spelling is a cognitive process which involves the interplay of a variety of cognitive abilities. Third, a number of strategies, some of which are more effective than others, can be employed in the spelling process. For spellers who are beyond the stage of emergent literacy, the primary strategies are the phonologic and the visual-orthographic strategies. Spelling proficiency is related to the use of phonologic strategies among young children, but once beyond the primary grades, the shift to greater reliance on visual-orthographic strategies is required in order to be able to produce spellings which are not only phonetically intact, but which are conventional. Finally, spelling ability develops in an orderly and identifiable series of stages culminating with the ability to spell most words correctly whether they are phonologically transparent or opaque. Most spellers reach this stage of ability as they develop awareness of and ability to use implicit knowledge of English language structures of various kinds, and as they develop an ever-increasing store of visual representations of words. Some spellers, however, do not attain this level of ability to spell words conventionally, and appear to be "stuck" on the developmental continuum at the phonologic stage, despite normal development in all language areas except spelling. These spellers are often described as unexpectedly poor spellers.

While there is a strong corpus of research and general agreement on the developmental aspects of spelling and the strategies employed by spellers at the early stages of development, much less is known about later stages of development and the transition to the mature stage. In addition, differing views in the area of cognitive processes related to spelling ability for spellers in the upper elementary years are reported in the literature. A number of investigations have been conducted in this area, often with dissimilar results. Part of the reason for this may be that many of the researchers have considered specific aspects of cognitive processing in isolation, and have also attempted to compare findings with research of similar types using different aged populations. Given the complex and developmental nature of the spelling process, the inconsistent findings are not surprising.

It has been suggested that greater use of qualitative methods in the investigation of spelling, and in-depth studies of a few individual subjects could provide greater insight into the spelling process, as could further research involving children who are at or beyond the age at which the transition to visual-orthographic strategies usually occurs.

Purpose of the Present Study

The literature reporting investigations of and theories related to the relationships between a number of cognitive processes and spelling ability was reviewed and many differing findings were noted. The well-documented view of spelling as a development process was discussed, with particular attention to the cognitive shift which occurs around age 10 and appears to be related to the change from primary reliance on phonologic spelling strategies to visual-orthographic strategies. Because of the lack of literature on studies involving testing of a number of cognitive processes with a single subject group, one purpose of this study was to explore the relationships between a variety of cognitive

processes and spelling ability and to develop cognitive profiles of good and poor spellers based on results of a number of tests of cognitive processes. A second purpose of this study was to explore the nature of the differences in these profiles between grade 5 and grade 7 students, as children move through the transition from primary reliance on phonologic to visual-orthographic strategies in spelling. Subjects in grade 5 and grade 7 were included because of the identification in the literature of age 10 as a critical transition point in spelling development. Finally, this study was designed to explore the differences between individual subjects who are good or unexpectedly poor spellers through a case study approach with two good and two unexpectedly poor spellers at the grade 5 level.

The following research questions provided the framework for meeting these purposes:

1. What are the relationships between spelling ability and ability in using certain cognitive processes?

2. What are the relevant characteristics of good and unexpectedly poor spellers as determined by academic performance and performance on selected cognitive tests?

3. How do these relationships and characteristics differ between students in grade 5 and grade 7?

4. How do selected representatives of the good and unexpectedly poor spellers at the grade 5 level differ from each other?

CHAPTER 3

Methods and Procedures

This chapter provides a description of the data collection and analysis procedures for the group and case study segments of the study. Further discussion will be provided in the relevant sections of Chapters 4 and 5.

Subjects

Students in two grade 5 and two grade 7 classrooms in an urban area of British Columbia participated in the first part of the study. All students who returned permission forms (see Appendix A) participated in the testing, but data collected from those students identified in their school records or by their classroom teachers as having general language deficits or mental handicaps were not included in the analysis. Students who did not complete the entire battery of tests were also excluded, resulting in a subject population of 57. In this group of 57 students there are 15 female and 16 male grade 7 students, ages 12 and 13, and 12 female and 14 male grade 5 students, ages 10 and 11. A majority of the students involved in the study are middle to upper-middle class children, with English as their primary language. This subject population does not represent a broad spectrum of socio-economic and cultural backgrounds, rather it provides a fairly homogeneous population, resulting in fewer factors for consideration in the analysis of differences between good and poor spellers. A second advantage in involving participants from this relatively stable socio-economic group is that most of the participants attended the same school for all or most of their school years, decreasing

the likelihood that instructional experiences would play a major role in the differences between good and poor spellers.

An initial analysis of the spelling and achievement test scores of the 57 participants was used to identify a number of possible subjects for the case studies. Students selected as possible subjects were those who had scored at or above grade level on the standardized mathematics and reading tests administered by the school, scored 80% or more on a test of phonologically transparent words, and were described by their teachers and/or school records as having average or better general language ability. Information letters were sent to these students and their parents, explaining the case study portion of the study and inviting them to participate (see Appendix B).

Four grade 5 students, two boys and two girls, were selected to participate in the case studies. One boy and one girl were selected to represent the good spellers. Each had scores above the mean on the spelling test for phonologically opaque words, indicating proficiency in spelling using the visual-orthographic strategy. Their written work in the classroom setting was generally spelled conventionally. They indicated confidence in their own spelling abilities, and an interest in participating in the study and learning more about their own spelling strategies.

One boy and one girl were selected to represent unexpectedly poor spellers. They had scores below the mean on the spelling test for phonologically opaque words. These scores were also four points below their scores on the phonologically transparent words, indicating greater reliance on a phonologic strategy when spelling. They were described by their classroom teachers as being strong students, with no general language deficiencies other than spelling, which is typical of unexpectedly poor spellers. They also indicated an interest in participating in the study and in finding out more about spelling strategies.

Setting

A suburban elementary school (grades K - 7), located in a stable, middle to upper-middle class neighborhood in an urban area of British Columbia, was the site of the first part of the study. Testing procedures were conducted in the students' regular classrooms. Interviews for the case studies were conducted in the participants' homes and in the school.

Testing Instruments

Tests used in this study were obtained from two sources. The Cat in the Hat Proofreading Test, the simple, complex and random patterns test, and the spelling strategies and ability test were replicated from descriptions of the tests provided in the original studies in which they were used. The specific cognitive factors, e.g. visual and auditory processing, spatial and closure abilities, simultaneous and sequential processing, were assessed using sub-tests selected from the Kaufman Assessment Battery for Children, a commercially prepared test published by American Guidance Services.

The Kaufman Assessment Battery for Children was selected because it contains sub-tests which address many of the specific cognitive factors of concern in this study. In addition, it provides a means of using the sub-tests to determine subjects' relative strengths in simultaneous and sequential processing.

Procedures: Testing

Participants were given eight tests, in class groups, by their regular classroom teachers. Five tests adapted from the Kaufman Assessment

Battery for Children, and the simple, complex, and random patterns serial recall test developed by Bruce and Cox (1983) were included to assess various cognitive styles or strengths of the participants. The Cat in the Hat proofreading tes., developed by Ormrod (1985) was included to determine if participants read by partial or full orthographic cues. A spelling test designed to assess the participants' use of visual-orthographic and phonologic spelling strategies (Barron, 1980) provided information about the participants' spelling proficiency and strategies employed when spelling.

Training in the testing procedures was provided for the teachers prior to the administration of the tests, and detailed instruction sheets were provided for each test. The instruction sheets contained information about the administration of the tests, timing, presentation of test materials, and a script for the teachers to follow in administering the test. Testing was done in four sessions of 10 to 30 minutes, over a two week period. The researcher hand-scored the tests, noting any interesting answers or irregularities. (See Appendix C for samples of testing materials.) Further discussion of the purposes of the various tests is provided in relevant sections of Chapter 4.

Description of Tests and Scoring

Five tests were adapted from the Kaufman Assessment Battery for Children, commonly referred to as the K-ABC (Kaufman & Kaufman, 1983). The adaptations were largely procedural and were made to facilitate group presentation of tests which were initially designed for individual assessments. The tests and their adaptations were discussed with one or more researchers at American Guidance Service, Inc., in order to ensure that the adaptations would not significantly alter the results of the tests or the underlying cognitive processes being assessed.

The sub-tests of the K-ABC were selected because they were, based on their descriptions in the Examiner's Manual, designed to assess cognitive processes selected for investigation by this researcher following a review of the literature. The following descriptions of the tests were summarized from the K-ABC Examiner's Manual.

Picture Completion (PC) - adapted from Subtest 4, Gestalt Closure

The Gestalt Closure test is designed to measure perceptual closure, inferences, and the ability to mentally convert abstract stimuli into a visual representation of a concrete object, a form of visual imaging. This involves simultaneous processing, attention to visual detail, long term memory, recognition of part-whole relationships, perceptual organization, spatial ability, and visual organization. The administration of the test involves presentation of incomplete line drawings of common objects. The subject then identifies the object and names it orally.

This test was selected to assess subjects' visual processing and imaging abilities. These visual abilities were identified by Caban, et al. (1978), Radaker (1963), Sears and Johnson ((1986) and Tenney (1980), as being related to spelling ability. Sloboda (1984) and Walker (1974) did not find this relationship between visual imaging ability and spelling for mature spellers. This test was included to assess the relationship between this visual process and spelling ability for transitional (grade 5) and more mature (grade 7) spellers, and to investigate any age related differences in this relationship.

Adaptation for group presentation involved having the subjects write the name of each object on a numbered answer sheet.

Numbers (NU) - adapted from Subtest 5, Number Recall

The Number Recall test is a digit span test, designed to measure automatic auditory-vocal memory. It involves sequential processing, reproduction of a model, and short term auditory memory. In this test, the

examiner reads a series of numbers and the subject responds by repeating the sequence orally.

This test was included to assess auditory memory and its relationship to spelling ability for upper elementary students. Auditory memory and processing play a role in Ehri's (1978) Word Identity Amalgamation Theory, as the sound of words is one of the word identities identified by Ehri. The role of auditory processes was also discussed by Drake and Ehri (1984) and Ormrod and Jenkins (1988), who suggested that over-enunciation of words was a good strategy for spelling instruction. Presumably, memory for these auditory presentations of over-enunciations would play an important role in the effectiveness of this strategy.

Adaptation for group presentation consisted of having the subjects write the numbers in sequence rather than repeating them orally.

Words and Colours (WC) - adapted from Subtest 7, Word Order

The Word Order test is designed to measure verbal memory and serial recall, involving auditory/visual integration. It is a sequential processing activity and involves auditory and motor memory, retention without rehearsal, short-term auditory memory, verbal comprehension, and visual perception of meaningful stimuli. During this test, the examiner names a series of common objects, which the subject then identifies by pointing to pictures of these objects in the same order in which they were named by the examiner. Interference is provided by having subjects name colours between the presentation of the visual stimuli and the naming of the objects.

As in the case of the Numbers test described above, this test was included to assess auditory memory and its relationship to spelling ability. In addition, the Word Order test involves auditory/visual integration, a process related to Ehri's Word Identity Amalgamation Theory and to Bryant and Bradley's (1980, 1985) studies of the convergence of visual and auditory processes in spelling and reading.

This test was adapted for group presentation by having subjects list the objects named by the examiner on an answer sheet. The answer sheet was headed by a copy of the pictures of objects used in the original test. The interference task was similarly modified in that the subjects wrote the names of the colours presented by the examiner rather than speaking them.

Shapes (SH) - adapted from Subtest 8, Matrix Analogies

The Matrix Analogies test is designed to assess analogic thinking, a simultaneous processing ability which entails analysis, attention to visual detail, the ability to distinguish essential from nonessential detail, and perceptual organization. The administration of the test involves presentation of incomplete 2 x 2 visual analogies. The subject then selects a design to complete the analogy. Designs are located on tiles which allows very young or physically handicapped children who might have difficulty with writing and drawing to complete the test.

This test is related to the Cat in the Hat Proofreading Test, in that it involves attention to visual detail. Frith (1980) and Ormrod (1986) identified use of full visual cues in reading as being related to spelling ability. This test is similar in that it assesses attention to visual detail, but provides a somewhat different perspective in that the detail is pictographic rather than orthographic.

The adaptations for group administration involved presenting subjects with test forms containing numbered copies of the designs which appear on the tiles in the K-ABC. Subjects selected a design to complete each analogy and wrote the number of the selected design on an answer sheet.

Pictures (PI) - adapted from Subtest 9, Spatial Memory

The Spatial Memory test is designed to assess spatial memory. This is a simultaneous processing ability which entails short term visual memory, perceptual organization, reproduction of a model, and visual

organization. The subject is shown a large card with an array of pictures of simple objects. The subject then points to the location of the objects on a blank 3 x 4 grid. The subject is not required to name the objects, nor to point to their locations in a specific order.

This test was included to assess visual memory and reproduction of a model. Conventional spelling entails both the ability to remember the visual aspects of words and the ability to reproduce that image in print.

Adaptation for group administration involved supplying the subjects with a grid on which each box in the grid was numbered. Subjects then indicated the location of the objects on the picture card by writing on an answer sheet the number of each box which corresponded to the location of an object on the picture card.

In addition to the specific cognitive factors assessed by the tests described above, combined scores on the tests produced scores on simultaneous and sequential processing.

Scores for the five tests described above were determined by counting the number of responses which matched the expected response on each test. Combined scores were used to determine subjects' relative strengths in simultaneous and sequential processing styles.

The following three tests were administered in addition to those adapted from the K-ABC.

The Cat in the Hat Proofreading Test (CAT)

This test was modelled after one used by Ormrod (1985) to test Frith's (1980) hypothesis that good and poor spellers differ in their reading styles. Frith (1978) and Ormrod used proofreading tests to determine if good readers of varying spelling ability employed differing levels of attention to the details of the print as they read. In both studies, subjects were presented with printed phrases, some of which contained spelling errors. Phrases were exposed for one second each, following which

subjects indicated whether the phrase was correct or contained an error. Testing was done on an individual basis, using computer assisted technology.

Adaptations for group testing consisted of using phrases from the children's book, The Cat in the Hat (Seuss, 1957), printed on large tag board cards. Ten of the twenty phrases contained single letter spelling errors, ten were spelled correctly. Each card was shown to the subjects for one second, followed by ten seconds during which the subjects indicated on an answer sheet whether the spelling in the phrase was correct or not by marking boxes labeled "OK" or "NOT OK".

Scoring for this test consisted of counting the number of correct responses.

Simple, Complex, and Random Patterns Test (VAR)

This test was adapted from one used by Bruce and Cox (1983) to measure and distinguish learning by rote and learning by rule. The test materials consisted of serial lists of permutations of four geometric symbols (a) a square, (b) a triangle, (c) a circle, and (d) an L shape. Each list contained five of these four-symbol permutations. The simple pattern list involved a simple rule: the first symbol is moved to the end each time to produce the next arrangement (1234, 2341, 3412, 4123, 1234). The complex pattern list involved a complex rule: the first and third symbols are moved to the end each time to produce the next arrangement (1234, 2413, 4321, 3142, 1234). The random list had no discernible pattern, or rule, (1234, 3412, 2134, 4213, 1234). The first and final permutations in each list were identical. Each subject was given three trials with each list. The order of presentation of the list types was scrambled. Each trial consisted of presentation of a pattern list, with exposure of each arrangement for five seconds. Following exposure of each list, or set of arrangements, subjects were given approximately 30 seconds to sketch in the second, third, and fourth arrangements on an answer sheet which contained the first and fifth arrangement separated

by three rows of four blank boxes. Answer sheets were collected and removed from sight of the subjects following each trial. In the Bruce and Cox study this test was administered to a group, using photographic slides of the permutation lists.

The only adaptation for this study was the use of large cards instead of slides for the presentation of the lists to the subjects.

The scoring of this test was somewhat more complicated than for the other tests in this battery. In order to determine whether subjects were employing rule-based strategies, rather than simply using rote memory on each of the tasks, raw scores for the random list task were subtracted from the scores for the simple and complex pattern tasks. Because there were twice as many responses in the simple and complex pattern tasks as in the random task, the following formula was used: [VAR-S (Simple pattern score) + VAR-C (Complex pattern score)] minus [2VAR-R (Random pattern score)]. Subjects who had greater success on the simple and complex pattern tasks than on the random task obtained a positive number for their final score. These subjects are considered to be stronger in learning by rule than in learning by rote. Subjects whose scores on the random task were equivalent to or greater than their scores on the simple and complex pattern tasks obtained a negative number, or zero, for their final score. These subjects are considered to be stronger in learning by rote than in learning by rule. Subjects rote learning ability was indicated by their score on the random patterns task. Their rule learning score was determined by the formula noted above.

