

THE DEVELOPMENT OF PHONOLOGICAL AWARENESS AND SPELLING COMPETENCE
IN BEGINNING SPELLERS

by

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Abstract

Phonological awareness is recognized as being a key factor contributing to students' development of early literacy skills. This study investigated the theoretical model which suggests that beginning spellers construct spellings using their knowledge of phonological awareness, orthography, letter names and letter sounds (Burns & Richgels, 1989; Read, 1986; Tangel & Blachman, 1995). Eighty-one kindergarten and grade one students were assessed in terms of their spelling competence, theory-related requisite skills (phonological awareness, knowledge of orthographic structure, letter names and letter sounds), and several control variables (vocabulary, word recognition ability and verbal memory). The results indicated that a substantial portion of the variance in students' spelling competence was accounted for by these requisite skills, and that the contribution of phonological awareness skills to spelling remained significant even after controlling for differences in students' vocabulary, verbal memory and word recognition ability. Subsequent analyses demonstrated that particular types of phonological awareness tasks were differentially associated with different levels of spelling competence. These findings suggest that there is a strong relationship between the development of phonological awareness and spelling competence in beginning spellers.

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THE DEVELOPMENT OF PHONOLOGICAL AWARENESS
AND SPELLING COMPETENCE IN BEGINNING SPELLERS

1

Chapter 1

Introduction and Literature Review

Some researchers interested in the development of spelling competence have concluded that the English spelling system is so irregular that students must learn to spell most words by memorizing them (Hillerich, 1977, 1982; Horn, 1957). However, since the 1970s, several researchers in the fields of linguistics, and cognitive and developmental psychology have adopted a different perspective. Based on their observations and analyses of the spelling errors young children made when they spontaneously attempted to spell words, they came to recognize spelling as a developmental process (Chomsky, 1971; Read 1971).

Since that time, additional research has replicated these findings and further delineated the development of spelling skills, extending from pre-school up through the intermediate grades and beyond (Beers 1980; Beers & Henderson, 1977; Evans & Smith, 1989; Gentry, 1978, 1982; Gentry & Gillet, 1993; Henderson, 1990; Schlagal, 1989; Treiman, 1993). Based on commonalities in developmental spelling error patterns, various models of spelling development have been proposed, consisting of stages during which students are perceived to be using different types of strategies to spell words (Frith, 1980; Gentry, 1978; Gentry & Gillet, 1993; Henderson, 1990; Marsh, Friedman, Welch & Desberg, 1980). Even though these models have been criticized somewhat as being oversimplifications of a complex process, theorists generally agree on the existence of overall developmental trends or changes in the relative use of available strategies as children learn to spell (Lennox & Siegel, 1994; Snowling, 1994; Treiman, 1993, 1994; Varnhagen, 1995),

and children's early attempts at spelling have come to be known as "invented spelling" (Chomsky, 1971), "creative spelling" (Read, 1986), or "developmental spelling" (Henderson, 1990). Various researchers have also theorized that beginning spellers construct spellings in a methodical though unconventional way, using their developing awareness of standard spelling, and their knowledge of the phonetic features of the language, letter names and letter sounds (Burns & Richgels, 1989; Read, 1986; Tangel & Blachman, 1995).

Although researchers continue to study and debate the relative importance of a range of variables to students' on-going development of early literacy skills, such as spelling, it is now recognized that phonological awareness is a key contributing factor. Phonological awareness is defined as the metalinguistic "ability to reflect on and manipulate the subunits of spoken language, the phonemes" (Tunmer, Herriman & Nesdale, 1988, p. 136). Even though the majority of research has involved the importance of phonological awareness in the development of reading competence, several studies have investigated the importance of phonological awareness and later development in reading and spelling, and have indicated that phonological awareness ability is related to success in both subject areas (Burns & Richgels, 1989; Griffith, Klesius & Kromrey, 1992; Lundberg, Olofsson & Wall, 1980; MacDonald & Cornwall, 1995; Stuart & Masterson, 1992; Vandervelden & Siegel, 1995). Of particular interest has been the finding that many students who have lacked phonological awareness skills have been able to improve their competence through phonological awareness training, and that such training has had positive effects on students' later development of word recognition and spelling skills (Ball & Blachman, 1991; Castle, Riach & Nicholson, 1994; DiVeta & Speece, 1990; Ehri & Wilce, 1987; Tangel & Blachman, 1992, 1995; Uhry & Shepherd, 1993).

There has also been some debate in the literature about the causal link between phonological awareness and reading and spelling skill development. That is, researchers have debated if phonological awareness is a precursor or by-product of the processes of learning to read and spell. It now seems apparent that "phonemic awareness is not a unitary, indivisible insight or ability. Rather there are various phonemic insights" (Juel, 1988, p. 437), some of which are prerequisite to and some of which are outcomes of learning to read and spell, and that as students become increasingly competent in reading and spelling, various kinds of phonological awareness skills continue or begin to develop in a reciprocal manner (Ball, 1993; Ellis, 1994; Kirtley, Bryant, MacLean & Bradley, 1989; Perfetti, Beck, Bell & Hughes, 1987; Vandervelden & Siegel, 1995). Of interest then are the kinds of phonological awareness skills that one could expect students, who demonstrate various types of phonological and orthographic skills through their early developmental spelling, to possess. In particular, how is young students' development of spelling competence related to their development of different kinds of phonological awareness skills? The delineation of such relationships may be of benefit to individuals performing assessments, as an analysis of young students' developmental spelling may also be able to serve as an indirect measure of students' phonological awareness skill development.

In order to establish the theoretical basis for this study, relevant research in the field of spelling, with a particular emphasis on developmental spelling theory, and current perspectives on developmental trends in students' spelling is reviewed. Research regarding the measurement of phonological awareness, studies linking the development of spelling and phonological awareness skills to reading, and additional research demonstrating the importance of phonological awareness to the development of spelling competence

alone are also reviewed.

Theoretical Background to Developmental Spelling

Some researchers have suggested that the English language is so inconsistent that spelling should be learned primarily through rote memorization (Hillerich, 1977, 1982; Horn, 1957). This opinion has influenced both our methods of teaching spelling, and our approach to assessing and analyzing students' spelling errors. Educators who share this perspective believe that spelling should be taught on a word-by-word basis, with an instructional emphasis on high frequency words (Hillerich 1977, 1982). In addition, errors should be analyzed with reference to the orthography of the correct word, and therefore labeled as "omissions," (when letter are left out), "additions," (when unnecessary letters are added), "reversals," (when letters are put in the wrong order), or "substitutions," (when one letter is used in place of another) (Spache, 1940), with serial-position effects taken in consideration (Jensen, 1962). However, during the 1970s, researchers began to conceptualize students' developmental spelling in a different way.