Spelling Test of Regular and Irregular Words

This test was used by Barron (1980) to assess good and poor readers' use of visual-orthographic and phonologic strategies in spelling common words. Subjects were given a spelling test using twenty regular (phonologically transparent) and twenty irregular (phonologically opaque) words matched for frequency and length. Barron described regular words as those which can be read and spelled through the use of

spelling-to-sound correspondence rules, using a phonologic strategy. Irregular words are those which can not be read and spelled through the application of these rules and consequently require the use of a visual-orthographic strategy based on direct access to the stored representation of the word in the speller's internal lexicon.

A shortened version of Barron's word list consisting of ten regular and ten irregular words was used in this study. The examiner read each word to the subjects, read a sentence containing the word, then repeated the word, in the traditional spelling test format. Subjects were given time to write the word on numbered lines on an answer sheet provided by the examiner.

Sequential and Simultaneous Processing

Scores for sequential and simultaneous processing were determined by combining scores on the five tests which were adapted from the Kaufman Assessment Battery for Children. Three of the five tests, Pictures, Picture Completion, and Shapes are described in the K-ABC as indicators of simultaneous processing ability. The combined scores on these three tests were totalled to produce a score for simultaneous processing ability. Two of the tests from the K-ABC, Numbers, and Words and Colours, are described in the K-ABC manual as tests of sequential processing ability. Scores from these two tests were combined to produce the sequential processing score. Because the total number of responses for the two sets of tests was not equal, percentage scores were determined for this part of the analysis. Changing the combined scores to percentages facilitated comparisons of relative strength in each of the two processing styles. In addition to the percentage score, a sequential/simultaneous differential score was determined by subtracting the sequential percentage score from the simultaneous percentage score. This was also done to facilitate comparisons between groups, as a majority of the subjects had higher scores on simultaneous processing than on sequential processing. Analysis of the scores on each of the five

tests used in determining the sequential and simultaneous scores lead this researcher to believe that one of the tests used in computing the simultaneous score was inappropriately easy for children in grades 5 and 7, and that this factor positively weighted the simultaneous totals. Consequently, in this study, sequential and simultaneous scores are discussed in terms of relative strength.

Achievement

Achievement scores reflect each subject's achievement in math and reading, as determined by the standardized achievement tests used in British Columbia public schools. Scores on the achievement tests, which were completed prior to this study, were obtained from school records.

Cognitive Scores

Cognitive scores were determined by adding the scores on the five tests adapted from the Kaufman Assessment Battery for Children, and are assumed to represent general cognitive development.

Overall Scores

Overall scores were determined by adding the achievement and cognitive scores for each subject. Scores from the Cat in the Hat proofreading test were not included, as they represent reading style rather than reading ability. The scores on learning by rote and by rule were also excluded, as these scores were determined by a formula which could result in a very capable subject receiving a negative number for her/his score.

Data Analysis

Test data were analyzed using the SPSS-X computer program on the IBM mainframe computer system at the University of Victoria. Pearson

correlation coefficients were determined for scores on each of the tests given to the subjects during this research, and the math and reading achievement scores obtained from the subjects' school records. The resulting correlation coefficients and one-tailed significance values were used in determining correlations between spelling and various other factors. This information was gathered for descriptive purposes, and to assist in the development of profiles of good and unexpectedly poor spellers. The relatively small number of subjects and large number of factors, and the non-random selection of subjects precludes statistical generalization.

The SPSS-X ALSCALE program was used for the multidimensional scaling analysis. This analysis is related to cluster analysis and factor analysis, and provides descriptive information based on the underlying structure of the data set. This information arises from analysis of a configuration of objects or subjects (in this case, subjects), much like a map. The configuration illustrates similarities and differences among points, with each point representing a subject. Points which are close together on the configuration represent subjects who have much in common, while subjects represented by distant points have little in common (Kruskal & Wish, 1978). This aspect of multidimensional scaling was useful in this study, as part of the purpose of the study was to explore and describe cognitive characteristics which were common to good spellers, and different from those of unexpectedly poor spellers.

Schiffman, Reynolds, and Young (1981) described multidimensional scaling as being useful for systematizing data when organizing concepts and underlying dimensions are not known to the researcher. The multidimensional scale is a useful approach for studies which are exploratory and descriptive, as is the present study. Kruskal and Wish (1978) recommended approaching this search for hidden structure in the data through the use of both a dimensional approach and a neighborhood approach. The dimensional approach involves analyzing the characteristics of subjects represented by points which are distant

from each other on the configuration. In this study, subjects located at the extremes of the horizontal and the vertical axes were identified. Their scores on the various measures used in this study were then compared for similarities and differences. The dimensions, or factors related to the axes, were identified in this way. The neighborhood approach focuses on characteristics of subjects represented by points which are close together. Systematic analysis of the characteristics of these close and distant points can reveal the underlying structure of the data set, the factors represented by the horizontal and vertical axes on the configuration, and the relative importance of the various factors.

Dimensional analysis of the configuration of subjects on the multidimensional scale produced from the data in this study was undertaken by comparing the scores on the various tests for subjects on the outer edges of the configuration. Scores for subjects on the far left of the scale were compared to scores for subjects on the far right, those on the top were compared to those on the bottom. Test scores which showed large variations from from top to bottom on the vertical axes were noted, as were tests which showed large variations from left to right on the horizontal axes. This information was then used to determine the probable factors or dimensions indicated by each axis. For example, the spelling scores of subjects located on the extreme left of the horizontal axis were similar to the spelling scores of subjects located on the extreme right of this axis. Spelling was rejected as a possible horizontal dimension. The simple, complex and random patterns test scores of the subjects on the extreme left were quite different from these scores for the subjects on the extreme right, consequently learning by rote or by rule was determined to be one of the dimensions of the horizontal axis. Simultaneous and sequential processing style was also identified as a dimension of this axis. Reading by partial or full cues and overall achievement were identified as the dimensions of the vertical axis.

Neighborhood analysis was conducted by examining the similarities among the various test scores of subjects in each quadrant of the

multidimensional scale, and in each apparent cluster of subjects. Common characteristics of members of each quadrant or cluster were noted, with reference to the dimensions represented by the axes.

Information from the multidimensional scale was used to produce profiles of average good and poor spellers, based on the total subject population, and of the grade 5 and grade 7 sub-populations. These profiles, or "average good spellers" and "average unexpectedly poor spellers" do not represent actual individuals. They are composites, based on the information provided in the multidimensional scale. These composites developed from the profile will be referred to as "idealized individuals" for the remainder of this report. The four subjects involved in the case study, on the other hand, are actual, real individuals, and were selected to represent the composites described in the profiles.

Procedures: Case Studies

Two good spellers and two poor spellers, identified through the tests and analyses described above, were selected from the original group of 57 subjects for the case studies. Each of the subjects was in grade 5. The two subjects who were selected to represent the poor spellers fall into the category of unexpectedly poor spellers, as their math and reading achievement scores were above average and their teachers' comments and school records indicated that they were strong in language areas other than spelling.

Each of the four subjects in the case study participated in a self-report spelling activity. During this activity, participants were asked to spell a number of phonologically opaque and transparent words. Following the spelling of each word, the participants were asked to describe the thought processes and strategies employed during the spelling of the word. These descriptions were audio-taped, analyzed for patterns, and discussed with the participants for further clarification. While it is

impossible to ensure that what is reported by subjects in a self-report activity is an accurate representation of cognitive acitivity, this is currently the best availabvle window on the processes and strategies employed in an activity such as spelling. The subjects in this case study approached the task seriously and thoughtfully, and endeavoured to provide clear and accurate information to the best of their ability. Further evidence of their abilities to accurately represent their thought processes was provided by an analysis of their spelling strategies, using an error analysis. This analaysis provided evidence that their reported strategies were being employed during the spelling process.

In addition to the written spellings produced during the self-report spelling activity, a writing sample was collected from each participant. This writing sample is a rough draft of a brief description of a favorite television program. The description was written at the request of, and specifically for, the researcher.

School records for each of the four participants in this part of the study were read and each participant's teacher was questioned about her or his perceptions of the participant's general ability, language development, and history as a student.

Data collected during the self-report spelling activity and from the writing sample were categorized and common patterns of similarity and dissimilarity among the participants' written and spoken responses were noted and analyzed in light of the findings of the first part of the study and the existing literature.

CHAPTER 4

Findings and Discussion: Factors Related to Spelling Proficiency

This study was designed to answer a number of questions related to the development of proficiency in conventional spelling. The exploration of these issues involved five basic approaches (a) adaptation and/or replication of existing studies in which the relationships between various cognitive abilities and spelling ability were determined, (b) use of a combination of scores from the cognitive tests described in Chapter 3 of this report to assess the relationship between spelling ability and simultaneous and sequential processing, (c) analysis of the dimensions and clusters of subjects found on the subject configuration produced by the multidimensional scaling procedure, (d) development of composite profiles of good and unexpectedly poor spellers using the information from the multidimensional scale, and (e) case studies of selected grade 5 subjects. Data collected in these ways were used to address the four questions posed by this study:

1. What are the relationships between spelling ability and ability in using certain cognitive processes?

2. What are the relevant characteristics of good and unexpectedly poor spellers as determined by academic performance and performance on selected cognitive tests?

3. How do these relationships and characteristics differ between students in grade 5 and grade 7?

4. How do selected representatives of the good and unexpectedly poor spellers at the grade 5 level differ from each other?

This chapter is a detailed analysis of the evidence, in an attempt to answer the first three questions. The final question will be discussed in Chapter 5.

Before beginning the discussion of findings related to the specific questions noted above, a discussion of the nature of the data and overall findings is needed. During the process of correlational analysis, it was noted that the results obtained when all subjects, grades 5 and 7, were included did not accurately reflect the nature of the data for either grade level subpopulation. In some cases, findings for the entire subject population failed to reach significance, while correlations between spelling and a given measure for either or both sub-populations, grade 5 subjects or grade 7 subjects, did reach significance. Further investigation lead the researcher to conclude that in many cases the collapsing of data between two very different subpopulations produced results which were not descriptive of the entire population nor of either subpopulation. Findings for the overall subject population are reported; however, the reader is advised that these findings may be misleading, and that greater attention should be given to the findings for subpopulations based on grade level groups in the discussion of the speller profiles produced by the multidimensional scaling analysis. The effect of collapsing data will be further explicated in the following discussions of the research questions, and in the concluding chapter of this report.

Cognitive Processes Related to Spelling Proficiency

This section is a discussion of the results of tests of specific cognitive processes, and the relationship of these results to spelling ability and

provides an answer to question 1: What are the relationships between spelling ability and ability in using certain cognitive processes?

This portion of the study was designed to be exploratory and descriptive. The correlational data are not assumed to represent causal relationships. Rather, this information was collected as a precursor to the multidimensional scaling analysis, and was used as an initial exploration of the relationships among spelling ability and the various cognitive factors included in the multidimensional scaling analysis. The correlational data then served as a check on the profiles produced from the multidimensional scale.

The strategies assessed in determining the relationships between cognitive strategies and spelling ability include (a) reading by partial or full cues, (b) learning by rule or by rote, (c) visual, auditory, and spatial processing, and (d) simultaneous and sequential processing. Correlations for each of these measures and spelling ability are reported in Table 1.

Reading by Partial or Full Cues

Assessment of subjects' approaches to reading using partial or full orthographic cues was based on research conducted by Frith (1978, 1980) and Ormrod (1985). A test based on Ormrod's Cat in the Hat proofreading test was used. The test involves identification of phrases as being correctly spelled or not correctly spelled. The assumption underlying the test is that subjects who can make these identifications read using full orthographic cues, and those who cannot make these identifications read using partial orthographic cues. Results were examined to determine whether there is a relationship between reading by partial or full cues and spelling ability.

Analysis was done by determining Pearson product-moment correlation coefficients of test scores for all subjects in grades 5 and 7 (N=57). (Results are reported in Table 1). A significant positive

Table 1

Correlations Between Spelling and Individual Factors for All Subjects (N = 57)

Standardized achievement tests		Reading and learning styles		Cognitive factors	
	SP1		SP1		SP1
Reading	.3730	CAT	.4781	NU	.4422
	p<.002 (S)		p<.001 (S)		p<.001 (S)
Math	.3764	Rule	.0340	PC	.1747
	p<.002 (S)		p<.401		p<.097
		Rote	.3836	SH	.3431
			p<.002 (S)		p<.004 (S)
				PI	.2617
					p<.025 (S)
				WC	.2590
					p<.026 (S)

Note. SP1 = Scores on a Spelling test of phonologically opaque words.
CAT = Partial or full cues
SH = Shapes
(S) = Significant correlation
NU = Numbers
PC = Picture completion
PI = Pictures
WC = Words and coulours

correlation (.4781, p<.001) was found between scores on the Cat in the Hat proofreading test and the spelling test on phonologically opaque words. These results indicate a strong relationship between reading by full cues and proficiency in spelling, and support the findings of Frith (1978, 1980) and Ormrod (1985).

The relationship between reading style and spelling ability is an indication of the role of visual attention to detail in spelling proficiency. Readers who read using full orthographic cues attend to the details of words in print as they read. It appears that reading in this way contributes to development of an intact visual store of words which can be used by spellers in producing conventional spellings for phonetically irregular words. This is in keeping with Frith's suggestion that most unexpectedly poor spellers have difficulty in selecting the correct graphemes when more than one grapheme could represent the sounds in a given word.

Learning by Rule or by Rote

Learning by rule or by rote was tested using an adaptation of a structure task developed by Bruce and Cox (1983). Bruce and Cox tested subjects' abilities to ascertain and apply simple and complex permutation rules, and compared scores on these tasks to scores on random permutation tasks which require simple rote memory. Their findings indicate that rote learning is related to spelling ability, but that rule learning is not.

Subjects in this study were presented with the same set of tasks. Analysis of the scores for all subjects indicate agreement that spelling and learning by rote are correlated (.3836, p<.002) and that spelling and learning by rule are not related. (See Table 1). This supports Bruce and Cox's findings.

The nature of English orthography is such that many words do not follow the expected spelling patterns. This was graphically demonstrated

in the study conducted by Hanna et al. (1966), in which it was found that a computer programmed to spell using approximately 300 spelling rules was able to spell about half of the common words it was given correctly. The ability to discern and apply patterns, as tested by the rule learning component of the test used in this study and in the Bruce and Cox study, is not related to spelling proficiency. Rather, the ability to learn by rote,which entails visual memory in the task used in this study, is related to spelling proficiency.

Cognitive Processes

The five tests used for assessing auditory, visual, and spatial processes were adapted from the Kaufman Assessment Battery for Children (K-ABC). Adaptations were made to facilitate group presentation. The adapted tests were renamed and coded by the researcher for this study.

Three of the five tests were identified in the K-ABC manual as tests of various visual processing abilities. The Gestalt Closure test, coded PC (Picture Completion), the Matrix Analogies test, coded SH (Shapes), and the Spatial Memory test, coded PI (Pictures) were used to assess various visual processing abilities of the subjects. These scores were then correlated with subjects' scores on the spelling test (SP1). Results for analysis of all subjects indicate a significant correlation (.2617, $p<.025$) of spelling and spatial memory (PI), which entails short term visual memory and visual organization. A significant correlation (.3431, $p<.004$) was also found for spelling and scores on the Shapes test, which entails attention to visual detail and visual organization (Kaufman & Kaufman, 1983). The correlation between spelling and gestalt closure (PC) was not significant.

These results are consistent with the findings on the Cat in the Hat and Rote and Rule tests, each of which entails elements of visual memory and attention to visual detail.

Spatial memory and ability were assessed by two of the tests, the Pictures (PI) test, adapted from K-ABC Spatial Memory, and the Picture Completion (PC) test, adapted from K-ABC Gestalt Closure. These tests also have visual processing aspects, and results of analysis of their correlations with spelling are discussed above. Evidence from these analyses suggests that spatial memory is correlated with spelling ability.

Two of the tests selected from the KABC for adaptation and use in this study entail auditory processes. The Numbers (NU) test, adapted from K-ABC Number Recall, is a digit span test. The Words and Colours (WC) test was adapted from K-ABC Word Order. Both are designed to asses processing abilities involving short term auditory memory and serial recall. Scores on each of the tests were significantly correlated with spelling scores for the overall subject population (Nu = .4422, $p<.001$); (WC = .2590, $p<.026$). (See Table 1).