Developmental Spelling Theory

Charles Read and Carol Chomsky. Charles Read's doctoral dissertation in linguistics and education in the 1970s is generally credited with signalling "a shift from viewing spelling in visual terms, as an attempt to memorize strings of letters, to viewing spelling in linguistic terms" (Treiman, 1993, p.27). Read studied the spontaneously produced spellings created by pre-school children who had had no formal spelling instruction. Based on his observations of these children and follow-up experiments, Read concluded that, in complete contrast to the traditional view, "children's beginning spelling is essentially phonetic. To a greater extent than adults or older children,

young children spell by representing speech sounds individually rather than by learning the spellings of whole words or morphemes" (Read, 1986, p. 1).

Read also observed that these children showed particular patterns in their developing abilities to represent certain aspects of words. For example, the children demonstrated particular difficulty representing vowels accurately. He noted that the children used their knowledge of letter names to represent the long vowel sounds, and then, based on their knowledge of how the long vowels are articulated, represented other vowel sounds with the letter-name-vowel they perceived to be closest in terms of place of articulation. In addition, he observed that the children tended to omit preconsonantal nasals, and that their judgments of how certain speech sounds should be represented varied from those of adults (Read, 1971; Read 1986).

Carol Chomsky's work during the early 1970s complemented that of Read. Chomsky contended that English orthography was more related to the sound structure of the language than it was generally thought to be, albeit at a deeper phonological level than that represented by surface phonetics. That is, English orthography represents the morphophonological structure or meaning based relationships among spoken words, and not necessarily their sounds. Chomsky believed that students' initial literacy experiences should introduce and extend their concepts of the written word through writing rather than reading, and that beginning spellers should have the opportunity to create spellings for words so that they can "come to trust their own linguistic perceptions, understand that they have a viable means for expressing them, and get plenty of practice in doing so" (Chomsky, 1971, p. 513). In addition, Chomsky indicated that, for more advanced students, spelling instruction would be more beneficial if, instead of being required to simply memorize the spellings of individual words, students were taught to recognize and exploit

the regularities in the language (Chomsky, 1970).

In summary, Read (1971, 1986) and Chomsky (1970, 1971) had a significant impact on the field of spelling research. Their work challenged researchers to re-examine their perspectives on the English language and how students develop competence in spelling, and established the theoretical basis for a number of related studies.

Paul and the University of Virginia researchers. In the years since Read's study, the work of several other researchers has contributed significantly to our current understanding of how students develop spelling competence. One such researcher is Paul (1976) who observed a group of kindergarten students in an attempt to replicate some of Read's results. After successfully doing so, she developed a theory of spelling development based on her observations, which includes four basic stages. According to Paul, students write the first letter or phoneme of each word or syllable during the first stage. During the second stage, children add the final phoneme of the word or syllable, progressing to represent the vowel during the third stage. Children at the fourth stage, who in Paul's study were already reading, produce more standard spelling. Paul also informally observed that the children used standard spelling for words they had learned to spell, and that they seldom invented the same spelling twice. Instead, they appeared to attack each word as if it were a new problem to solve. She noted that often the children could not read back what they had just written, and concluded that, to the children, the process seemed to be more important than the product.

Additional research was also carried out by a group of researchers led by Henderson (1979, 1990), based at the University of Virginia. Like Paul, these researchers also attempted to determine if Read's findings could be

replicated with other children. Initially focussing on early spelling development, but through the years extending up to focus on students' abilities through the intermediate school years and beyond, their cumulative work is considered to "constitute the largest single body of work on creative spelling in school" (Read, 1986, p. 51).

One of Henderson's students was James Beers (1980), who concentrated on grade one and two students' developing abilities to represent vowels in their spelling. Based on his results, Beers formulated the hypothesis that students progress through four stages as they learn to spell vowels: omission of the vowel, use of a letter-name to mark the vowel, a transitional stage during which the vowel is marked in a non-standard way, and the emergence of the correct form. In more general terms, he further hypothesized that "a child's knowledge about written words is acquired systematically, developmentally, and gradually. The acquisition process is too complex to be limited to serial learning or word memorization" (Beers, 1980, p. 45).

Beers and Henderson (1977) studied the development of orthographic concepts in grade one students, as revealed by their creative writing spelling errors over a six month period, in an effort to determine if the students would demonstrate progress in a stage-like manner. In particular, they concentrated on students' errors related to long and short vowels, vocalic r, and morphological markers. They concluded that the children they studied seemed to create a hierarchy of strategies, which initially relied on their awareness of speech sounds and how sounds are articulated and gradually came to include more lexical and syntactic information as they became more familiar with the structure of written language.

Recognizing that his developmental studies did not yield the kind of evidence necessary to determine how children learned about words, but rather

information about what children learned and the order in which they learned it, Henderson (1990) hypothesized that three organizational principles, alphabetic, within-word pattern, and meaning, govern the way in which students learn to spell words -- spelling by sound, spelling by pattern and spelling by meaning. Based on his observations and patterns which emerged in his research data of the apparent gradual development of students' competence with each of these types of strategies, Henderson developed a five stage model of spelling development or increasing word knowledge, spanning age one to adulthood. Although recognizing that the overlapping developmental stages are based on somewhat arbitrary divisions, given that students' progress is continuous, Henderson noted that, based on his observations, students tend to proceed through "periods of rapid change and then longer periods when a new understanding is tested and refined" (p. 40).

For Henderson (1990), stage one (age one to seven) is the preliterate stage, during which children gain an initial understanding of written language. At this stage children may imitate writing, but there is little evidence of an understanding of letter-sound correspondence (e.g., writing "jjed" for "ship"). Stage two (age five to nine) is the letter-name stage, during which children use a phonetic strategy including the letter-name strategy when spelling (e.g., writing "ru" for "are you"). Stage three (age six to twelve), the within-word pattern stage, is the period during which students learn to associate given letter patterns to sounds and meanings (e.g., writing "tiem" for "time"). The final two stages, stage four (age eight to eighteen), the syllable juncture stage, and stage five (age ten to adulthood), the derivational constancies stage, constitute the periods during which students incorporate consonant-doubling principles (e.g., writing "popping" not "poping") and etymological principles (e.g., recognizing the

relationship between "please" and "pleasant") into their growing repertoire of spelling strategies.