These tests were included primarily as indicators of sequential processing style, for the analysis of cognitive processing style discussed below. However, it was interesting to note that a positive correlation exists for each of the tests and the spelling test, which indicates a relationship between auditory memory and serial recall, and spelling ability. This correlation may be an indication of a relationship between over-all cognitive development and/or memory, and spelling ability, or of a relationship between sequential processing style and spelling ability. This is an area which calls for further research, with more specific testing instruments, in order to determine which of the cognitive processes underlying the ability to perform the test tasks are related to spelling ability.

Simultaneous and Sequential Processing Styles

Leasak, Hunt, and Randhawa (1982), in their study on the effects of simultaneous processing training on school achievement, found that although the training did not result in statistically significant

improvements for grade 4 students' overall ability with simultaneous processing tasks, it did result in significant changes in achievement scores on some sections of the Wide Range Achievement Test. Spelling was one of the areas in which subjects showed significant increases, suggesting a relationship between simultaneous processing and spelling ability.

Three of the five tests adapted from the K-ABC are indicators of simultaneous processing: Pictures (PI), adapted from K-ABC Spatial Memory; Picture Completion (PC), adapted from K-ABC Gestalt Closure; and Shapes (SH), adapted from K-ABC Matrix Analogies. Two of the tests -- Numbers (NU), adapted from K-ABC Number Recall, and Words and Colours (WC), adapted from K-ABC Word Order -- assess sequential processing. Analysis of scores was conducted on the simultaneous processing tests (PI, PC, and SH), and on the sequential processing tests (NU and WC). Analysis of test scores for the entire subject population indicate that both simultaneous and sequential processing scores are related to spelling ability.

This finding seems to suggest a relationship between over-all cognitive development and spelling ability. However, further investigation of the relationships among processing style, reading style, learning style, and specific cognitive abilities, using the multidimensional scaling procedure, resulted in differing configurations of these factors for good spellers at the grade 5 and grade 7 level. The profiles produced using the multidimensional scale provide some indication of a relationship between developmental aspects of spelling and relative strength in either simultaneous or sequential processing style. This is discussed in greater detail in the section of this chapter in which question 3 is discussed.

SUMMARY OF FINDINGS RELATED TO QUESTION 1: What are the relationships between spelling ability and ability in using certain cognitive processes?

A number of cognitive processes and abilities are correlated with ability to spell. Reading style involving the use of full orthographic cues is correlated with spelling ability, as is learning by rote. Results from the tests adapted from the Kaufman Assessment Battery for Children indicate that a number of processes are related to spelling ability. Visual processes involving short term visual memory, visual/perceptual organization, attention to visual detail,and the ability to distinguish essential from non-essential detail, were found to be related to spelling ability.

Spelling and short term auditory and verbal memory were correlated, indicating a positive relationship between auditory processes and spelling ability.

Two of the tests assess visual-spatial abilities. The scores on these tests were inconclusive with respect to correlation with spelling ability, in that one of the tests (PI) was correlated with spelling while the other test (PC) was not. The primary difference is that the Pictures (PI) test assesses short term visual and spatial memory, while the Picture Completion (PC), a gestalt closure test, assesses long term memory and the ability to convert abstract stimuli into concrete mental representations.

In addition to the above noted processes, analogic thinking and the ability to reproduce a model, whether presented visually or auditorily, are correlated with spelling ability.

Both simultaneous and sequential processing scores were correlated with spelling in the analysis of the overall subject population. While there is some evidence that general cognitive development correlates with spelling ability, there are other factors which must be considered with respect to this finding. These issues are discussed below, in answer to question 3. Also, it must be noted that many of the tests used in this study rely on more than one type of cognitive ability. For example, the tests whose combined scores produced the simultaneous processing score are also tests of visual processing, and the tests used to assess sequential processing are also tests of auditory processing. The

relationship between visual and simultaneous processing abilities, and auditory and sequential processing abilities have been noted and documented by other researchers (Luria, 1966; Margolin, 1984).

In summary, reading using full orthographic cues, learning by rote, visual and auditory memory were found to be related to spelling ability in upper elementary students. Positive correlations were found for the tests reflective of both simultaneous and sequential processing styles. These results indicate a relationship between overall cognitive development and spelling ability.

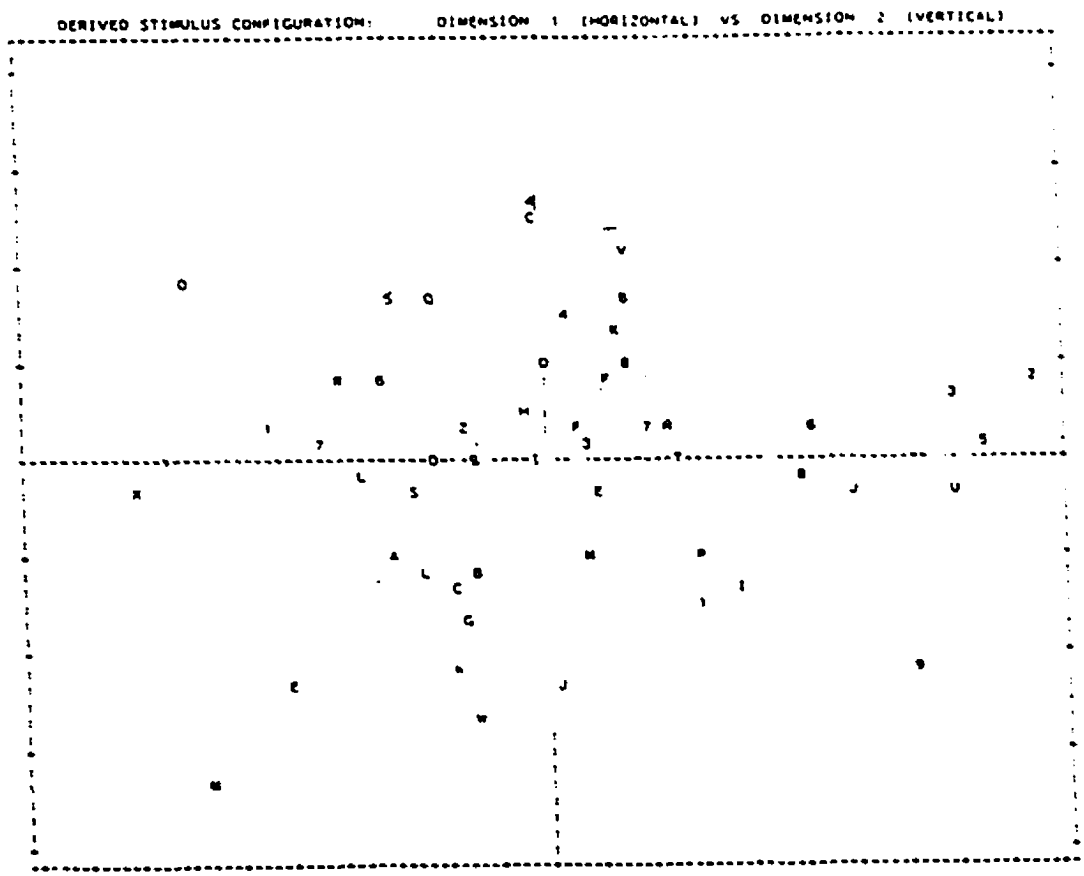
Profiles of Proficient and Non-proficient Spellers

A multidimensional scaling procedure was employed in answering Question 2: What are the relevant characteristics of good and unexpectedly poor spellers as determined by academic performance and performance on selected cognitive tests?

All subjects' scores on the tests of cognitive processes, spelling of phonologically opaque words, and standardized achievement scores obtained from school records were included in the analysis. The resulting subject configuration (Table 2) was analyzed using dimensional and neighborhood analysis. Analysis of scores for the subjects located on the extremes of each axis, combined with average scores for all subjects in each group, indicate that the vertical axis is related to reading style (use of full or partial orthographic cues) and the horizontal axis is related to learning by rote or learning by rule, and relative strength in sequential or simultaneous processing. The extreme left of the horizontal axis represents strength in learning by rote and sequential processing style. The extreme right of this axis represents learning by rule and simultaneous processing style. The top of the vertical axis represents reading using full orthographic cues, while the bottom represents reading using partial cues. Due to the overlap of cognitive strategies assessed

Table 2

Multidimensional Scale Configuration Plot



Note. Each point on the configuration represents a student. The four case study students are indicated as follows:
Sindy = 4 Ben = 5 (top left) Carrie = 8 Seton = 9 (bottom right)

Table 3
Mean Scores by Group for All Subjects (N = 57)

Math	Rdg	Sp	R&R	Cat	Seq	%	SIM	%	S-S	O	A	C
Top left												
7.9	7.6	8.6	-3.6	17.7	16.8	65	25.2	72	7	83.8	24.1	59.7
Bottom left												
6.4	6.3	3.7	-2.6	14.3	13.4	52	23.3	67	15	67.4	16.4	51
Top right												
8.1	7.9	8.6	5.5	18.1	15.1	58	28.1	80	22	85.9	24.6	61.3
Bottom right												
7.6	6.9	5.8	5.6	15.1	12.1	47	25.2	72	25	72.7	20.3	52.4

Note. S-S = Simultaneous score minus sequential score.
O = Overall achievement score, derived by adding Math, Reading, Spelling, Cat in the Hat, Sequential and Simultaneous scores.
A = Achievement score derived by adding Math, Reading, and Spelling scores.
C = Cognitive test score, derived by adding Cat in the Hat, Sequential and Simultaneous scores.

by the tests related to sequential and simultaneous processing, it is likely that auditory and visual processing are also related to the horizontal axis. Using this information, profiles were developed for each of the four groups. Mean scores on each of the measures were determined for each group (Table 3), and these means were used as the scores for the idealized individuals which represent each group (Table 4). The means on the measures identified as the horizontal and vertical dimensions of the multidimensional scale were compared using t-tests, in order to determine if the groups were significantly different on the measures. Significance was attained in each case.

Subjects in group one, the top left group, are proficient spellers. They are the strongest of the four groups in learning by rote and in sequential processing ability. Their sequential/simultaneous differential score is the lowest of any group, which indicates their relative strength in sequential processing. Their reading style is to read using full cues.

The second group, the top right group, is also made up of proficient spellers. This group is strong in learning by rule, and has the highest average scores on reading using full cues and over-all score. This group also has the highest average simultaneous processing score, supported by a high sequential/simultaneous differential score.

Groups three, bottom right, and four, bottom left, are made up of subjects who are not proficient spellers. Average scores for each group indicate that members of both groups read using partial cues. They are also similar in that the average over-all score for each group is lower than the average over-all score for group one or group two.

Subjects in the bottom right group, group three, are strong in learning by rule, and simultaneous processing. They have the highest sequential/simultaneous differential score of the four groups.

Subjects in the bottom left group, group four, rely on rote learning and are stronger at sequential processing than subjects in group three.

Table 4

Descriptions of Idealized Individuals from the Group Profiles

Typical Grade 5 Good Speller	Typical Grade 7 Good Speller
Rote learner	Rule learner
Sequential processor	Simultaneous processor
Reads using full cues	Reads using full cues
Good speller	Good speller
Grade 5 (N=12)	Grade 7 (N=13)
Grade 7 (N=9)	Grade 5 (N=2)

Typical Grade 5 Poor Speller	Typical Grade 7 Poor Speller
Rote learner	Rule learner
Sequential processor	Simultaneous processor
Reads using partial cues	Reads using partial cues
Poor speller	Poor speller
Grade 5 (N=8)	Grade 7 (N=8)
Grade 7 (N=1)	Grade 5 (N=4)

Comparisons drawn between the two top groups, the good spellers, and the two bottom groups, the poor spellers, show that the top groups scored higher on most measures than the bottom groups, indicating that proficient spellers are generally stronger in achievement and in over-all cognitive development than the non-proficient spellers.

When the data for all subjects (N=57) is considered, the profile of the proficient, visual-orthographic, speller is that she or he is performs well on tests of cognitive ability, achieves approximately one year above grade level in math and reading, reads using full orthographic cues, as tested on the Cat in the Hat Proofreading Test, and may be relatively strong in either learning by rote and sequential processing, or in learning by rule and simultaneous processing. The profile for the non-proficient speller is that s/he is less well developed cognitively than the proficient speller, scores at or near grade level in math and reading, reads using partial orthographic cues, and may be relatively stronger in either learning by rote and sequential processing, or learning by rule and simultaneous processing. These idealized individual proficient and non-proficient spellers may be of either gender, as all four groups were made up of nearly equal numbers of girls and boys.

SUMMARY OF FINDINGS RELATED TO QUESTION 2: What are the relevant characteristics of good and unexpectedly poor spellers as determined by academic performance and performance on selected cognitive tests?

The multidimensional scaling analysis produced a configuration of subjects which allowed differentiation and description of the relevant characteristics of good and unexpectedly poor spellers. These findings must be qualified in that there are certainly other cognitive factors which play a role in the ability to spell well. In addition, the collapsing of data for grade 5 and grade 7 subjects produced somewhat misleading results. As will be shown in the following section, there are notable differences

between the subpopulation of grade 5 subjects and the subpopulation of grade 7 subjects, and these differences were averaged out in the overall analysis used to develop speller profiles. The averaging out of scores masked a number of distinctions between subjects in grade 5 and in grade 7, and between good and poor spellers in each grade group.

Differences Between Grade Groups

The findings related to question 3: Do these relationships and characteristics differ between grade 5 and grade 7, and if they do, what is the nature of the differences? proved to be the most interesting of the study.

The following discussion of grade 5 and grade 7 speller profiles is based on averages of scores for each grade level in each of the four groups on the multidimensional scale. Profiles for grade 5 subjects in each group will be discussed first, followed by a discussion of the grade 7 subjects in each group. Comparisons will then be drawn between the grade 5 and grade 7 subject groups.

Profiles for Grade 5 Subjects

In this section of the analysis, only grade 5 subjects are included, and any reference to subjects refers to the grade 5 subpopulation only. Any scores given are averages for the grade 5 subjects in each group. These averages are reported in Table 5.

Although two or more subjects appeared in each of the four groups, 77% of them (20 of 26) were in the two groups on the left side of the configuration. Analysis of the multidimensional scale by halves indicates that subject groups appearing on the left side are stronger in learning by rote, and in sequential processing than the subject groups on the right.

Table 5
Mean Scores by Group for Grade 5 Subjects (N = 26)

Math	Rdg	Sp	R&R	Cat	Seq	%	Sim	%	S-S	O	A	C
Top left												
7.1	7.2	8.3	-4.8	18.2	17.6	68	23.4	67	1	81.8	22.6	59.2
Bottom left												
6.3	5.9	3.5	-2.8	14.4	13.1	50	22.9	65	15	66.1	15.7	50.4
Top right												
7.6	8.7	7.5	2	18	15	58	25	71	13	81.8	23.8	58
Bottom right												
6.3	7.8	4.8	5.3	13	12.8	49	26.375		26	71	18.9	52.1

Note. S-S = Simultaneous score minus sequential score.
O = Overall achievement score, derived by adding Math, Reading, Spelling, Cat in the Hat, Sequential and Simultaneous scores.
A = Achievement score derived by adding Math, Reading, and Spelling scores.
C = Cognitive test score, derived by adding Cat in the Hat, Sequential and Simultaneous scores.

The groups in the left half also have lower average overall scores than the right hand groups. In addition to being clustered predominantly on the left half of the scale, subjects are unevenly distributed among the four groups. A large majority (12 of 14) of the good spellers clustered in the top left group, while only two of the good spellers appeared in the top right group. Similarly, a large proportion of the poor spellers (8 of 12) clustered in the bottom left group, with only four of the poor spellers appearing in the bottom right group. This produces a fairly even distribution between the top and bottom halves of the scale. Subjects in the top half are better spellers, have higher math and reading achievement scores than subjects in the bottom half of the scale, and read using full orthographic cues.

The largest cluster of grade 5 subjects (N = 12) is in the top left group. This group has the highest average spelling score and is characterized by above average reading and math scores. It has the highest learning by rote, reading by full cues, and sequential processing scores of any of the four groups. This group and the top right group share the highest overall score, but the composition of the scores is slightly different. The top left group scored slightly higher on the cognitive total and slightly lower on the achievement total than did the top right group.

The second largest cluster is the bottom left group. This group shares some characteristics with the top left group, including strength in learning by rote, and relative strength in sequential processing. It has the lowest achievement test score in math and shares the lowest score in reading with the bottom right group. The bottom left group is at grade level in reading, and slightly above grade level in math. This group has the lowest over-all, achievement, and cognitive totals and the lowest average spelling score of the four groups.

The bottom right group contains four subjects. The average reading score for this group is two years above grade level, and the math score is also above grade level. This group has the highest score for learning by rule and for simultaneous processing and scored the lowest of any group

in sequential processing and reading by full orthographic cues. This group is also made up of subjects who are poor spellers.

The final group, the top right, contains only two members of the grade 5 subpopulation. Subjects in this group have the highest average achievement scores in math, and reading, and high scores on reading by full cues, and learning by rule. Although these two students scored higher than average on both sequential and simultaneous processing, simultaneous processing is somewhat stronger than sequential processing in comparison to the other groups. The average spelling score for this group is the second highest of any group.

The top left group, containing twelve subjects, provides a profile of an average grade 5 proficient speller. The bottom left group, containing eight subjects, provides a profile of an average grade 5 non-proficient speller.

Profiles for Grade 7 Subjects

In this section of the analysis, only grade 7 subjects are discussed. Any reference to subjects refers to grade 7 subjects only, and test scores are averages for grade 7 subjects in each group. Mean scores are reported in Table 6.

Three of the four groups contain relatively large numbers of grade 7 subjects. Of the 31 subjects, 22 appear in the top half of the scale, indicating that 71% of them are good spellers. Of the nine subjects on the bottom half of the scale (poor spellers), only one is in the bottom left group.

The top right group contains the largest number of subjects (N=13). This group has the highest scores in learning by rule, reading by full cues, and simultaneous processing of any of the groups. The sequential/simultaneous differential score for this group is the second highest of the the four groups. It also has the highest over-all and

Table 6
Mean Scores by Group for Grade 7 Subjects (N = 31)

Math	Rdg	Sp	R&R	Cat	Seq	%	Sim	%	S-S	O	A	C
Top left												
9	8	8.9	-2	17.1	15.7	60	27.6	79	19	86.3	25.9	60.4
Bottom left												
7.8	9.6	5	-2	14	16	62	27	77	15	79.4	22.4	57
Top right												
8.3	7.8	8.8	6	18.2	15.1	58	28.5	81	23	86	24.9	61.8
Bottom right												
8.2	6.4	6.3	5.6	16.1	11.8	45	24.6	70	25	72.8	20.9	51.9

Note. S-S = Simultaneous score minus sequential score.
O = Overall achievement score, derived by adding Math, Reading, Spelling, Cat in the Hat, Sequential and Simultaneous scores.
A = Achievement score derived by adding Math, Reading, and Spelling scores.
C = Cognitive test score, derived by adding Cat in the Hat, Sequential and Simultaneous scores.

cognitive scores. It is next to last in reading, but the average score is still at grade level. Subjects in this group are proficient spellers.

The top left group (N=9) has the highest score in math, reads using full orthographic cues, and is second to the top right group in over-all score. The average reading score is only slightly above grade level. This group is second to the top right group in sequential processing, but third overall on the sequential/simultaneous differential score. This group contains good spellers.

Subjects in the bottom right group (N=8) are not proficient spellers. This group has the lowest average score in reading, and is the only group to score below grade level in reading. The average math score for this group is slightly above grade level. Scores indicate they read using partial orthographic cues, and are stronger in learning by rule than in learning by rote. Although this group has the lowest simultaneous and sequential processing scores, the sequential/simultaneous differential score of 25 is the highest of the four groups, indicating relative strength in simultaneous processing. This group has the lowest cognitive, achievement and over-all scores of any group.

The bottom left group contains only one subject. This subject is the least proficient speller of the grade 7 subjects, but has a higher reading score than any of the averages for other groups. This subject is strong in learning by rote and reads using partial cues, as indicated by scores on the tests used. S/he has the highest sequential processing score and the lowest sequential/simultaneous differential score, indicating relative strength in sequential processing. Despite proficiency in reading, her or his total cognitive, achievement, and over-all scores are only slightly better than those of the bottom right group.

The profile for an average grade 7 proficient speller can be found in the description of the top right group. This idealized individual is strong in learning by rule, reads using full orthographic cues, and has a strong simultaneous processing style. S/he scores within the normal grade level range in reading, and slightly above the normal grade level range

in math on standardized tests. Thirteen of the grade 7 good spellers were in the group represented by this idealized individual's profile.

The relatively large numbers of subjects, nine of the grade 7 good spellers, in the top left group lead to an investigation of similarities, and differences, which might serve to expand this profile, as the subject groups in the top half of the scale are all proficient spellers. Their shared characteristics are as follows: above grade level scores on the math achievement test; reading by full cues; and high cognitive, achievement and over-all scores. The proficient spellers in the top right group are also proficient in learning by rule and are stronger in simultaneous processing skills than the subjects in the top left group. The top left group is strong in learning by rote, and is stronger in sequential processing skills than the top right group.

The distinction of good and poor speller groups at the grade 7 level is not as clear cut as the distinction of these groups at the grade 5 level. This will be further discussed in the concluding chapter of this report.

Comparison of Grade 5 and Grade 7 Speller Profiles

There are a number of similarities between the average grade 5 proficient speller (top left group) and the average grade 7 proficient speller (top right group), which were discussed in answer to question 2, above. Scores for each group are reported in Table 7. Both subject groups scored above grade level on the math achievement test. Both the grade 5 and grade 7 proficient spellers are next to last among the four groups on their reading achievement test scores. Both groups have the highest scores for reading using full cues and for cognitive development.

There are some notable differences between these fictional composite average grade 5 and grade 7 good spellers. The grade 5 proficient speller has the highest average score in learning by rote of any grade 5 group. In contrast, the average grade 7 proficient speller has the highest

Table 7
Mean Scores by Group for Grade 5 (N = 26) and Grade 7 (N = 31) Subjects

Math	Rdg	Sp	R&R	Cat	Seq	%	Sim	%	S-S	O	A	C
						Top left						
Grade 5												
7.1	7.2	8.3	-4.8	18.2	17.6	68	23.4	67	1	81.8	22.6	59.2
Grade 7												
9	8	8.9	-2	17.1	15.7	60	27.6	79	19	86.3	25.9	60.4
						Bottom left						
Grade 5												
6.3	5.9	3.5	-2.8	14.4	13.1	50	22.9	65	15	66.1	15.7	50.4
Grade 7												
7.8	9.6	5	-2	14	16	62	27	77	15	79.4	22.4	57
						Top right						
Grade 5												
7.6	8.7	7.5	2	18	15	58	25	71	13	81.8	23.8	58
Grade 7												
8.3	7.8	8.8	6	18.2	15.1	58	28.5	81	23	86.7	24.9	61.8
						Bottom right						
Grade 5												
6.3	7.8	4.8	5.3	13	12.8	49	26.3	75	26	71	18.9	52.1
Grade 7												
8.2	6.4	6.3	5.6	16.1	11.8	45	24.6	70	25	72.8	20.9	51.9

score in learning by rule of any of the grade 7 groups. Similarly, the grade 5 proficient speller has the highest sequential processing score of any grade 5 group, while the grade 7 proficient speller has the highest simultaneous processing score.

The second group of grade 7 proficient spellers (N=9) is located in the same group as the average grade 5 proficient spellers (top left) and shares many characteristics with this grade 5 group. This group of grade 7 subjects (top left group) has higher average scores in learning by rote and sequential processing than the larger group of grade 7 proficient spellers (top right).

These findings suggest that the pattern of abilities for grade 5 subjects is clearly different for good and poor spellers, and that for many grade 7 subjects the pattern is reversed on some cognitive abilities or styles, most notably learning by rote or by rule, and use of simultaneous or sequential processing strategies. A large majority of the grade 5 proficient spellers have higher scores on learning by rote and sequential processing than the other grade 5 groups. This is reversed for the larger group of grade 7 proficient spellers, who have higher scores on learning by rule and simultaneous processing. The second group of grade 7 proficient spellers is similar to the grade 5 proficient spellers in that they have higher scores on learning by rote, and like the larger group of grade 7 proficient spellers in that they have higher scores on simultaneous processing.

The differences in cognitive profile between the idealized individual grade 5 and grade 7 good spellers provides support for the view that a major cognitive shift occurs around age 10, and that this shift has an effect on ability to spell using visual-orthographic strategies. The idealized individual grade 7 good speller has apparently made this shift. S/he is able to attend to visual detail, process information in a simultaneous fashion, and discern and apply patterns, as tested in the learning by rule task in this study. As noted above, the patterns in English orthography are not reliable when approached at the phonologic

level. However, there is evidence of the reliability of patterns when approached from the more sophisticated morphographic and orthographic perspectives. It appears that the ability to analyze and apply patterns is a hallmark of mature spelling.

Further indication of the differences between grade 5 and grade 7 can be found in the mean scores on learning by rote or by rule and simultaneous and sequential processing for these grade groups. Because of the small number of subjects, statististical analysis will not be reported. However, it was interesting to note that the mean score on the difference between learning by rule or by rote was -2.2 for grade 5 students and +3.0 for grade 7 students. When the difference score is used, a positive number indicates greater reliance on rule learning strategies, while a negative number indicates greater reliance on rote learning strategies. The mean score on sequential processing for the grade 5 subjects (15.3) was slightly higher than the mean score for grade 7 subjects (14.4). The scores for simultaneous processing were the opposite, with the grade 7 mean (25.4) being somewhat higher than the grade 5 mean (23.8). While the small numbers of subjects in the sub-groups precludes formal statistical analysis, this information may be useful in providing a basis for future research.

SUMMARY OF FINDINGS RELATED TO QUESTION 3: How do these relationships and characteristics differ between students in grade 5 and grade 7?

The most consistent difference between grade 5 and grade 7 proficient spellers is the shift from relative strength in sequential processing to relative strength in simultaneous processing. While the grade 5 proficient speller group scored higher on sequential processing than did any other grade 5 group, both of the grade 7 proficient speller groups scored higher on simultaneous processing than did the other grade 7 groups. Although the smaller group of grade 7 proficient spellers (N=9) did not differ from the grade 5 group of proficient spellers on

learning by rote, the larger group of grade 7 proficient spellers (N=13) showed greater reliance on learning by rule.

The shift from greater reliance on sequential processing to simultaneous processing between grade 5 and grade 7 is reflected in the shift in primary spelling strategy at these stages of spelling development. Generally, students in grade 5 are around age 10, and have not yet reached the mature stage of spelling development. Their spellings are characterized by continued reliance on a phonologic strategy, with increasing use of visual-orthographic strategies as they move toward the mature stage. Phonologic strategies are sequential, entailing a matching of sounds to letters in a linear fashion. It appears likely that as students make the cognitive shift to increased ability in simultaneous processing, this shift is demonstrated in their increasing ability to apply visual-orthographic strategies when spelling.

The tests used to determine simultaneous processing style in this study have a strong visual component. As noted above, the literature on simultaneous and sequential processing indicates that there is such a relationship between visual processing and simultaneous processing. The shift to greater reliance on simultaneous processing by grade 7 may also be an indication of increased ability or preference for visual processing, including attention to detail and visual memory, both of which have been noted to be related to the development of a store of visual representations of words in memory. This visual store is critical to the ability to use visual-orthographic strategies in spelling, as noted by Frith (1980) and Ehri (1980).

In summary, investigations of Questions 1, 2, and 3 through the analysis of a variety of test scores indicate that proficient spellers are visual-orthographic spellers and that these spellers have a different cognitive pattern than non-proficient, phonologic spellers and that these patterns change from grade 5 to grade 7. The use of a multidimensional scaling procedure resulted in clear differentiations between good and

poor spellers in grade 5 and grade 7, and between grade 5 and grade 7 good and poor spellers.

CHAPTER 5

Case Studies

Four grade 5 students were selected for further analysis in order to answer question 4: How do selected representatives of the good and unexpectedly poor spellers at the grade 5 level differ from each other?

Two of the students, Ben and Sindy were selected from the top left group of the multidimensional scale, and represent this group of typical grade 5 proficient spellers. Carrie and Seton were selected from the bottom right group, and represent unexpectedly poor spellers.

Three sources of information were analyzed for these students, a self-report spelling activity, a first draft writing sample, and scores on the tests described in the first part of this study. Test scores for each subject, the group in which they appear, and the grade 5 mean are reported in Table 8. Spellings produced during the self-report spelling activity are presented in Table 9. Spellings produced during the first draft writing activity, which resulted in connected text, are presented in Table 10. The strategies reported by the subjects during the self-report spelling activity are presented in Table 11.

The self-report spelling activity entailed asking each subject to describe how s/he thought about each word while writing it during a standard format spelling test. This activity was conducted individually with each subject. The subjects also wrote brief descriptions of their favourite television shows, which provided the researcher with samples of their spelling in connected text. The subjects' self-reports and misspellings in the test and the writing activity were analyzed for patterns of reported and actual strategies employed.

Table 8
Subject Scores, Group Means and Grade 5 Means

Math	Rdg	Sp	R&R	Cat	Seq	%	Sim	%	S-S	O	A	C
Sindy												
7.2	7.8	10	2	20	23	88	23	65	-23	91	25	66
Ben												
8.3	9.1	10	-2	19	21	81	24	69	-12	91.4	27.4	64
Top left group												
7.1	7.2	8.3	-4.8	18.2	17.6	68	23.4	67	-1	81.8	22.6	59.2
All grade 5's												
6.7	7.0	6.5	-2.2	16.2	15.3	59	23.8	68	9	75.5	20.2	55.3

Math	Rdg	Sp	R&R	Cat	Seq	%	Sim	%	S-S	O	A	C
Carrie												
7.4	8.6	6	7	14	16	62	26	74	12	78	22	56
Seton												
6.7	8.6	4	8	11	10	38	32	91	53	72.3	19.3	53
Bottom right group												
6.3	7.8	4.8	5.3	13	12.8	49	26.3	75	26	71	18.9	52.1
All grade 5's												
6.7	7.0	6.5	-2.2	16.2	15.3	59	23.8	68	9	75.5	20.2	55.3

Table 9
Spellings Produced During Self-Report Spelling Activity

Test words	Misspellings		
	Ben & Sindy	Seton	Carrie
smoke			
twelve			
dividend			divident
comfortable		comfertible	
expiration		experation	experation
American		amearican	americain
budget			
business		busness	buisness
autumn		autem	autum
canoe		knu	canoo
camouflage		cemmoflage	camifloge
sauerkraut	sour crout	sourcrout	sourcrout
women			
natural			
caution			
exit			

Table 10

Examples of Spellings Produced in Connected Text

Ben	Sindy	Seton	Carrie
certain	fashion	transportation	perfectly
characters	popularity	equipment	imaginations
gossiping	directors	containment	recommend
chauffeur	everyone	ghostbusters	proper
	everbody	cherictors	charictors
	* (everybody)	* (characters)	*(characters)
	thier	stattus	lawer
	* (their)	* (status)	* (lawyer)
		mortorcycle	marrage
		* (motorcycle)	* (marriage)
		extermnate	allways
		* (exterminate)	* (always)

Note. Words without asterisks are the actual spellings produced by the subjects. Some of these spellings are conventional and are provided as examples of the types of words the subjects are capable of spelling.

The subjects selected for this part of the study are described in their school records, and by their teacher, as being at or above grade level. This description is supported by their scores on the grade 5 standardized achievement tests in reading and math. Their scores on these tests are above the average of test scores in math and reading for the grade 5 subjects in this study, with the exception of Seton's score in math, which is the same as the grade 5 average. Ben, a proficient speller, has the highest scores of the four in both math and reading. Seton and Carrie, the unexpectedly poor spellers, are tied for the second highest score in reading, with Sindy, a proficient speller, having the lowest reading score. Although the lowest of the four subjects, Sindy's reading score of 7.8 is two years above grade level. Carrie has the second highest math score. Seton's math score is the same as the grade 5 subject average, and is approximately one year above grade level. These subjects are similar in that each is a capable, high achieving student. Their dissimilarities appear in their proficiency in conventional spelling, and in their scores on the various tests used in this study. Although all four are competent students, Carrie and Seton, the poor spellers, do not appear to process information in the same ways as Sindy and Ben.