Another one of Henderson's students, Gentry (1978, 1982; Gentry & Gillet, 1993) also studied the development of students' spelling, focussing, in particular, on students' early spelling development and growing ability to represent both vowel and consonants. Integrating his own research with the work of Read, Henderson, Beers and other researchers in the field, Gentry developed the hypothesis that young students pass through five stages as they begin to develop spelling competence, with each of the stages "representing a different conceptualization of English orthography ... which, over time, enables the competent speller to rely on multiple strategies, including visual, phonological, and lexical or morphological" (p. 193). For beginning writers, Gentry suggests that these stages mark the emergence of knowledge related to familiarity with the alphabet, the alphabetic principle, and an awareness of phonemes. Gentry's five sequential developmental spelling stages are:

1. the precommunicative stage - "the natural early expression of the child's initial hypotheses about how alphabetic symbols represent words" (Gentry, 1982, p. 194)
 - a. some knowledge of the alphabet is demonstrated through the use of letter forms in messages
 - b. no knowledge of sound-symbol correspondence is demonstrated
 - c. the principle of left-to-right directionality in writing may or may not be demonstrated
 - d. number symbols may be included as part of the spellings of words
 - e. messages may be written using only some or many different

letters of the alphabet

f. lowercase and uppercase letters are used indiscriminately, with a preference usually being shown for uppercase forms

2. the semiphonetic stage - students come to recognize that letters represent sounds; this stage represents the emergence of the alphabetic principle and a beginning awareness of phonemes

a. letters start to be used to represent the sounds in words;

however, the letters provide a partial, not a total, mapping of the sounds in the word

b. often, only the initial consonant is used to represent an entire word

c. letter-name strategies may be used, with a single letter (e.g., r or l) used to represent a word, sound or syllable instead of using a vowel and consonant combination

d. knowledge of the left-to-right sequence of letters in words is demonstrated

e. a more complete knowledge of the letters of the alphabet is demonstrated

f. students may or may not be aware of how to segment words

3. the phonetic stage - all of the sounds heard in words are represented

a. there is a total mapping of letter-sound correspondence with all of the surface sound features of the words represented

b. particular spellings for certain details of phonetic form are systematically developed, such as: tense vowels, lax vowels, preconsonantal nasals, syllabic sonorants, -ed endings, retroflex vowels, affricates and intervocalic flaps

- c. "letters are assigned strictly on the basis of sound, without regard for acceptable English letter sequence or other conventions of English orthography" (Gentry & Gillet, 1993, p. 30)
 - d. an awareness of word segmentation and spatial orientation is generally demonstrated
4. the transitional stage - the speller begins to pay more attention not only to how English spelling sounds, but also how it should look
- a. basic conventions of English orthography are followed (i.e., vowels are in every syllable, nasals are represented before consonants, vowels and consonants are used in place of letter-names, vowels are used before syllabic r, common letter sequences are used, vowel digraphs are used liberally, silent e is used for long vowels, and common endings [e.g., -s, 's, -ing] are used conventionally)
 - b. knowledge of morphological and visual spelling strategies is demonstrated
 - c. all appropriate letters may be included, but some may be reversed; spellers have not yet developed the ability to recognize what looks right
 - d. spellers do not yet show evidence of other factors thought to be related to spelling competence (e.g., stress, morpheme boundaries, position in the word, phonological influences)
 - e. knowledge of alternative spellings for a given sound is demonstrated
 - f. an increasingly greater proportion of words are spelled correctly when writing

5. the conventional stage - spellers know the English orthographic system and how it works, and are able to integrate the semantic, etymological, visual and phonetic aspects of the system

- a. knowledge of the English orthographic system is demonstrated
- b. phonetic knowledge becomes expanded to include a recognition of word environmental constraints (e.g., stress, position in word)
- c. semantic knowledge becomes expanded to include a recognition of word structure, including prefixes, suffixes, contractions, compound words and homonyms
- d. increased knowledge of silent letters and consonant doubling is demonstrated
- e. use of alternative spellings and visual checking increases as a correction strategy
- f. uncommon alternative patterns and irregular spellings continue to be mastered; many words are spelled correctly

Thus, a number of researchers have contributed to our understanding of students' developmental spelling, by not only replicating Read's (1971, 1986) and Chomsky's (1970, 1971) work, but extending it (Beers, 1980; Beer & Henderson, 1977; Gentry, 1978, 1982; Gentry & Gillet, 1993; Henderson, 1990; Paul, 1976). As a result of their observations, these researchers have proposed stage models of spelling development based on apparent developmental patterns in students' spelling from the beginning stages, up through the intermediate years and beyond, and suggested changes to spelling curricula and instructional practices based on their research findings.

Application to instructional practice. As a result of these studies, a number of recommendations have been put forward with regard to spelling instruction. In particular, researchers advocate that students should be

taught at their spelling instructional levels, which are established by administering a developmental spelling measure, consisting of words that require spelling skills and abilities considered to be indicative of each of Gentry's (Gentry & Gillet, 1993) or Henderson's (1990) spelling stages. Teachers then analyze the types of errors made by students and estimate their stages of spelling development based on overall patterns noted in the students' correct and incorrect spellings (Bear & Barone, 1989; Gentry & Gillet, 1993; Henderson, 1990; Morris, Nelson, & Perney, 1986; Richgels, 1986; Schlagal, 1989). For example, Henderson's spelling stages include the preliterate, letter-name, within-word pattern, syllable juncture, and derivational constancy stages. Students at the preliterate stage would not be expected to demonstrate a clear understanding of sound-symbol correspondence, whereas students at the letter-name stage would be expected to have established sound-symbol correspondence for consonants and some consistency in the use of vowels. Students at the within-word pattern stage would be expected to have mastered short vowels and be developing their knowledge of long vowel spelling patterns, while students at the syllable juncture and derivational constancy stages would be expected to demonstrate the ability to combine syllables, and a developing knowledge of morphology respectively.

Once students' stages of developmental spelling have been determined, it is suggested that they be grouped, according to their demonstrated ability levels, for direct instruction in spelling and word study specific to their apparent stage of development. That is, students at the preliterate stage may work on developing their knowledge of the alphabet and concept of a "word", and students at the letter-name and within-word pattern stages may focus on short and long vowel patterns respectively. Instruction for students at the syllable juncture stage may include work on affixes, whereas students at the

derivational constancy stage may study word families and derivations.

Nelson (1989) suggests that developmental spelling theory "hinges on the idea that individuals naturally differ in spelling ability along a single continuum" (p. 261). In order to provide students with the most appropriate instruction, teachers must be able to recognize students' current levels of development and provide them with activities which foster their continued progression along the developmental spelling continuum (Bear & Barone, 1989; Gentry & Gillet, 1993; Henderson, 1990; Henderson & Templeton, 1986; Invernizzi, Abouzeid & Gill, 1994; Templeton, 1991). However, in addition to a formal instructional program, researchers also advocate for informal in-context spelling instruction, provided by giving students many opportunities to write in an environment conducive to the development of literacy skills, and establishing expectations and giving feedback appropriate to students' individual developmental levels (Gentry & Gillet, 1993; Henderson, 1990; Schickedanz, 1990; Timberlake, 1995).

In summary, based on the findings and recommendations of researchers in the field of developmental spelling, a number of changes to spelling curricula and instructional practice have been suggested. These include: teaching students according to their apparent stage of spelling development (Bear & Barone, 1989; Gentry & Gillet, 1993; Morris, Nelson, & Perney, 1986; Richgels, 1986; Schlagal, 1989), and providing students with formal and informal level-appropriate instruction, including word study (Bear & Barone, 1989; Gentry & Gillet, 1993; Henderson, 1990; Henderson & Templeton, 1986; Invernizzi, Abouzeid & Gill, 1994; Schickedanz, 1990; Templeton, 1991; Timberlake, 1995).