Ben is a typical member of the grade 5 good speller group (top left on the multidimensional scale). He is strong in learning by rote, reads using full cues, and is better at processing information sequentially and auditorially than simultaneously and visually.

During the self-report spelling activity, Ben mentioned the use of visual and orthographic information more than any other strategies. Comments about the look of a word, such as "It just looks right" and about the structure of words, "'Comfortable.' Well, it's not a very long word if you take off the 'able.' That's the way you do most of your spelling, probably. Most words have suffixes on the end. If you get rid of the suffixes, most words are pretty easy," were common in Ben's self-report. In addition to these two strategies, he cited the other strategies, except use of rules, at least once. He has a variety of strategies in his repertoire, and is

competent at using them to spell words that are not in his visual store. However, the visual/orthographic strategies are his preferred approach to spelling.

Sindy is also a typical representative of the grade 5 proficient spellers group, except in the area of learning by rote. Her rote and rule task difference score of +2 indicates that she relies on rule based learning strategies more effectively than do the others in the top left group, which had an average score of -4.8. (Negative scores indicate greater reliance on rote strategies, and positive scores indicate greater reliance on rule based strategies.) Sindy's sequential/simultaneous processing differential score of -23 indicates even greater use of sequential processing strategies than the average for her group (-1). As this was one of the key determiners of subject location on the multidimensional scale, this above-average score apparently counteracted the relatively high score on learning by rule, which would have ordinarily placed Sindy in the top right group.

Sindy cited use of orthographic information nearly as often as Ben did, in the self-report spelling activity. For example, she described her thoughts while spelling 'expiration' as follows, "It's on the Dairyland carton - it just says 'expire' - expiry, like expiry date - but you can pretty well make out the rest of the word. Like you know that ex - you know that it would be an X there, not a C or a K..." She also cited visual information, "'Camouflage.'....I don't know if that's right....There might be a J there (pointing to the G). That doesn't look right even if you put the U there." After spelling the words, Sindy often indicated that she had seen the word before. When reporting on her spelling of 'twelve', she said "You could forget the E on the end there. I know it's there. I just think of the music sheet for 'Twelve Days of Christmas' and I see the E is there."

Sindy is a proficient speller, who, like Ben, relies predominantly on the use of visual-orthographic strategies. Also like Ben, she did not cite the use of spelling rules or phonics rules in any of her self-reports. She did

Table 11

Strategies Reported During Self -Report Spelling Activity

Strategies	All 4	2 Good Spellers	2 Poor Spellers	Carrie	Seton	Ben	Sindy
Orthographic	17	14	3	3	0	8	6
Morphographic	6	5	1	1	0	3	2
Rule	2	0	2	1	1	0	0
Analogy	9	4	5	3	2	2	2
Used it before	1	0	1	0	1	0	0
That's how/ I know how	7	4	3	1	2	2	2
Had it on a spelling test	7	3	4	2	2	1	2
Visual	13	7	6	3	3	5	2
Shape	3	0	3	3	0	0	0
Seen it before	21	11	10	6	4	2	9
Phonologic / Sounding out	15	6	9	3	6	2	4

Note. The category entitled "visual" includes any response about the actual visual characteristics of a given word. "Seen it before" is listed separately, because it was a very common response and was often followed by a remark such as, "But I can't remember what it looks like," and subsequent use of a non-visual strategy.

mention sounding out strategies in the spelling of three of the words. Ben mentioned sounding out twice.

Carrie and Seton are fairly typical of the subjects in the bottom right group of the multidimensional scale, in that they are both stronger in learning by rule than by rote and in simultaneous processing than in sequential processing. They also read using partial cues. They are atypical of this group in that they scored nearly three years above grade level on the standardized reading test, and are in grade 5. A majority of the subjects in this group are grade 7 subjects, and scored near grade level on the standardized reading test. Carrie and Seton also scored well above grade level on the standardized math test, while the overall average math score for subjects in this group was slightly below grade level. Despite their high overall school achievement, Carrie and Seton are not proficient spellers. They are typical examples of what Frith (1978, 1980) terms unexpectedly poor spellers.

Actual numerical scores on the spelling test used during the self-report spelling activity demonstrate the clear difference between Carrie and Seton, the unexpectedly poor spellers, and Ben and Sindy, the good spellers. Carrie and Seton each misspelled eight words. In contrast, Ben and Sindy misspelled only the word sauerkraut, a word neither of them was familiar with nor could recall ever seeing in print. Seven of the misspellings produced by Seton and Carrie were for the same test words, words which are irregular. or phonologically opaque, in their orthographic representations.

A similar pattern was found in the children's writing activity products. Ben had no spelling errors in his draft, despite his use of difficult and irregularly spelled words such as 'certain', 'characters', and 'chauffeur'. Sindy spelled many difficult words, including 'directors', 'realistic', and 'fashion' correctly, but transposed the E and I in 'their' twice in her draft. She also omitted the Y in 'everybody', but spelled 'everyone' correctly, indicating a possible "slip of the pen". Seton and Carrie, on the other hand, had a number of misspellings in their drafts. Seton misspelled

'characters', 'status', 'motorcycle', and 'exterminate', but spelled other potentially difficult words, including 'containment', correctly. Carrie misspelled 'characters', 'lawyer' and 'marriage', but spelled 'recommend', a commonly misspelled word, correctly. Most of the misspellings produced by Seton and Carrie were for phonologically opaque words, and their spellings were phonetically accurate representations of the words. The one exception was Seton's spelling of 'motorcycle' as MORTORCYCLE. This spelling represents Seton's pronunciation of the word 'motorcycle', as noted by the researcher during subsequent conversation with Seton.

Analysis of the errors on the spelling test and the writing produced by the subjects indicates that Ben and Sindy, the good spellers, rely primarily on visual-orthographic strategies, and that Seton and Carrie, the poor spellers, use phonologic, or sounding-out, strategies as their primary approach to the spelling process. Ben and Sindy were able to spell phonologically opaque words conventionally. Spelling of this type of word is an indication of use of visual-orthographic strategies, as these words cannot be spelled correctly using a phonologic strategy. Sindy's spelling of 'their' as THIER is further indication of use of a visual strategy. All of the visual elements of the word are included, though the order is incorrect. In addition, THIER is not an accurate phonologic representation of the word.

Seton and Carrie produced misspellings which were phonologically intact, but incorrect. Spellings such as CHARICTORS for 'characters' , EXTERMNATE for 'exterminate', AUTEM for 'autumn, and CANOO for 'canoe' are typical of spellings produced by using a phonologic strategy. The spellings are a direct representation of the sounds heard by the speller. In addition, Seton's spelling of 'motorcycle' as MORTORCYCLE, which was consistent with his pronunciation of the word, provides evidence that his spelling strategies involve use the sounds of words. The unconventional spellings produced by Carrie and Seton are

evidence of their continued reliance on phonologic strategies in spelling, and inability to use visual-orthographic strategies successfully.

The subjects' responses during the self-report spelling activity supported the analysis of spelling strategy through spelling errors produced in the test and the connected text.

During the self-report spelling activity, Carrie mentioned sounding-out strategies on three of the words. She mentioned use of visual information on three of the words, for example, after writing camouflage, she said, "This looks wrong. I don't see this one very often." She also mentioned the shapes of words three times, as in "Twelve - I just know that one. I don't know why, maybe the shape." Carrie used analogy strategies on three words, as indicated in her analysis of the strategies she used to spell American/AMERICAIN. "The ending is easy because I just had a spelling test on 'fountain', 'villain', and it all had A-I." In this case, Carrie's use of an analogy strategy was not effective. Carrie noted having seen many of the words before, a number of them on spelling tests. When describing how her memory for these words operated, the following conversation ensued:

Carrie: This one (canoe) I see a lot in spelling books.

Researcher: Can you close your eyes and see it in your head?

Carrie: Not really. I just remember it.

Researcher: What is that memory like?

Carrie: Like a dictionary, with the sounds.

Researcher: Do you remember it letter by letter?

Carrie: Not really.....by the sounds. 'Can', I know how to spell 'can', and 'ooo' is O-O.

Researcher: Are there other ways that 'canoe' could be spelled?

Carrie: (After generating a number of alternate spellings) These all look weird.

Researcher: You must have some memory of how it looks.

Carrie: I've seen the word a lot, and not exactly the letters, but the shape.....the shape stays in my head.

Carrie knows she has some memory of the words, and recalled that she has seen particular words before. It initially appeared that either her memory for particular words is not visually intact, or that she has difficulty accessing her visual store of words, or both. Her low score on the Cat in the Hat proofreading test is an indication that her spelling problems result from a poorly developed visual store of words, rather than an inability to access that information. People who read using partial orthographic cues, as is indicated in Carrie's case by her low scores on the Cat in the Hat test, do not attend to the visual details of individual words as they read. Instead, they read in what Frith has termed an elegant and efficient style which involves sampling the print and processing it in meaningful chunks, rather than in word by word fashion. This results in good readers who are poor spellers, as they lack the detailed, intact visual representations of words in memory that readers who attend to the details of words in print develop. This pattern of partial word identity amalgamation in memory is consistent with Ehri's word amalgamation theory (1978), as well as Frith's (1978, 1980) and Ormrod's (1985) partial cues theory.

Seton, a competent cartoonist with a well-developed, quick wit, had one of the lowest scores on sequential processing, and one of the highest scores on simultaneous processing, of any of the subjects in grade 5 or 7. These test scores indicate that Seton sees the world in gestalts. His score on the rote and rule tasks indicates that he is able to discern and apply rules in visual tasks. He sees the big picture, and readily interprets it, without much attention to detail. His reading style, predictably, is to read using partial cues. Seton is not a proficient speller, but is capable of producing phonetically accurate spellings. He described himself as a good speller, "Yes, I am a good speller. I can spell most words five or six different ways. I'm just not sure which one is

right." This observation echoes Frith's (1980) observation that many spelling difficulties result from a breakdown in word processing at the grapheme selection level. Seton, and other spellers according to Frith, have the phonologic knowledge to be able to produce a number of phonetically accurate representations of words. What they lack is the ability to match their attempts against some form of stored visual representation of the conventional spelling in order to see which of the possible graphemic representations is the correct one.

The strategies reported by Seton during the self-report spelling activity were consistent with the strategies noted in the researcher's analysis of strategy based on the spelling errors he produced. The analysis of errors indicated that Seton was relying primarily on a phonologic strategy when spelling. Sounding out, a phonologic strategy, was Seton's most commonly reported approach to spelling the words on the self-report activity spelling test. He did not mention orthographic or morphologic information, such as the use of root words, but did report use of analogy on two occasions. On one of these occasions, the spelling of 'canoe', he combined analogy and visual strategies, with interesting results. When asked how he figured out the spelling for 'canoe', which he spelled KNU, the following conversation ensued:

Seton: I guessed.
Researcher: What kind of information did you use?
Seton: "'Gnu'. I saw one at the zoo once, and it had its name on it, on the cage."
Researcher: Have you seen the word 'canoe' before, in print?
Seton: Not very much.

When asked how he spelled the words on the spelling activity, Seton said, "I usually did syllable to syllable, and vowels and such, or just the sounds." He did cite the use of a rule on one occasion, when spelling

'camouflage', which he spelled CAMMOFLOJE. In answer to the question, "How did you know to put two Ms there?" he explained:

> "Well, one syllable, plus one vowel, plus one consonant .....um..... and.....the consonant is before the vowel, double the consonant if the suffix begins with a vowel, but DO NOT double the consonant when the suffix begins with a consonant."

Seton also noted that he had had a number of the words on spelling tests, or that he had used the words before in his stories. There wasn't any relationship between these previous experiences with words and his ability to spell them correctly.

SUMMARY OF FINDINGS RELATED TO QUESTION 4: How do selected representatives of the good and unexpectedly poor spellers at the grade 5 level differ from each other?

Each of the four subjects selected for the case study is a capable, intelligent student, as indicated by the high scores on math and reading achievement tests attained by each subject. Each is a bright, interested, and interesting young person with many interests and talents which they pursue outside of school time. Yet, two of the subjects, Carrie and Seton, are not proficient spellers in testing or free writing settings. The purpose of this part of the study was to compare the individual subjects' test scores, their strategies, as determined by analysis of their spelling errors found in the tests and free writing tasks of this study, and their self-reported use of strategies in the self-report spelling activity.

Analysis of the individual subjects' test scores on the survey of cognitive processes used in this study indicates that the good spellers differ from the unexpectedly poor spellers in a number of ways. Both Sindy and Ben, the proficient spellers, read using full cues, while Carrie and Seton, the non-proficient spellers, read using partial cues. Sindy

and Ben have strong sequential processing skills, and Carrie and Seton have strong simultaneous processing skills. Rule learning scores are high for Carrie (+7) and Seton (+8). Sindy has a positive rule learning score (+2), but it is lower than the scores for Carrie and Seton. Ben had a negative score (-2), which indicates slightly stronger rote learning than rule learning ability.

When completing the self-report spelling activity, Ben and Sindy cited the use of orthographic information far more often than Carrie. Seton did not cite the use of orthographic information in any of the spelling tasks. Each of the subjects mentioned the use of visual information, e.g. "It doesn't look right," but Ben mentioned this more often than the others. Carrie's use of visual information was based on the shape of the word, rather than a detailed picture of the letters in the word. This is likely a result of her reading style, using partial orthographic cues, and was not a very effective strategy for producing conventional spellings. Use of rules was cited by Carrie and Seton, but this strategy of using spelling rules did not help them produce conventional spellings. In some cases, this was because they were attempting to apply a rule to an irregular word, or because they had parts of the rule confused. Seton's description of the consonant doubling rule reported above is an example. Rule use was not reported by Sindy or Ben.

In summary, Sindy and Ben are strong in sequential processing skills and read using full orthographic cues. Their reading style, using full orthographic cues, is consistent with a sequential approach to cognitive tasks and appears to have resulted in a strong, accurate visual store of words encountered in print, and a sound knowledge of the structure of English orthography. They are proficient spellers of words in testing settings and in their own production of connected text. They rely primarily on visual-orthographic strategies when spelling, and their proficiency as spellers indicates that they have a well-developed visual store of words and are able to access that stored visual information about words. They are competent users of visual-orthographic spelling

strategies, which indicates that they have made, or are well into the process of making, the cognitive shift which occurs around age 10 (Frith, 1980). Sindy and Ben are at the mature stage of spelling development.

Carrie and Seton differ from Sindy and Ben in a number of ways. They are stronger in simultaneous processing ability than in sequential processing ability and read in a somewhat holistic manner, using partial orthographic cues. Their simultaneous processing approach to cognitive tasks and use of what Frith (1980) terms an elegant and efficient reading style have not interfered with their achievement in reading, but have apparently interfered with their ability to develop a mental store of visual representations of words. They are, consequently, phonologic spellers, which results in phonetically accurate, but unconventional spellings. Both Carrie and Seton are also stronger in learning by rule than in learning by rote, and are able to discern rules and apply them to novel situations. This ability, and seeming preference for, use of rules in cognitive tasks could be an additional hindrance to Carrie and Seton, particularly when spelling at the phonologic level, as many English words are irregular or violate commonly known spelling rules.

Carrie and Seton's spelling errors indicate reliance on phonological strategies, which indicates that they may not have made the cognitive shift which usually occurs around age 10 (Frith, 1980). Both demonstrate good understanding of the phoneme-grapheme correspondence rules, and apply those rules in their spellings. They also use analogy strategies, and there is some indication that visual information is used on rare occasions. The misspellings which indicate some reliance on visual information, e.g. Carrie's spelling of 'business' as BUISNESS indicate that the stored visual representations of words are not complete, accurate, and/or fully accessible. Carrie and Seton are at the stage described by Gentry (1984) as the transitional stage, where children begin to use other strategies, but continue to rely primarily on the phonologic strategy when spelling.

These four young people, Carrie, Seton, Ben, and Sindy, are alike in that they have all attained above average achievement in reading and mathematics in school and have many interests and talents which they pursue and develop outside of school hours. They each scored above the grade 5 subject population average on the over-all score developed by adding scores on the cognitive tests adapted from the K-ABC battery. Yet, Sindy and Ben differed from Carrie and Seton in the cognitive profiles which resulted from the multidimensional scaling procedure.

Sindy and Ben are in the top left group, the group from which the idealized individual grade 5 good speller was drawn. They are typical of good spellers at their grade level. Carrie and Seton are in the bottom right group on the multidimensional scale configuration. They are not typical grade 5 poor spellers, who tend to be low in other areas of language development and academic achievement. They are atypical, or unexpectedly poor spellers. They are both proficient in reading and other language skills, and spelling appears as an unexpected problem in their academic career. While they are atypical of poor spellers in general, their cognitive profiles are consistent with existing descriptions of unexpectedly poor spellers.

In summary, Sindy and Ben process information sequentially, Carrie and Seton process information simultaneously. Sindy and Ben learn by rote, Carrie and Seton learn by rule. Also, Sindy and Ben read using full orthographic cues, Carrie and Seton read using partial cues. Most notably, for purposes of this study, Sindy and Ben are good spellers. Carrie and Seton, despite their academic similarities to Sindy and Ben, are, unexpectedly, poor spellers. Their cognitive processing and reading styles, which make them effective in many areas of school and life, are interfering with their abilities to use visual-orthographic strategies and to move to the final, mature stage of spelling development. Like many others, including adults, they are "stuck" on the continuum of spelling development, most probably as a result of their cognitive processing, learning, and reading styles.

CHAPTER 6

Conclusions and Implications

This study was designed to explore spelling proficiency in normal children in grades 5 and 7, and the cognitive factors which are related to this development. In order to limit the number of factors which might affect spelling development either positively or negatively, subjects were selected from a stable middle- to upper-middle class school population. The subjects were identified in their school records and by their teachers as average or above average students, and as being normal in their general language abilities. These subjects participated in a number of tests designed to demonstrate various cognitive abilities, including visual and auditory processing and memory, spatial abilities, and simultaneous and sequential processing styles. Two cognitive processes related to learning style, learning by rote or by rule and reading by partial or full orthographic cues, were assessed. The subjects wrote spelling tests comprised of phonologically transparent and opaque words. In addition to the testing conducted as part of this study, the subjects' scores on math and reading standardized tests were obtained from their school records and included in the analysis.

Computer assisted analysis of the test scores produced correlation and multidimensional scaling information which was used to determine relationships between spelling ability and various cognitive factors. Profiles for good and poor speller groups were also developed using this information.

In addition to the large group quantitative study, qualitative analysis was conducted on information obtained from and about four of the students in grade 5 who were selected as representatives of good and poor spellers. The poor spellers were proficient in reading and other

language modes, and are thus considered to be unexpectedly poor spellers. Self-report spelling activities, and analysis of writing samples, in addition to the test data collected during the large group testing, constitute the data on these four subjects. Analysis consisted of determining patterns between and among the subjects, with respect to cognitive and other abilities, perceived use of various spelling strategies, actual use of these strategies, and the relationship of strategy use and cognitive factors.

One aspect of this study was replication of existing studies, only with different age groups. The Cat in the Hat Proofreading Test was taken directly from Ormrod's (1985) study of the effects of reading style on spelling spelling ability. Ormrod's work was based on earlier work conducted by Frith (1978, 1980), in which Frith explored the relationship between reading by partial or full orthographic cues and spelling ability.

The simple, complex and random patterns task, called learning by rote or by rule in this study, was taken from Bruce and Cox's (1983) study of the relationship of these learning styles to spelling.

Although not a replication, the investigation of simultaneous and sequential processing styles grew out of work conducted by Leasak, Hunt, and Randhawa (1982), in which they suggested a possible relationship between simultaneous processing and spelling ability.

The conclusions with respect to this aspect of the study are discussed below, followed by the overall conclusions of this study.

Findings Related to Existing Research

The findings of this study concur with the findings and theories of Frith (1978, 1980) and Ormrod (1985) with respect to the relationship of reading style and spelling ability using visual-orthographic strategies. In both the correlational analysis and the multidimensional scaling analysis, proficiency on the Cat in the Hat Proofreading Test and spelling ability

were found to be related. Subjects who scored well on the Cat in the Hat test were determined to have a reading style which involved the use of full orthographic cues. In other words, these subjects pay attention to the visual details of individual words as they read. This attention to detail appears to assist in the development of intact visual representations of words in a mental store. This information is critical to the ability to spell using a visual-orthographic strategy.

Reading using full or partial orthographic cues was the only factor or dimension which remained stable in its relationship to spelling ability across grade levels. It was highly correlated with spelling ability at grade 5 and at grade 7, and appeared as the vertical axis on the multidimensional scale.

These findings support Bruce and Cox's (1983) suggestion that rote learning and spelling ability are related, but a pattern emerged in the multidimensional scale which suggests the need for further research in this area. Rote learning and spelling scores were correlated for the whole subject population, which supports Bruce and Cox's findings. However, the profiles produced on the multidimensional scale show a shifting pattern between grades 5 and 7. The profile produced for the idealized individual at the grade 5 level included strength in learning by rote as one of the descriptors of this individual. This pattern shifted at the grade 7 level, where a larger number of proficient spellers were classed as rule learners than as rote learners. The subjects for Bruce and Cox's study were university students. If the trend found in this study continues, it would be expected that the relationship between spelling and rule learning would grow even stronger as subjects matured. Further research with subject groups at various ages would contribute to understanding of the relationship between between rote and rule learning styles and spelling ability, and how this relationship differs across ages.

As an artifact of another study, Leasak, Hunt, and Randhawa (1982) noted a possible relationship between simultaneous processing and

spelling achievement, and suggested the need for further research in this area. This was one of the key elements of the current study, and the findings of this study do not provide evidence of this relationship for the younger subjects. Leasak et al., conducted their study with grade 4 children. The relationship between sequential processing and spelling ability was stronger in the younger grade 5 population, and the relationship between spelling ability and simultaneous processing was stronger in grade 7. It is possible that the instructional intervention conducted in the Leasak et al. study, which involved teaching grade 4 children specific simultaneous processing strategies, provided the subjects with the ability to use these strategies which normally do not appear until after the cognitive shift which occurs around age 10. Two types of further research would add to the understanding of Leasak et al.'s findings, and the findings of this study. A long term follow-up of the subjects involved in Leasak et al.'s study, or a similar study, would provide some indication of the stability of the subjects' access to simultaneous processing strategies, and the long term effect on spelling ability. Further research using teaching and testing materials related to simultaneous processing which did not also entail visual processing and visual memory strategies would also shed light on the direct relationship between simultaneous processing and spelling ability. Currently, the relationship between simultaneous processing tasks and tests and visual processing tasks and tests are thoroughly interwoven, and it is difficult to gain a clear distinction between the two.

Conclusions and Implications from this Study

The conclusions of this study are summarized in the following statements.

Statement 1: Growth in spelling proficiency is a developmental process and is related to cognitive development, as indicated by the correlations found between spelling ability and various cognitive processes assessed in this study.

Methodological Implications

One of the issues which lead to this study was the existence of differing research findings related to cognitive processes and spelling ability. Analysis of these research reports suggested that the different results could be the an artifact of the differing ages of the subjects in the various studies. This study was designed to include subjects in grade 5 (approximately age 10) and grade 7 (approximately age 12), as previous researchers have identified age 10 as a critical turning point in cognitive development related to spelling ability (Frith, 1980). Additionally, this growth in spelling proficiency had been described by previous researchers as resulting from moving from primary reliance on phonologic strategies to greater reliance on visual-orthographic strategies.

It became apparent early in this study that collapsing data across subject groups of different ages was not an effective approach to spelling research. It also became apparent that statements about the relationships between cognitive processes and spelling ability were not valid unless qualified by a description of the ages of the populations under study. For example, one of the findings in the portion of this study which involved all 57 subjects, grades 5 and 7, was that both simultaneous and sequential processing styles were correlated with spelling ability. Analysis of the grade 5 and grade 7 subject groups separately indicated that sequential processing was correlated with spelling ability at the grade 5 level, but not at the grade 7 level. Simultaneous processing was not found to be significantly correlated with spelling ability for either group.

Clearly, collapsing data across ages does not always present findings which accurately represent the nature of the data. This is particularly true when a developmental process, e.g. growth in spelling proficiency is being investigated.

The correlational measures used in this study were not used for the purpose of demonstrating causality, nor to test an a priori hypothesis. Rather, they were used to explore the relationships among various cognitive factors and spelling ability as part of an investigation which is essentially descriptive. The correlational data was useful in providing a means of comparing cognitive processes and their relative relationships to spelling ability, and ways in which these relationships differ between good and poor spellers.

Theoretical Implications

The cognitive profiles for subjects in grade 5 are different from the profiles for subjects in grade 7. A majority of the grade 5 subjects are strong in sequential processing, and learning by rote. A majority of the grade 7 subjects are strong in simultaneous processing and learning by rule. It should be noted that learning by rote refers, in this case, to the ability to memorize visually presented symbol arrays. Learning by rule refers to the ability to discern permutation rules for the patterns in these arrays and to apply the pattern rules to new arrays. It does not refer to the use of learned rules, e.g. phonics rules.

Grade 5 subjects were stronger overall in tests involving auditory processing than in tests involving visual processing. This pattern was reversed for a majority of the grade 7 subjects, who had higher scores in the tests involving visual processing. These findings suggest that auditory factors are still strongly related to the spelling process for children in grade 5, approximately age 10. For a majority of the grade 7 children in this study, visual factors are more strongly related to the spelling process.

These differences in the cognitive profiles for subjects in grade 5 and grade 7 provide support for the theory that a major cognitive shift occurs around age 10. A greater number of grade 7 subjects were found to have cognitive profiles similar to grade 5 students than grade 5 students having profiles similar to grade 7 subjects, indicating the possibility that this cognitive shift either occurs later than age 10, or that it begins at age 10 but takes two or more years to develop. The nature and timing of this shift is an area which calls for further research.

The spelling scores of the subjects provide further evidence that the cognitive shift described above is related to spelling development. Subjects at both grade 5 and grade 7 levels were generally competent in spelling phonologically transparent words. On spelling of phonologically opaque words, which requires the use of visual-orthographic strategies, however, grade 7 students as a group scored considerably higher. Approximately 74% of the grade 7 subjects scored 90% or better on this test, while only 27% of the grade 5 subjects did so. This suggests that the cognitive shift does occur, and that it is related to a move to greater use of visual-orthographic strategies, but again points to the possibility that it occurs later than age 10. There is also evidence that the rate of this development varies considerably among individuals.

Instructional Implications

Children's cognitive development proceeds at varying rates and children have different cognitive processing styles, strengths, and weaknesses. Although these cognitive profiles do not seem to be related to general academic achievement, they are related to spelling development. Classroom teachers can promote growth in spelling competence by recognizing individual differences in development and providing instruction in spelling which is appropriate to the individual. An analytical approach to the assessment of children's spelling in connected text, with particular attention to words which are unconventionally

spelled, but can be sounded out (evidence of an auditory, phonologic approach), and those words which may not be phonologically intact, but which look similar to the conventional spelling (evidence of a visual-orthographic approach), can provide teachers with insight into children's levels of spelling development. Instruction in the use of phonologic and visual-orthographic strategies can then be provided as needed by the individual students. This would seem to be particularly important for students in grades 5, 6, and 7, as this is the time when the shift to greater reliance on visual-orthographic strategies occurs for most students. For those students who are undergoing this transition, the teacher should expect a large number of unconventional spellings, and should provide the student with opportunities to practice proofreading, including use of the spell checking program available on most word processors, dictionaries, and the assistance of good spellers in the classroom. The focus should be on spelling as a visual process, while recognizing that the student in this transition may not have the cognitive ability or exposure to words in print needed to develop a strong, intact mental store of visual representations on which to draw when spelling. Ample opportunities to read and to write also assist in the transition to mature spelling for most students, as these experiences provide the student with exposure to words in print, and to practice with representing words in print.

When spelling is seen as a semiotic process, part of the larger semiotic of language, its purpose is seen as communication of meaning through use of a symbol system. Children use writing, hence spelling, to communicate. Facility with the phonologic spelling strategy allows children to communicate. Although many of their spellings may be unconventional, children who have not yet made the cognitive shift which supports their use of visual-orthographic strategies and the consequent production of conventional spellings should be encouraged to use writing as a mode of communication. Their writing not only fulfills one

aspect of the human need to communicate with others, but the practice of writing is supportive of growth in spelling ability.

An overall implication of this conclusion is that teachers and parents would be well advised to recognize and accept that children who have not made the cognitive shift which is related to use of visual-orthographic strategies may produce many unconventional spellings. This is not evidence of lack of care on the child's part, in most cases, but rather is evidence of the child's place on the continuum of spelling development.

Statement 2: As shown by the multidimensional scaling procedure, the cognitive profiles for good spellers are markedly different than the profiles for poor spellers at the grade 5 level. The profiles for good and poor spellers also differ at the grade 7 level, but the differences are not as clearcut as at the grade 5 level.

Methodological Implications

The multidimensional scaling procedure used in this study was useful in finding underlying patterns and relationships in a relatively large and diverse data pool. Use of the procedure provided information similar to that obtained from a factor analysis, in that analysis of the dimensions, or axes, of the resulting configuration allowed identification of features which set subjects apart from each other. Information similar to that found in a cluster analysis was obtained through a neighborhood approach to the configuration. This involved determining the factors which caused subjects to cluster on the configuration. The neighborhood and dimensional analyses together provided a way of describing, or creating a cognitive profile for, good and poor spellers at the grade 5 and grade 7 levels, as well as for the entire subject population as a group.

The multidimensional scaling procedure is not often used in educational research. Yet, it appears to have particular usefulness in this

area, as there are often many factors to consider when investigating an educational issue. One of the constraints of traditional quantitative approaches to educational research has been the difficulty in maintaining statistical strength when a number of factors were included in a relatively small, and not always randomly selected, subject population. The multidimensional scaling procedure is not adversely affected by these constraints, and is designed to factor in consideration of a number of varying factors. The ability to create multifaceted profiles to represent groups of subjects would appear to be useful in describing learning and learners of various kinds.

Theoretical Implications

Subjects selected for this study are similar in many ways. They are from a stable, comfortable neighborhood, have attended the same school, and have been academically successful in that school. They have been exposed to the same type and amount of spelling instruction. Yet, some are good spellers and some are not. A possible reason for this difference among seemingly similar children may be found in their cognitive profiles.

When profiles were developed for the subjects in this study, the resulting configuration showed clear differentiations among good and poor spellers at the grade 5 level. Only a very few good spellers appeared in the groups that had a "poor spellers' profile", and vice versa. Additionally, all but two of the good spellers at the grade 5 level appeared in a single grouping, indicating that there was little variation in cognitive profiles for good spellers at this level. The results for subjects at the grade 7 level were not so clear. While good and poor spellers were clearly differentiated in the cognitive profile groups, two groups had large numbers of good spellers. It appears that a wider range of cognitive abilities and styles may be related to spelling ability among

older children than among younger children. This is an area which bears further investigation.

The findings of this study relate to the theory that a cognitive shift occurs around age 10 and that this shift is related to the transition from primary reliance on phonologic spelling strategies to primary reliance on visual-orthographic strategies. The location of the grade 5 and grade 7 students in the profile groups developed using the multidimensional scale suggest that this shift occurs later than age 10, or that it is a prolonged transition rather than a sudden shift. The clear differentiation of spellers at the grade 5 level, with all but two of the grade 5 good spellers appearing in the same profile group on the left side of the scale, and all but four of the grade 5 poor spellers appearing in one profile group, also on the left side of the scale, suggests that this shift has not occurred for most grade 5, age 10, students. The pattern for grade 7 is quite different, with nine of the good spellers appearing on the left side of the scale,and thirteen of the good spellers appearing on the right side of the scale. As the left to right dimension is an indication of cognitive processing style, it appears that this cognitive shift may actually occur closer to age 12 than to age 10. Further research in this area would help to clarify the timing and nature of this cognitive shift which has been identified in the literature, and which is apparent in the cognitive profiles developed in this study.

Instructional Implications:

The instructional implications which arise from this conclusion are consistent with those arising from Statement 1, above.

Statement 3: The case study portion of this study strongly suggests that home background, educational experience, and academic achievement

do not affect spelling development, but that cognitive profiles, including learning, processing, and reading styles, do affect spelling development.

Methodological Implications

The use of quantitative and qualitative data is useful in research into spelling development. The case studies provided concrete examples, which served as a form of triangulation for the quantitative date. Findings from the quantitative portion of the study were checked against findings from the case studies, and vice-verse, and information from each portion of the study was used to expand, explain, and enrich findings from the other portion.