Current Perspectives and Research Considerations

More recently, other researchers have questioned the delineation of students' spelling abilities into discrete stages (Lennox & Siegel, 1994;

Snowling, 1994; Treiman, 1993, 1994; Varnhagen, 1995). In stage theories, children's development is regarded as a progressive series of qualitatively different periods which appear in an invariant sequence and during which different sets of principles govern behavior. Gentry (1977) notes that although students may produce spellings characteristic of more than one stage when they write, their overall progress is continuous and does not fluctuate between stages or regress from a higher to a lower stage of development. However, Varnhagen (1995) indicates that for spelling the "progression from stage to stage is not invariant as implied by a stage description ...[and] the sequence of development for correct spelling may be different for different words" (p. 260). Examinations of students' spellings of the same words over time have indicated that students' spellings can vary, with words that were apparently mastered suddenly being misspelled, suggesting that students used strategies that were developmentally less mature. According to Varnhagen, stage theories that represent students' spelling development as the integration of increasingly complex strategies would seem to be unable to explain this apparent regression in development. Treiman (1993) notes that, in contrast to Gentry's (1978, 1982; Gentry & Gillet, 1993) stage theory, "semiphonetic, phonetic, and transitional spellings are less distinct and less well defined than they first appear to be" (p. 31).

Researchers have also questioned the apparent assumption that students have a limited range of strategies that they can use at given stages of spelling development (Lennox & Siegel, 1994; Snowling, 1994; Treiman, 1993, 1994; Varnhagen, 1995). Lennox and Siegel (1993) studied the spelling errors produced by students with a reading or an arithmetic disability, and normally achieving students, and could find no evidence that, at a given point in their spelling development, students changed from primarily using phonological to

visual spelling strategies, as stage models imply. They concluded that "students begin to learn the phonological and visual skills necessary for spelling from the initial stage of learning. They gradually accumulate skills and, when they have a large enough store of knowledge, use these skills in their spelling" (Lennox & Siegel, 1994, p. 96).

Treiman (1993) conducted a longitudinal study of the spelling development of grade one students, and although she replicated many of the results described by Read and the University of Virginia researchers, she also found evidence of students' use of a range of spelling strategies. Treiman concluded that in the analysis of children's spelling errors Read, and other researchers who followed in his footsteps and adopted his methodology, overlooked or underanalyzed the influence of orthography on children's spellings. Treiman's observations of the spelling of the grade one students in her study indicated that from the beginning, and particularly as they had greater exposure to print, the students had some understanding about which letter sequences are legal and which are illegal in English. To verify her observations, she conducted a study involving students from kindergarten to grade two, and adults, which required them to indicate which one of a pair of pseudowords was more like a real word. Her results showed that even the kindergarten students were able to perform above chance on this test and that students' abilities improved across grade levels, indicating that students had at least some knowledge of English orthography from the early phases of spelling development, and that orthographic knowledge improved over time. Treiman (1994) concluded that beginning spellers take advantage of what they know, including information about phonology, letter names and common spelling patterns. Their spelling develops not in stages, but reflects gradual and continuous improvements in their phonological and orthographic knowledge base.

Further evidence for beginning spellers' early use of orthographic strategies comes from Goswami & Bryant (1990), who investigated the ability of beginning spellers to use orthographic analogies in their spelling of new words. Goswami found that students as young as age seven were able benefit from instruction in the spelling-by-analogy strategy. In a related experiment, Snowling (1994) reported that students as young as eight, who were primed to spell nonwords using an analogy strategy, demonstrated the ability to use lexical information when spelling. In addition, the students displayed "knowledge not only of simple sound-spelling correspondences but also about the probability of occurrence of different spelling-sound relations in the orthography" (p. 120).

A number of other concerns, related to spelling research methodology, have also been raised. Most studies of students' development in spelling have been conducted using error analysis procedures, which involve the interpretation of students' spelling miscues to attempt to determine which strategies -- phonological, orthographic or morphological -- students were able or unable to apply when spelling. Several researchers have proposed that future studies should concentrate on investigating both the range and relative use of spelling strategies by students as they gain overall competence in spelling (Varnhagen, 1995). As early strategy use has been found to be primarily phonological and orthographic, Treiman (1993) suggests that errors should be analyzed in terms of both of these factors. Traditional orthographic error analysis, which simply considered if a word was spelled correctly or not based on a comparison of a student's spelling of a word to the standard form of the word, is insufficient for explaining how a student came to spell a word the way he or she did. Similarly, phonological approaches which only consider whether or not a student correctly represented

the phonemes in a word are also inadequate. Therefore, error analysis procedures used to investigate students' beginning spelling development need to use a combination of approaches in order to assess students' relative use of both spelling strategies (Lennox & Siegel, 1994; Treiman, 1993).

However, some researchers believe that the error analysis procedure, while useful, can lead to false assumptions. Spelling analysis procedures which only analyze spelling errors do "not allow for a complete and differentiated description of childrens' cognitive processing during spelling" (Varnhagen, 1995, p. 269), as it cannot be assumed that the strategies students use when they misspell words are the same strategies that they use when they spell words correctly (Lennox & Siegel, 1994). Therefore, error analysis procedures may not differentiate between students with an underdeveloped repertoire of spelling strategies, and those who have developed a range of spelling strategies but sometimes lack the ability to apply them appropriately (Varnhagen, 1995).

Other researchers stress the importance of taking processing demands into consideration before conclusions or generalizations can be made about the results obtained from studies (Snowling, 1994). For example, some spelling research is considered to be "naturalistic," in that it is conducted using students' spontaneous spellings taken from stories they have written. Other research is deemed to be "experimental," because it is conducted using dictated spelling words, specifically chosen to contain constructions the researchers wish to study. Task or processing demands must be taken into consideration as it has been noted that students' "spelling will normally be better when they are writing single words than when they are composing a 'story'" (Snowling, 1994, p. 112). Therefore, it cannot be assumed that conclusions based on research conducted using dictated spelling words, for

example, will be applicable to students' spelling assessed using a different format or within a different context.

In summary, some researchers are currently questioning the appropriateness of delineating students' spelling abilities into discrete stages (Lennox & Siegel, 1994; Snowling, 1994; Treiman, 1993, 1994; Varnhagen, 1995), as Henderson (1990) and Gentry (1978, 1982; Gentry & Gillett, 1993) have done, as students' spelling is seldom found to develop so systematically. In addition, researchers have questioned the apparent assumption that students have a limited range of strategies that they can use at given stages of spelling development (Lennox & Siegel, 1994; Snowling, 1994; Treiman, 1993, 1994; Varnhagen, 1995), as several studies have shown that beginning spellers have the ability to use both phonological and orthographic spelling strategies. As such, researchers have suggested the importance of investigating both the range and relative use of spelling strategies by students as they gain overall competence in spelling (Varnhagen, 1995). Researchers studying beginning spelling development should therefore use spelling analysis procedures which consider students' use of both phonological and orthographic spelling strategies (Treiman, 1993).