The use of case studies can be useful in bringing to light conflicts, or possible dichotomies in the data. In this study, the seeming dichotomy in the relationship between strength in auditory processing and use of visual-orthographic spelling strategies, and between visual processing strength and phonologic spelling, (discussed below) did not surface in the quantitative portion of the study. Rather, it was during the exploration of the relative strengths, abilities, and spelling strategies of the four children in the case studies that this dichotomy came to light.

Theoretical Implications

Sindy and Ben, the good spellers in the case study, are adept in the use of visual-orthographic strategies, and are aware of their use of these strategies. Their scores on the large group tests indicate they read using full orthographic cues, learn by rote, and are strong auditory processors. Carrie and Seton, the unexpectedly poor spellers, whose poor spelling is unexpected because of their proficiency in other academic and language areas, use phonologic strategies more often than any other strategy. Their cognitive test scores indicate that they read using partial cues, learn by rule, and are strong visual processors. The seeming

dichotomy here is that the test scores for these four subjects indicate that the good spellers, those who report use of visual strategies, scored much higher on the cognitive tests which involve auditory processes than on those which involve visual process. The poor spellers, who rely primarily on phonologic strategies, had much higher scores on the cognitive tests involving visual processes than on those involving auditory processes.

The apparent disconnection between cognitive profile and spelling strategy use, noted above, can be partially explained by the theories proposed by Ehri (1980, 1982, 1988), Frith (1978, 1980), and Bryant and Bradley (1980, 1985).

Frith suggested that reading using full cues is related to spelling ability, in that readers who attend to the details of words in print are more likely to develop intact visual representations of words in their visual memories than are readers who read using partial cues. Carrie and Seton, the unexpectedly poor spellers in the case study, read using partial cues, are stronger than the average grade 5 student in visual and simultaneous and weaker than the average grade 5 student in processing than in sequential and auditory processing, and spell phonologically. They exemplify Frith's theory. Both are three years above grade level in reading and produced many unconventional, but phonologically intact, spellings.

The relationship between reading using partial cues, strength in visual processing, and use of phonologic spelling strategies may be explained by the co-occurrence of strength in simultaneous processing. The tests of visually based cognitive processes in this study all involved spatial or gestaltic visual abilities. These tests are also the tests used to determine strength in simultaneous processing. People who read using partial cues are also using a gestaltic or simultaneous approach. They do not appear to move across the print in a linear and systematic fashion. Rather, they read in large chunks, with little attention to the visual details of individual words. This simultaneous, gestaltic approach to reading seems to result in poor development of a mental store of intact visual

representations of words. Without this connection of visual representations, or identities, of words to the sound and meaning representations, a process which Ehri terms amalgamation of word identities, spellers cannot use visual-orthographic strategies. They use phonological strategies, in a sense, as a default approach.

Good spellers, e.g. Ben and Sindy in this study, rely primarily on visual-orthographic strategies, are strong auditory processors, read using full cues, and are strong sequential processors. Again, the key to this seeming dichotomy appears to be in the cognitive style. A sequential processing style bears a natural relationship to reading using full cues, the reading style which is related to the development of an intact visual store of words. A sequential approach to reading involves moving systematically across the print, with attention to details. This allows amalgamation of the visual identity of words with the other word identities in an individual's internal lexicon. The visual representation can then be systematically, though apparently not always consciously, compared to what one has written.

The key difference, that which may explain many of the other differences explored in this study, appears to this researcher to be in whether simultaneous or sequential processing styles are stronger for individual spellers. As noted above, their appears to be a theoretical relationship between simultaneous and sequential processing style and each of the other cognitive, learning and reading styles assess in this study. Further research into the relationships between simultaneous and sequential processing styles and the other factors assessed in this study, as well as further research on the specific relationship between each of these processes and spelling ability would help clarify whether it is in fact a set of cognitive abilities and styles--a particular cognitive profile--which is related to spelling ability, or whether a single factor, relative strength in simultaneous or sequential processing style, underlies both spelling ability and the over-all cognitive profile.

Bryant and Bradley (1980, 1985) proposed that children's reading and spelling difficulties are related to their inability to use both visual and phonologic information in reading and in spelling. They found that young children tended to read in chunks, and to spell by sound segments. In other words, they read by eye and spell by ear. Bryant and Bradley suggest that as children gain more experience with literacy, they become increasingly able to use both strategies for both processes, and this is critical for success in reading and spelling. People who continue to spell by ear and read by eye become "backward" readers and spellers.

The strategies reported by and actual spellings produced by the four case study subjects support this theory, at least with respect to spelling. The good spellers reported the use of visual strategies, and do seem to "spell by eye," while the poor spellers reported phonologic strategies, and seem to "spell by ear". Bryant and Bradley's theory is not supported, with respect to reading, by the findings of the case studies. All four of the case study subjects were above average readers, despite variations in their spelling abilities and cognitive profiles. The two who read using partial orthographic cues, who seemingly skim across the page sampling visual bits here and there, seem to be reading by eye. They certainly are not attending to the individual sounds of words on the page. Yet, they read as well or better than the other two, who read carefully across the line of print.

Reading style and ability were explored in this study only in relationship to spelling development. The seeming conflict between the findings of this study and Bryant and Bradley's theory, with respect to reading ability, could provide a base for future research.

Instructional Implications:

There are two basic instructional implications arising out of the case study portion of the study. First, despite similarities in home background, school experience, general academic ability, and type and amount of

spelling instruction, some children become proficient spellers and others do not. This difference in spelling ability appears to be a reflection of differing cognitive styles. An instructional approach which meets the needs of both simultaneous, visual learners, and sequential, auditory learners is indicated, as is a recognition that children who have certain cognitive strengths, weaknesses, and/or styles will not be proficient in producing conventional spellings for phonologically opaque words, given traditional approaches to spelling instruction.

Second, while it was not an issue specifically addressed in this study, it appears that formal spelling instruction does not result in proficiency in spelling. Despite exposure to many of the same teachers and the same spelling instructional program, two of the four participants in the case study are poor spellers, and two are good spellers. The broad range of spelling ability among the large sample of students (57 in total), most of whom also had very similar school and spelling instruction experiences also indicates that spelling ability is affected by factors other than instructional experience. Further research into the effects of spelling instruction would help clarify this issue.

This study was not designed to explore instructional issues. Yet, it seems that formal spelling instruction, as done traditionally, is not what makes the difference in whether a child becomes a good speller or not. Perhaps greater attention to the developmental aspects of spelling, and provision of word studies which are appropriate to the child's developmental level would help more children gain proficiency in spelling. Additional information on this type of approach to spelling instruction can be gained from many useful teacher resource books, e.g. *Spel. . . is a Four-Letter Word* (Gentry, 1987) and *Spell by Writing* (Bean & Bouffler, 1987).

Recommendations for Further Research

A number of areas for further research have been noted throughout this report. These recommendations for further research fall into three major areas, reading style, cognitive processing style, and the relative effects of instruction and cognitive profile on spelling development.

Reading style, using partial or full orthographic cues, has been identified by Frith (1980), Ormrod (1985) and in this study, as being related to spelling development. Reading using partial orthographic cues is, as Frith notes, an elegant and efficient reading style. It works very well as a reading style. Yet, it appears to negatively affect spelling ability, as readers who use this style do not develop the intact visual store of words needed to use the equally elegant and efficient visual-orthographic spelling strategy. Further research on the effects of training readers to read using full orthographic cues, and on spelling instructional strategies which may be effective for readers who read using partial orthographic cues would aid in the understanding of this relationship between reading style and spelling ability, as well as providing practical solutions for the unexpectedly poor speller.

The relationships among cognitive processing style, the cognitive shift which occurs around age 10 or 12, and spelling ability also requires further research. Research into cognitive processing and learning styles in general has resulted in the development of curricular materials which present information in a variety of ways in order to meet the needs of students having differing learning styles. Greater understanding of the cognitive processing styles of children in the upper elementary grades, specifically as they relate to spelling ability, would provide a framework for the development of more effective spelling instructional materials and practices in these grades.

Finally, the whole area of spelling instruction for upper elementary grade children needs further investigation. Although not specifically addressed in this study, it was noted that within the group of 57 students

who participated in this study, there were some who were good spellers, and some who were not, despite similar instruction in spelling, similar levels of academic achievement, and similar home backgrounds. It appears possible that spelling instruction in and of itself is not what makes the difference between good and unexpectedly poor spellers. Further investigation into spelling instruction based on cognitive and developmental factors could result in recommendations for materials and classroom practices which might assist all normally functioning students to become proficient conventional spellers.

Some Afterthoughts

The case study data provide some insight into the cognitive profiles, spelling strategies, strengths, and academic achievements of Sindy, Ben, Carrie, and Seton. What they fail to convey, however, is the vitality, brightness, talents, and interests of these young people. Seton is a good example. Although a very poor speller, Seton writes well-crafted stories, plays, cartoon scripts, and screenplays, and produces high quality illustrations to accompany them. His creativity and unbounded imagination are apparent in all that he does, including spelling. When asked if he was a good speller, he replied enthusiastically, " Oh, yeah, I can spell most words five or six different ways!" He did produce many unusual, but, to Seton at least, logical spellings, including KNU for canoe, which does, as he pointed out, sound like gnu.

Fortunately for Seton, and perhaps someday for the rest of the literate world, Seton's inability to spell conventionally has not affected his drive to write, nor his ability to write well. It appears quite certain that it is his particular cognitive profile, his "wiring", which makes him so exceptionally creative and talented. It appears that it is this same "wiring" which makes him a poor speller. He can't spell, but he can think, and as a colleague, a scientist and author, once noted, it is critical that we as educators know the difference, and recognize our priorities. The scientist said, "No, I can't spell. Who cares? I can hire someone to spell for me -- but I can't hire someone to think my thoughts. Be careful that you never close the door on what a child has to say because he can't spell the words he needs to say it."

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APPENDICES

Appendix A

Permission Form

Dear Student and Parents,

I am a graduate student in the Faculty of Education at the University of Victoria. In my study of factors related to the development of spelling ability, I would like to test the students in grades five and seven at H. T. Thrift Elementary School. All of the tests are group tests, and involve the students in writing answers to questions and problems designed to assess their spelling ability and related cognitive abilities such as visual memory, spatial memory, and sequencing. The tests will be conducted in the classrooms, by the regular teacher, during school time. Students should find the tests non-threatening and enjoyable, as there are no "right and wrong" answers. The results of the tests will be confidential and will not affect the student's mark in any way.

Preliminary results of the study will be shared with parents, students, and teachers next fall. Should you have any questions about the study, please feel free to contact me at the University of Victoria, 721-7831, or send a note to the school and I will call you.

Please read and return the attached permission form.

Thank you for your interest in this research.

Sincerely,

Ardys Smith
Graduate Student

I, _____, am the parent or guardian of _____ and give my permission for him/her to participate in the spelling study being conducted by Ardys Smith. I understand that participation is voluntary and that I may request that my child be removed from the study at any time, either by writing or phoning the school. It is also my understanding that all information gathered in the study will be confidential and that participation will not affect my child's grades.

Signature of Parent/Guardian _____

Date : _____

I, _____, am a student at H. T. Thrift Elementary School, and I am willing to participate in the spelling research study to be conducted by Ardys Smith. I understand that the tests I take will not affect my grades, and that I may be excused from participation in the study at any time by asking my teacher or the researcher, Ms. Smith.

Signature of Student _____

Date : _____

Appendix B

Case Study Permission Form

Dear Student and Parents,

I will be conducting a follow-up study during the summer holidays. This study will involve four students who will be selected from the students involved in the first part of the study, and their parents. Each student will be interviewed about his/her spelling abilities, spelling instruction, attitudes toward spelling, and reading and writing abilities. Parents will be interviewed about the same things, and asked to share information about their child's early reading and writing attempts. The interviews will require about four hours with the student and about one hour with the parents. All interviews will be scheduled at the convenience of the student and parents.

If you would like to participate in the follow-up study, please sign and return the permission form below. You will be contacted early in the summer.

Thank you for your interest in this research.

Sincerely,

Ardys Smith
Graduate Student

I, _____, the parent/guardian of _____, give my permission for him/her to be a participant in the follow-up spelling study. I am also willing to participate in the interviews. I understand that the information used in the study is confidential, and that we may withdraw from the study at any time.

Signature of Parent/Guardian _____

Date : _____

I, _____, am a student at H. T. Thrift Elementary School, and I am willing to participate in the summer follow-up study on spelling. I understand that the information used in the study is confidential and that I may withdraw from the study at any time.

Signature of Student _____

Date : _____

Home address _____
_____
_____

Telephone : _____

APPENDIX C

Testing Materials and Instructions

TEST INSTRUCTIONS

Spelling Test:

1. This test is just like a regular spelling test. I will say the word, use it in a sentence, and repeat the word. Write only the word, not the whole sentence. If you don't know how to spell the word, just give it your best try and put down as much of it as you can.

2. Find the "Spelling" section on your answer sheet.

TEST WORDS

1. prove She swam across the lake to prove to the lifeguard that she could swim. prove

2. autumn The leaves turn brown in the autumn. autumn

3. tooth The little boy lost his tooth when he bit the apple. tooth

4. prize The artist won first prize at the art contest. prize

5. island The fishermen camped on an island. island

6. doubt Some people doubt that bigfoot exists. doubt

7. smoke Forest fires create a lot of smoke. smoke

8. thumb Humans have four fingers and a thumb on each hand. thumb

9. smooth The lake was as smooth as glass. smooth

10. bleed If you cut your finger, it will bleed. bleed

11. tender The roast was juicy and tender. tender

12. cough People with colds often cough a lot, too. cough

13. police Someone called the police to report an accident. police

14. strike The batter did not strike out. strike

15. brave Astronauts must be very brave people. brave

16. sweat The runner worked up a sweat. sweat

17. business The store owner enjoyed owning her own business. business

18. adjust He had to adjust the T.V. because the picture was not very clear. adjust

19. bonus Some teachers give bonus points for extra work. bonus

20. sweet Candy is sweet. sweet

TEST INSTRUCTIONS

Pictures

1. (Pass out numbered grid) Find the Pictures section on your answer sheet. Now, find the part that says "Practice-Pictures." Put your pencils down.

2. I will show you a page with some pictures on it. You may not be able to tell what the pictures are, but that is not important. What you need to do is to try to remember where the pictures are, and think about where they would be on the grid that you have on your desk. When I am showing you the pictures, you should have your grid turned over, so you can't see it, and your pencils down.

After I show you the picture page, I will say "Now write" and you will write the numbers of the boxes that would have pictures in them if the grid was placed on top of the picture page.

3. We'll do one for practice. Remember, pencils down, grids face down, and eyes up here. (Show picture page for 5 seconds only).

4. Now, write.

5. Pencils down when you are finished, so I will know we can go on.

6. You should have written 1, 6, 7, and 12, in any order. They don't have to be in order, so you could have 6, 1, 7, 12, and that would be alright, too.

7. Remember, pencils down, and grid face down when you are finished, and turn the grid over and write your answers on the answer sheet when I say "Now write".

8. I will show you eight picture pages, and after each one, you will have time to write the numbers on your answer sheet.