Summary: Theoretical Background to Developmental Spelling

In summary, developmental spelling theorists have contributed significantly to our understanding of students' developing competence in spelling by outlining some of the elements that children learn and the order in which they appear to learn them. They have also shown how learning to spell involves more than rote memorization, such as the development and eventual integration of a range of spelling skills and strategies, progressing from simple to more complex notions of how English works (Zutell, 1996). The work of other researchers has shown how English orthography is not necessarily

arbitrary or irregular, and has lead to the recognition that alphabetic orthography may represent the morphophonological structure of spoken words, and not necessarily their sounds (Chomsky, 1970).

Of particular relevance to this study is the theoretical model suggesting that beginning spellers construct spellings in a methodical though unconventional way, using their developing awareness of standard spelling, and their knowledge of the phonetic features of the language, letter names and letter sounds (Burns & Richgels, 1989; Read, 1986; Tangel & Blachman, 1995). It should be noted, however, that few if any empirical studies have attempted to assess the validity of this model.

In addition, several researchers have suggested that the stage models of spelling development proposed, while of benefit in providing a general outline of skill development, oversimplify the process and are incomplete. Although it is generally recognized that students' spelling does "progress from incomprehensible to increasingly more comprehensible forms" (Varnhagen, 1995, p. 259), that "for beginning spellers who are encouraged to write on their own, spelling is more an attempt to represent a word's sound than it is an attempt to recall a word's memorized spelling" (Treiman, 1993, p. 279), and that beginning spellers do not appear to be aware of or use morphological strategies (Treiman, 1993), it is also recognized that beginning spellers have a range of strategies available to them from the initial stage of learning to spell (Lennox & Siegel, 1994; Snowling, 1994; Treiman, 1993, 1994; Varnhagen, 1995). Given that "it is the interplay of these developing abilities that is critical to the acquisition of spelling" (Snowling, 1994, p. 121), it is now proposed that research should concentrate on studying both the range and relative use of spelling strategies by students as they gain overall competence in spelling (Varnhagen, 1995). As early strategy use has been

found to be primarily phonological and orthographic, Treiman (1993) suggests that students' spellings should be analyzed in terms of both of these factors.

Theoretical Background to the Measurement of Phonological Awareness

Although researchers continue to study and debate the relative importance of a range of variables to students' on-going development of early literacy skills, such as spelling, researchers now recognize that one of the metalinguistic skills, phonological awareness, is a key contributing factor. Metalinguistic skill is defined as the ability to consciously reflect on and manipulate the structural features of spoken language, and include phonological awareness, word awareness (which is often amalgamated with phonological awareness), syntactic awareness and pragmatic awareness. Phonological awareness and word awareness "refer to the ability to reflect on and manipulate the subunits of spoken language, the phonemes and words" (Tunmer et al., 1988, p. 136). Phonological awareness, which at the level of the phoneme is often referred to simply as phonemic awareness, has been studied a great deal in recent years due to repeated findings linking skill in phonological awareness to later success in reading (Tunmer et al., 1988).

Although the majority of research has emphasized the importance of phonological awareness in the development of reading competence, several studies have demonstrated that phonological awareness ability is related to success in both reading and spelling (Burns & Richgels, 1989; Griffith, Klesius & Kromrey, 1992; Lundberg, Olofsson & Wall, 1980; MacDonald & Cornwall, 1995; Stuart & Masterson, 1992; Vandervelden & Siegel, 1995). Of particular interest has been the finding that many students who have lacked phonological awareness skills have been able to improve their competence through phonological awareness training, and that such training has had

positive effects on students' later development of word recognition and spelling skills (Ball & Blachman, 1991; Castle, Riach & Nicholson, 1994; DiVeta & Speece, 1990; Ehri & Wilce, 1987; Tangel & Blachman, 1992, 1995; Uhry & Shepherd, 1993).

There has been some debate in the literature about the causal link between phonological awareness and reading and spelling skill development, particularly in determining if phonological awareness is a precursor or by-product of the processes of learning to read and spell. Researchers generally agree that phonological awareness consists of a range of abilities and insights, some of which are prerequisite and some of which are outcomes of learning to read and spell, and that as students become increasingly competent in reading and spelling, various kinds of phonological awareness skills continue or begin to develop in a reciprocal manner (Ball, 1993; Ellis, 1994; Juel, 1988; Kirtley, Bryant, MacLean, & Bradley, 1989; Perfetti, Beck, Bell, & Hughes, 1987; Vandervelden & Siegel, 1995). Researchers must therefore take into consideration the various factors which may influence students' successful performance on the phonological awareness tasks used in their experiments.

Research methodology considerations. According to Bradley and Bryant (1985), studies investigating the relationship between phonological awareness and spelling and reading skill development may be correlational, longitudinal or intervention training studies. Each type of study has merit and can provide us with valuable information, particularly when the results of different kinds of studies are combined. For example, concurrent correlational studies can be used to indicate if a relationship exists between variables, longitudinal correlational studies can be used to "establish a genuine relationship in the real world" (p. 28), and intervention training

studies can help establish or prove a causal link. However, the integrity of the results gained from any of these types of studies may be questioned if researchers do not control for possible extraneous variables when they design their research procedures.

McBride-Chang (1995) conducted an investigation into the phonological awareness construct, and found that in addition to speech perception, general cognitive ability and verbal memory explained unique variance in relation to the construct. For example, with respect to memory, McBride-Chang found that segmentation tasks with five-phoneme stimuli were especially demanding for young children, making it difficult to distinguish memory from phonological awareness. Given that phonological awareness research should be focussing on students' ability to "reflect on and manipulate the subunits of spoken language, the phonemes and words" (Tunmer et al., 1988, p. 136), regardless of their abilities in other areas, Goswami and Bryant (1990) and Bradley and Bryant (1985) suggest that researchers need to control for differences in children's general cognitive ability and verbal abilities, such as vocabulary and memory, in order to ensure that any relationship discovered is uncontaminated by extraneous factors. Research on phonological awareness has not always taken the potential confounding effect of related skills like vocabulary and verbal memory into consideration.

Of some concern to researchers in the area has been the use of a wide range of measures of phonological awareness in research studies, as the variability may have an impact on the kinds of conclusions one could draw from the cumulative research base. Varying task demands in terms of type, location of phonological contrast, and instructions, Stanovich, Cunningham and Cramer (1984) administered a range of phonological awareness tasks to kindergarten students and were able to demonstrate "considerable comparability and

interchangeability among the tasks used to measure the construct" (p. 175), suggesting that various phonological awareness tasks are in fact measuring the same construct and that "results from different investigations are probably not too contaminated by disparate task requirements" (p. 188). However, it remains apparent that measures of phonological awareness can vary along at least two dimensions, relative to the cognitive and linguistic complexity of the task (Cole & Mengler, 1994).

With respect to the cognitive complexity of tasks, various researchers have developed models identifying apparently different levels of phonological awareness, and the tasks used to measure them. For example, Yopp's (1988) studies have lead her to conclude that there are "two highly related factors that underlie phonemic awareness: Simple Phonemic Awareness and Compound Phonemic Awareness" (p. 175), measured respectively with tests of phonemic segmentation and phoneme deletion. Based on a review of the literature, Ball (1993) outlines a phonological awareness continuum divided into emerging (e.g., sound play), simple (e.g., rhyme, alliteration, blending, segmentation) and complex (e.g., deletion, substitution) tasks. She describes the emerging tasks as requiring "a relatively shallow phonemic processing ability that corresponds roughly to a child's sensitivity to sound structure" (p. 131), and the complex tasks as requiring "a much deeper level of phonemic processing that involves explicit, conscious, and analytic skills necessary to access and manipulate phonemic representations" (p. 131), and greater demands on memory.

Based on her review of the literature, Adams (1990) suggests that there are at least five different levels of phonological awareness tasks. In order of increasing difficulty, these are:

1. tasks which measure phonological awareness by having students demonstrate a knowledge of nursery rhymes (e.g., recite "Humpty Dumpty")

2. oddity tasks, which require the child to compare and contrast the sounds of words, containing rhyme or alliteration, in a systematic way (e.g., "cat", "bit", "mat" - Which one does not rhyme?)
3. blending and syllable-splitting tasks, which require that children construct words using isolated phonemes, or isolate phonemes in words themselves (e.g., /c-a-t/ - What word is that?)
4. phonemic segmentation tasks, which require the child to analyze words completely into a series of phonemes (e.g., tell me each sound in "cat")
5. phoneme manipulation tasks, in which the child must be able to add, delete, or move designated phonemes in words (e.g., say "cat", change /k/ to /f/)

In addition to cognitive complexity, there is also evidence to suggest that task difficulty can be manipulated quite easily by varying linguistic demands. For example, Schreuder and van Bon (1989) investigated the effects of various word properties, namely length, CV structure, syllabic structure, and meaning, on students' ability to segment words. Although they found that word meaning appeared to have no effect on students' ability to segment words, they did find that students had more difficulty with tasks involving pseudowords, presumably because of the greater demands placed on memory, and therefore in identifying the sounds in the words. Pseudowords are often used in phonological awareness tasks to avoid the possibility that students' responses would be affected by their knowledge of how a word is spelled (Lindamood, Bell & Lindamood, 1992). Schreuder and van Bon also found that students had more difficulty segmenting longer words, especially if they were monosyllabic. That is, students found it less difficult to segment long words that were bisyllabic than monosyllabic words of the same length. However, the researchers felt that some of the effects of word length could be explained by

the difficulties students experienced segmenting monosyllabic words with several and/or complex consonant clusters.

McBride-Chang (1995) also found that manipulations of the speech sounds used as stimuli in phonological awareness tasks, such as phoneme deletion, position analysis and phoneme segmentation, had a significant impact on task difficulty. "Item difficulties within these tasks were affected by numbers of phonemes, types of phonemes, numbers of phonemes within a phoneme cluster, and position of phonemes within a nonsense word" (p. 187). Of these variables, McBride-Chang found the biggest effect was for numbers of phonemes, and it was speculated that this was related to increased identification and memory demands. Although a significant effect for stop versus fricative consonants was not found for segmentation tasks, type of phoneme did have a significant effect on position analysis tasks with stop consonants being more difficult to identify. Significant effects were also found related to the position of the phoneme to be manipulated. Manipulation of middle phonemes in position analysis and deletion tasks was found to be more difficult than tasks requiring the manipulation of either initial or final phonemes. The effect of number of consonants in an initial or final consonant cluster was found to be very large in phoneme deletion tasks, with difficulty increasing relative to the number of consonants in the cluster. These findings are consistent with those of Treiman (1985) who has noted that young children's judgments regarding speech sounds, in particular those that constitute consonant clusters, may differ from that of adults, and therefore "it may not be justified to consider the ability to make explicit judgments about speech sounds as a unitary skill" (p. 199).

In summary, researchers conducting studies related to phonological awareness need to ensure that they control for extraneous variables such as

cognitive and verbal ability, including vocabulary and verbal memory, to try and ensure that any relationship they may find between phonological awareness and reading or spelling skills is uncontaminated by other factors (Goswami & Bryant, 1990). It is also important that researchers recognize that phonological task difficulty may vary due to cognitive and/or linguistic complexity (Adams, 1990; Ball, 1993; McBride-Chang, 1995; Schreuder & von Bon, 1989; Yopp, 1988). Tasks developed with respect to these dimensions appear to tap different abilities, some of which are present before students begin formal literacy instruction, and some of which develop in a reciprocal manner, as students gain increased competence in reading and spelling (Juel, 1988). It is therefore important for researchers to use controlled or standardized phonological awareness tasks in their research studies.

The Development of Spelling and Phonological Awareness Skills in Relation to Reading

Several researchers have proposed developmental theories related to the acquisition of reading and spelling skills (Ehri, 1987; Frith, 1985; Goswami & Bryant, 1990; Marsh, Friedman, Welch & Desberg, 1980). However, according to Ellis (1994), Frith's (1985) model is of particular note because it "provides a theoretical framework within which spelling and reading interact to advance the learner towards increased proficiency in each ability" (Ellis, 1994, p. 158). In Frith's (1985) model, students progress through phases in their reading and spelling development when their relative use of logographic, alphabetic and orthographic strategies varies, and they demonstrate the predominant use of different strategies when they read and when they spell. That is, Frith theorizes that students' early reading development is dependent on and responsible for the development of their use of logographic strategies, whereas students' beginning spelling is dependent on and responsible for the

development of their use of alphabetic strategies. However, as students continue to develop their early literacy abilities, their relative use of the various strategies changes. For example, students begin to demonstrate an increased use of alphabetic strategies, developed through spelling, when reading. They then demonstrate an increased use of orthographic strategies when reading, which eventually become more prominent in students' spelling as well.

In relation to students' development of phonological awareness skills, it has been hypothesized that, if students' beginning spelling is more related to their use of alphabetic strategies, then early spelling may be more related to students' phonological awareness skill development, such as the ability to segment phonemes, than their early reading development. However, researchers also suggest that skill development in phonological awareness and spelling may facilitate students' gradual increase in the use of decoding in reading, which may result in increased exposure to print through reading. This in turn may facilitate students' development and use of orthographic spelling strategies (Cataldo & Ellis, 1988; Ellis, 1994).