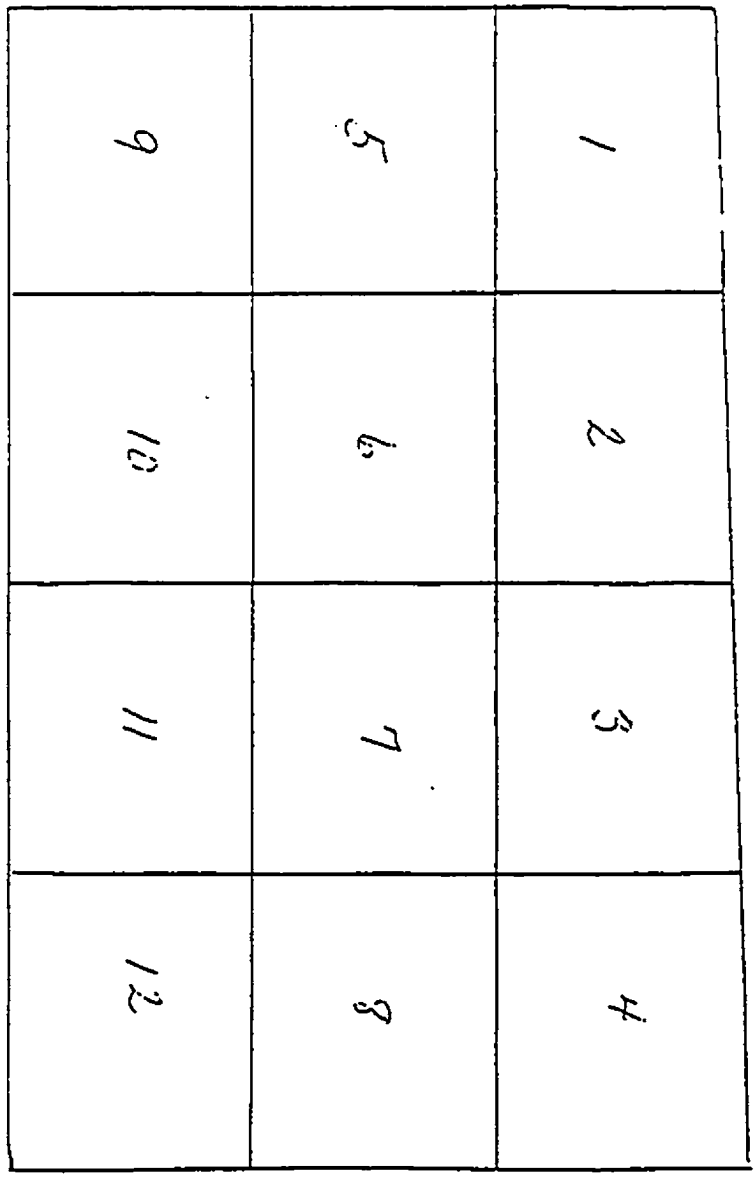
9. (Show first picture page for five seconds. Put it face down on table). Now write.

10. (After approx. 30 seconds) Pencils down, grids face down. Ready? (Show second picture page for 5 seconds) Now write.

11. Continue through all eight picture pages.

Pictures Page

Pictures Grid



TEST INSTRUCTIONS

Numbers

1. Pencils down. I will read a set of numbers. When I finish, I will say "Now, write," and you can pick up your pencils and write any of the numbers you can remember, in the same order as I said them.

2. When you are finished writing the numbers, put your pencils down, and look up here, so I will know that you are ready to go on to the next set of numbers.

3. We will do the Practice set first. Find the Numbers section on your answer sheet. Put your finger on the space that says "Practice - Numbers". This is where the first set of numbers will go.

4. Pencils down, eyes up here. Everyone ready?

5. 2 - 3 - 7. Now write. (Read numbers evenly, approx. 1 per second, and avoid grouping them into sets as you read).

6. (Check to see that everyone got the numbers down correctly). Remember, pencils down when you are finished, and don't pick them up again until I say "Now write".

7. Find A on your paper, put your finger on it, and look up here. Ready?

8. 5 - 6 - 4. Now write. (Allow about 30 seconds).

9. Pencils down, finger on B.

10. 10 - 1 - 6. Now write. (Allow about 30 seconds).

11. Pencils down, finger on C.

12. 9 - 4 - 2. Now write.

13. (Continue above sequence, including 30 seconds to write, for the following number sequences).

D. 9-3-6-8.	E. 4-1-9-6.	F. 3-9-5-2.
G. 5-4-8-1-10.	H. 5-9-2-3-8.	I. 2-10-3-8-9.

J. 10-2-4-1-8-5.

K. 9-8-3-10-1-6.

L. 1-5-2-9-4-3.

M. 4-2-5-[illegible]6-3-10.

N. 3-1-4-10-6-5-9.

O. 8-10-1-5-9-6-2.

P. 6-9-4-1-8-3-5-2.

TEST INSTRUCTIONS

Picture Completion

1. (Pass out test forms) Put your test forms face down, so you cannot see them.

2. Find the Picture Completion section on your answer sheet. Now find the part that says "Practice - Picture completion". I will show a picture, with part of it missing, and you write what you think it is on the practice space.

3. (Show sample picture - the bird) Now, write what you think this is. Pencils down when you are finished.

4. (Call on someone to tell what it is) Did anyone get anything else? You could have had bird, eagle, seagull, or a number of other bird names.

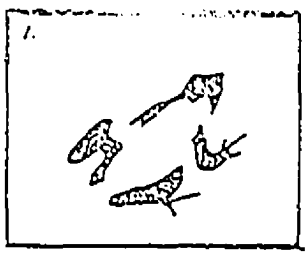
5. Turn your test sheet over. Look at each picture, and notice that each has a number by it. Write what you think each picture is on the answer sheet, by the number that goes with it.

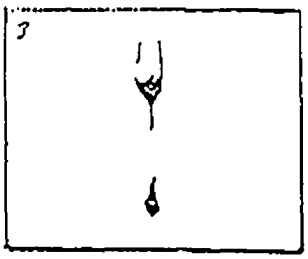
6. Skip any you don't know, and do as many as you can. When you finish, if you have time, go back and try to guess what the others are.

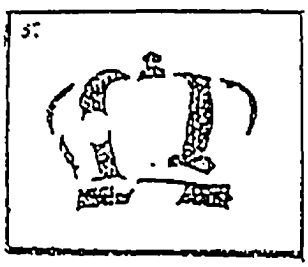
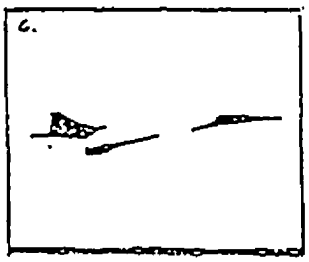
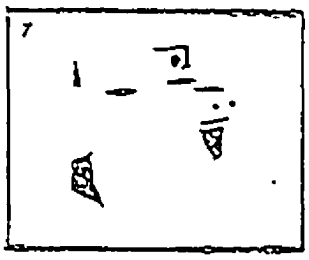
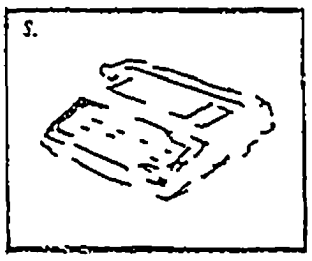
7. Spelling does not count on this. Just write the names of the things as well as you can. Any questions?

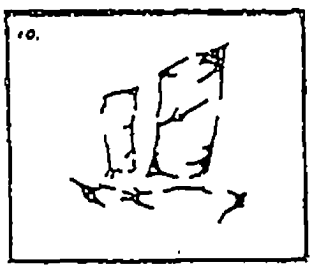
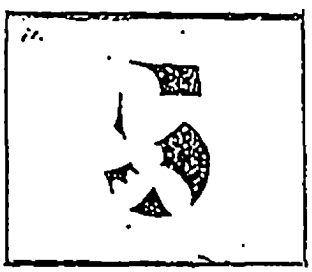
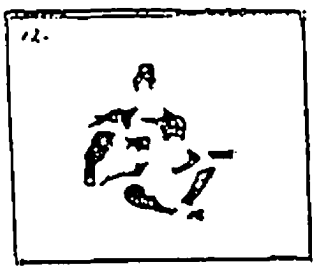
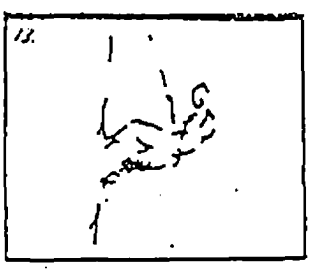
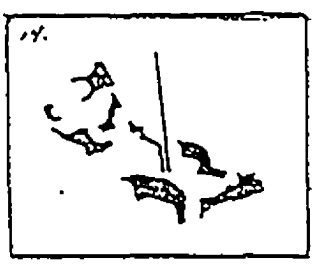
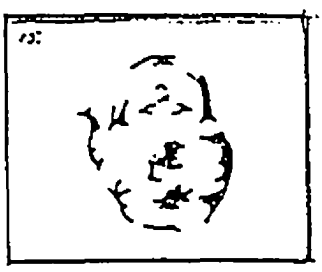
8. You have five minutes. Pick your pencils up, and begin.

Picture Completion Test Sheet





TEST INSTRUCTIONS

Shapes

1. Turn your tests face down, and put your pencils down.

2. For this test, you will be finding things that go together.

3. Find the Shapes section on your answer sheet. Now, find the part that says "Practice - Shapes".

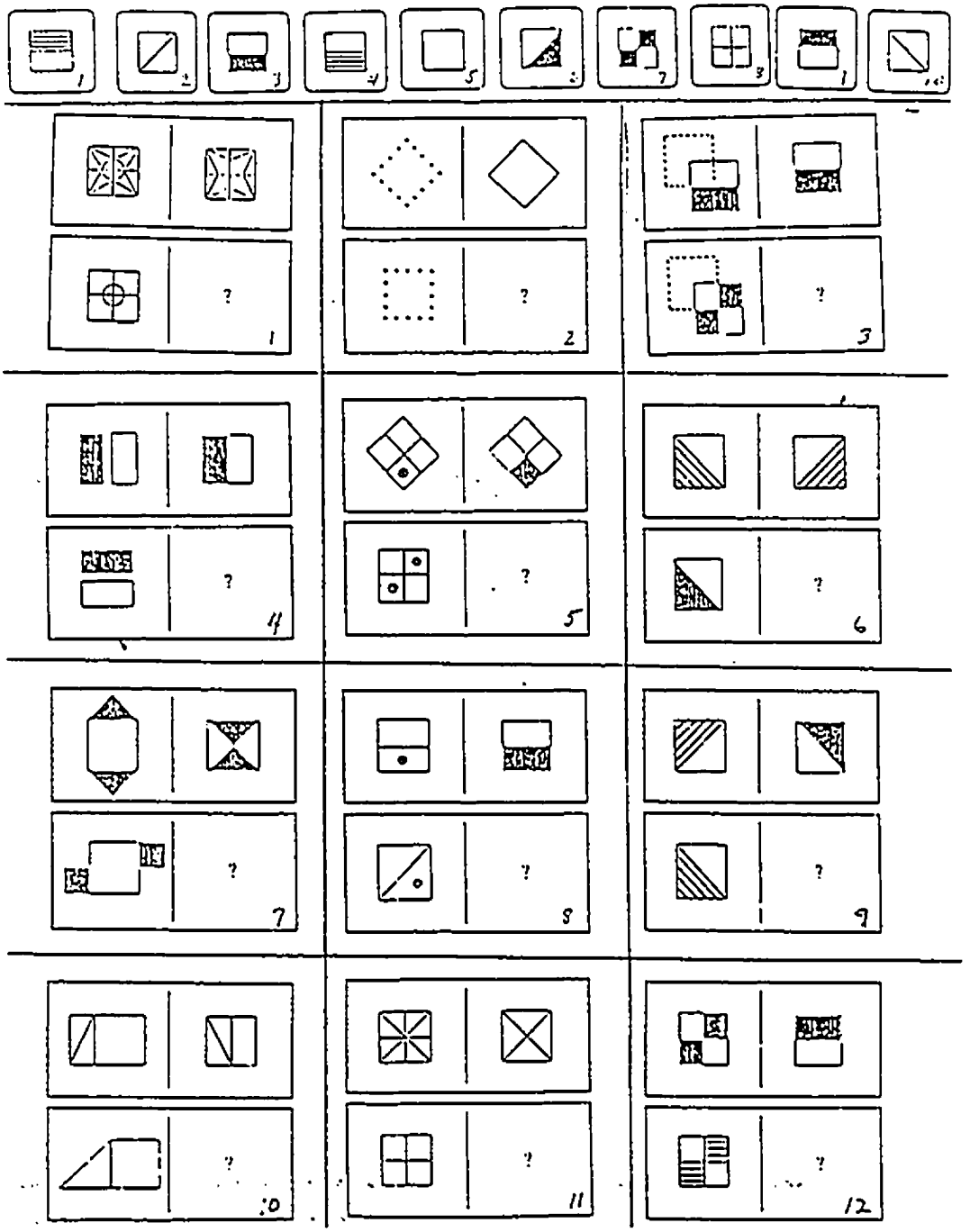
4. Turn your test paper over and look at the numbered figures at the top. You will be using these figures to answer the questions in this test.

5. Eyes up here. (Point to first figure on practice sheet) This figure goes with this figure (Point to second figure), just as this figure (Point to bottom left figure) goes with . . . . . Which of the figures at the top of your test sheet would go here ? Write the number of that figure on your answer sheet where it says "Practice - Shapes".

6. (Check to see that everyone did this properly)

7. There are twelve items on this test. Do them the same way we did the practice item. Find the figure you need to finish each problem, and write the number of that figure by the number of the problem on the answer sheet. Some figures may be used more than once, and some may not be used at all. Skip any you can't do, and do as many as you can. You have 10 minutes. Begin.

Shapes Test Sheet



TEST INSTRUCTIONS

Simple, Complex and Random Patterns

1. Pass out answer booklet for Trial 1.

2. "I will be showing you s set of large cards with rows of figures on them. I will show you five cards. Then, you will have a short time to draw the rows of figures you saw on the cards on the answer sheet. We will do one for practice, so you can see how it is done. Find the place in your answer booklets that says 'Practice' at the top. When you find it, put your finger on it so I will know you are ready to begin."

3. When all have found the right spot, "Eyes up here, and get ready. I will show each card for a very short time. While I am showing the cards, your pencils must be out of your hands, and your answer booklets turned over. As soon as I say, 'Now write', you may pick up your pencils and begin to draw the rows of patterns in the boxes in your booklets. Any questions? Ready?"

4. Show first set of cards.

5. Check that everyone has done it in the right way. Clear up any problems with instructions.

6. Begin first actual card set, following sequence as in practice run. Continue through all card sets.

TEST INSTRUCTIONS

Words and Colours

1. Find Words and Colours on your answer sheet.

2. For this test, I will say some words, then I will show you two colours. First, you will write the colours on the back of your answer sheet, then turn it over to the front, and write the words I said on the correct line on the front.

3. When you finish, put your pencils down, turn your papers over, and look up here.

4. Find "Practice - Words and Colours" on your answer sheet. This line is where the words for this part will go. Now, turn your answer sheets over, pencils down. Remember, you have to write the colours first, then turn your paper over and write the words. The pictures are there to help you remember. Write the words in the order I say them.

5. Ready? BALL CAT (Show two colour cards).

6. (Remind them to write colours first, if need be).

7. (Check practice item).

8. All the words for each item go on one line. Be sure you are on the right line each time. The colour names on the back don't have to be numbered, but keep them in order.

9. Pencils down, paper over. STAR MOON BALL (Show two colours).

10. (Continue for the rest of the words listed below. Remember to show two colour cards each time. Allow approx. one minute to write the colours and words).

2. TREE SHOE HAND
3. SHOE CAT HAND STAR
4. CAT SHOE BALL HAND
5. SHOE STAR HAND BALL TREE
6. STAR SHOE MOON BALL HAND
7. BALL SHOE STAR HAND CAT TREE
8. MOON TREE BALL STAR CAT SHOE
9. TREE STAR CAT MOON HAND BALL SHOE
10. CAT BALL STAR TREE SHOE MOON HAND

TEST INSTRUCTIONS

Cat in the Hat

1. For this test, you will be proofreading for spelling mistakes.

2. Find Cat in the Hat on your answer sheet.

3. I will show you a card with part of a sentence on it. I will show it for only one second, so you have to be fast.

4. After I show the card, quickly mark on you answer sheet if it was O.K. - no spelling errors, or Not O.K. if it had a spelling error in it.

5. This will be fast, so keep your pencils in hand, ready to mark O.K. or Not O.K. Just put a check or an X right in the box to show which one it is.

6. Finger on number one, pencils ready, eyes up here.

7. (Show first card for one second. Allow 10 seconds or less to check off answer).

8. Finger on number 2. Ready? (Show next card). (Continue.)

AGS®
American Guidance Service, Inc.

January 17, 1992

Ardys Smith
406 Jeckell Street
Whitehorse Yukon Y1A 1V2
CANADA

Dear Ardys Smith,

This letter confirms the permission I gave to you to use portions of the Kaufman Assessment Battery for Children (K-ABC) in your Ph.D. dissertation at the University of Victoria, British Columbia. The specific items you requested are:

Subtest 4 - Gestalt Closure
Subtest 5 - Number Recall
Subtest 7 - Word Order
Subtest 8 - Matrix Analogies
Subtest 9 - Spatial Memory

We would be interested in receiving a copy of your dissertation for our files. You may send it to the attention of Dr. Gary Robertson, Vice President, Test Publishing.

Please let me know if I can be of further assistance.

Yours sincerely,

LeAnn Velde
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