Although there is no evidence to suggest that children develop reading and spelling skills by progressing through a series of discrete or identifiable stages, there is evidence of a link between children's reading and spelling, and of qualitative changes that occur in students' relative use of phonological and orthographic strategies as they begin to develop competence in reading and spelling (Goswami & Bryant, 1990). As such, a number of studies have been conducted to investigate the relationship between the development of spelling and phonological awareness skills in relation to reading. While some studies have investigated the interplay between young students' spelling and reading skills, as suggested by theories such as

Frith's, other reading research studies have included spelling measures because "children's spellings provide a much needed window through which one can observe the development of their knowledge of the phonology and orthography of their language. This is especially true for children whose word-decoding skills are so rudimentary that very limited information can be obtained from analysis of their reading performance" (Stage & Wagner, 1992, p. 287). Studies investigating the development of spelling and phonological awareness skills in relation to reading have been conducted using concurrent and longitudinal correlational, and intervention training research designs.

Concurrent correlational studies. Burns and Richgels (1989) conducted a study to determine if explicit use of phonological knowledge is associated with early spelling development, and explored possible connections between early spelling and reading skill development. The researchers assessed the subjects in their study, four-year-olds with above average intelligence, on a variety of measures including an invented spelling test developed by one of the researchers, scored in relation to students' ability to represent the sounds in the words that were dictated to them. The students were also assessed to determine their knowledge of the alphabet, ability to segment syllables and phonemes, ability to associate sounds with letters, concepts about print, and ability to read environmental print, individual words, and short passages. The results of their study indicated that although all of the subjects in their study were capable of reciting the alphabet and recognizing letters, not all of them were capable of inventive spelling, suggesting that knowledge of the alphabet is a necessary but not sufficient prerequisite for spelling. The researchers did find a significant relationship between students' spelling ability and their knowledge of sound-symbol correspondence and ability to segment phonemes, although no relationship was found between

students' ability to spell and segment syllables. They also found that students who demonstrated some ability to spell, and students who were not yet inventive spellers, did not differ in their concepts about print, but did differ significantly on the word reading tasks. None of the students who were "non-spellers" were proficient word readers. However, many of the "spellers" were also not proficient at reading words, despite their ability to segment words and knowledge of letter-sound associations. These results lead the researchers to conclude that, consistent with Frith's theory, for these four-year-olds of above average intelligence, word reading seems to be a separate ability from word spelling at this early stage of literacy development.

Vandervelden and Siegel (1995) also investigated the relationship between phonological awareness, spelling and reading skill development in a group of students in kindergarten, and grades one and two. The researchers assessed the students' abilities using informal measures of their letter knowledge, speech-to-print matching, ability to read pseudowords, ability to learn words using paired association, and ability to spell words and pseudowords, scored on the basis of the number of phonemes correctly represented in the students' spelling. The students were also assessed using the word reading subtest of the Wide Range Achievement Test-Revised (WRAT-R), an informal sight vocabulary test and the Test of Written Spelling. Phonological awareness measures included the following tasks: initial phoneme recognition, final phoneme recognition, phoneme location, phoneme recognition/location identification, sequential segmentation, and deletion and substitution. Vandervelden and Siegel found strong relationships between basic forms of phonological awareness (e.g., initial phoneme recognition and partial segmentation) and early word-reading skill; however, these same phonological awareness tasks showed a weaker relationship with more advanced

word-reading and accuracy in spelling. Deletion and substitution tasks, more advanced measures of phonological awareness, were found to be more strongly related to advanced word-reading and spelling accuracy. The researchers also found that sequential segmentation was related to students' spelling ability and measures of their phonological recoding in reading, such as pseudoword reading and speech-to-print matching. This led them to suggest that students' use of phonological recoding in spelling facilitates the development of their sequential segmentation skills, which is strongly related to the students' ability to use phonological recoding in reading. Thus, these researchers also suggest that early spelling and reading skills appear to develop in a reciprocal manner, "with phonological recoding and phoneme awareness as sets of skills that develop gradually and reciprocally with learning to read and write" (p. 873). However, as these results are from a concurrent correlational study, all that can really be concluded is that a relationship exists among kindergarten, grade one and two students' early skill development in reading, spelling and phonological awareness.

Longitudinal correlational studies. Longitudinal studies have also been conducted by researchers to explore the relationship between students' skill development in phonological awareness, spelling and reading. Lundberg, Olofsson and Wall (1980) conducted a study in Swedish with kindergarten children, to whom they administered phonological awareness tasks, including measures of segmentation into syllables and phonemes, synthesis of syllables and phonemes, phoneme position, phoneme reversal and rhyme production. The researchers then measured the students' reading and spelling achievement, using word reading, spelling dictation and teacher ratings of students' reading, spelling and writing ability, language comprehension and production, through the primary grades. The researchers also controlled for differences

in cognitive ability by administering two non-linguistic decentration tests, thought to simulate the cognitive demands of the phonological awareness tasks, and Raven's Progressive Matrices. Their results suggested that students' achievement levels could be predicted by measures of phonological awareness given in kindergarten, but they found that two measures in particular seemed to be the best predictors of later achievement, in both basic spelling and reading skills. These measures were the segmentation of words into phonemes and the reversal of phonemes (i.e., pronouncing words completely backwards).

Stuart and Masterson (1992) conducted a longitudinal study with a group of students they first assessed as four-year-olds. The researchers administered six phonological awareness tasks, including measures that required them to produce and identify rhymes, supply the final syllable and phoneme of words, and identify and segment the initial phoneme. At age six, the students were administered the short form of the British Ability Scales, including subtests of digit recall, matrices, similarities and naming vocabulary. At age ten, the students completed formal tests of their single word reading and spelling, and informal tests of their single word reading and spelling of regular and irregular words, and pseudowords. With cognitive ability partialled out, the researchers found significant relationships between students' performance on the phonological awareness tasks, which they had completed at age four, and their performance six years later, at the age of ten, on measures of the students' reading and spelling.

MacDonald and Cornwall (1995) conducted a longitudinal study that investigated students' progress over an 11-year period. They found that phonological awareness, as measured by a task involving sound deletion administered when students were six years of age, was a significant predictor of the students' achievement in word identification and spelling skills both

concurrently and long-term, when both socio-economic status and vocabulary development, as measured by the Peabody Picture Vocabulary Test-Revised (PPVT-R), were controlled.

Longitudinal studies have also been conducted in order to compare students' literacy development in differing instructional environments. Griffith, Klesius and Kromrey (1992) compared the predictive ability of measures of phonemic awareness with regard to grade one students' end-of-the-year literacy achievement in traditional versus whole language classrooms. Students' end-of-the-year spelling performance was determined by having the students' complete two informal spelling tests, which assessed their sound-symbol correspondence of dictated words, and words in context, and the Test of Written Spelling. Students' reading was assessed by having them read pseudowords, and complete the comprehension subtest of the Comprehensive Test of Basic Skills (CTBS), and their writing fluency was assessed by counting the number of words that students wrote in writing samples. The researchers found that measures of segmentation, blending, deletion and substitution, administered to students at the beginning of the school year, predicted their end-of-the-year achievement in reading and spelling in both learning environments, with students who began the year with higher levels of phonemic awareness performing better than students with less phonemic awareness on all measures.

Taken together, the results of these longitudinal correlational studies indicate that a significant relationship exists between students' development of skills in spelling, reading and phonological awareness. That is, students' early competence in phonological awareness is a significant factor in predicting students' later development of competence in both reading and spelling. However, in order to establish a causal link between early

phonological awareness ability and later skill development in reading and spelling, it is necessary to review the results of intervention training studies.

Intervention training studies. Some research studies have been conducted to determine if providing kindergarten and first grade students with training in phonological awareness has a significant effect on their subsequent ability to read and spell words. One such study was conducted by Ball and Blachman (1991), who investigated the effects of training in phonemic segmentation and instruction in letter names and sounds on kindergarten children's reading and spelling skills. Prior to the intervention, the children were assessed using the PPVT-R, and the Word Identification subtest of the Woodcock Reading Mastery Test (WRMT). Students who were significantly below the mean on the PPVT-R, or who could read more than three words on the WRMT, were not included in the study. Students were also assessed, prior to treatment, with a phoneme segmentation test and a test of letter-name and letter-sound knowledge. Children were then grouped according to gender and PPVT-R scores into one of three groups, each taught by a different teacher: (a) a phonemic awareness training group, (b) a language activities group, or (c) a control group. During the seven-week-long intervention, the students in the phonemic awareness group practised segmentation activities and learned letter names and sounds. Students in the language activities group worked on vocabulary development activities and received the same letter-name and letter-sound training as the students in the phonemic awareness group. Students in the control group received no training.

At the end of the intervention, the students were assessed using tests of phoneme segmentation, knowledge of letter names and sounds, the Word Identification subtest of the WRMT, and informal tests of word recognition and

spelling, scored according to accuracy in phonetic representation. Although there were no differences among groups on the test of letter names, the students in both the language activities and the phonemic awareness group scored significantly better than the students in the control group on the test of letter-sound knowledge. In addition, the students in the phonemic awareness group scored significantly better than students in both of the other groups on the measures of phoneme segmentation, word identification and spelling. Ball and Blachman concluded that kindergarten students trained in phoneme segmentation, combined with instruction linking the phonemic segment to alphabet letters, develop a greater ability to break the alphabetic code, as demonstrated by significantly better performance on measures of word reading and spelling.

Ehri and Wilce (1987) investigated whether teaching kindergarten children to spell phonetically improves their word reading abilities. In this study, students were initially matched based on their performance on measures of letter name and sound knowledge, word reading, the PPVT, and nonword spelling, and then separated into training and control groups. Students in the training group were taught to spell words phonetically, using letter tiles. Coupled with the spelling instruction was modelling and practice in phonemic segmentation. Subjects in the control group were taught to match letters to isolated sounds. Following the five-week intervention, the students were tested using the pre-treatment measure of learning words through paired-association, and additional measures of students' ability to spell nonsense words, spelling recognition, and phonemic segmentation. The students in the training group performed significantly better than the students in the control group on all of these measures, leading Ehri and Wilce to conclude that training kindergarten students in letter-sound correspondence and

phonemic segmentation, practised through phonetic spelling, has a significant effect on the students' ability to learn to read words. However, given that three of the researchers' measures were only administered after the treatment, it is not possible to determine if the group differences on these measures were in fact due to the intervention.

In a related study, Uhry and Shepherd (1993) investigated the relationship between segmentation/spelling training and reading with grade one students. Prior to the intervention, students were assessed using the Slosson Intelligence Test, the Word Attack and Word Identification subtests from the WRMT, the Gray Oral Reading Tests, the Gates-MacGinitie Reading tests, the Spellmaster Diagnostic Tests, scored using bigraph counts, and measures of phonological awareness including Rosner's Test of Auditory Analysis Skills, the Block Segmentation Test, the Roswell-Chall Auditory Blending Test, and the Sound Blending subtest of the Illinois Test of Psycholinguistic Abilities. Before the treatment, students in the experimental and control groups did not differ prior significantly with respect to age or Slosson Intelligence Test scores.

During the six-month-long intervention, students in the experimental group practised reading, segmenting and spelling words using manipulatives and computer-based activities, while the students in the control group practised reading the same words as the control group, but did not receive instruction or practise segmenting and spelling them. At the end of the intervention, assessment results indicated the students in the experimental group performed significantly better than the students in the control group on all measures, except the measure of listening comprehension, on which there was no significant difference between groups. Given that group differences could not be accounted for by differences in age, intelligence or listening skills, Uhry

and Shepherd concluded that these results suggest that a causal relationship exists between segmenting/spelling training and beginning reading development.

In summary, results from concurrent and longitudinal correlational research studies indicate that a significant relationship exists among students' development of skills in phonological awareness, reading and spelling (Burns & Richgels, 1989; Griffith, Klesius & Kromrey, 1992; Lundberg, Olofsson & Wall, 1980; MacDonald & Cornwall, 1995; Stuart & Masterson, 1992; Vandervelden & Siegel, 1995). In addition, results from intervention training studies have indicated that training in phonological awareness has positive effects on students' later development of word recognition and spelling skills (Ball & Blachman, 1991; Ehri & Wilce, 1987; Uhry & Shepherd, 1993). Therefore, given this apparent reciprocal relationship between the development of students' skills in phonological awareness, spelling and reading (Ball, 1993; Ellis, 1994; Kirtley, Bryant, MacLean & Bradley, 1989; Perfetti, Beck, Bell & Hughes, 1987; Vandervelden & Siegel, 1995), researchers investigating the relationship between phonological awareness and spelling need to ensure that they control not only for cognitive and verbal abilities, such as vocabulary and verbal memory, but also for the possible effects of students' reading abilities.

Phonological Awareness and the Development of Competence in Spelling

Research that has been conducted to investigate the importance of phonological awareness in early literacy development has generally focussed on students' development of reading, or reading and spelling skills. Only a few researchers have focussed their investigations exclusively on the relationship between competence in spelling and phonological awareness.

Concurrent correlational studies. Liberman, Rubin, Duques and Carlisle (1985) did investigate the spelling ability of a group of kindergarten

children in relation to their ability on eight language-related tests, including measures of phonological awareness. Students in this study were given a dictated spelling test, which was scored according to their ability to represent the phonemes in the words either with phonetically-related or conventional letter(s). The students were also given language-related tests, assessing the students' ability to segment and delete phonemes, to write letters representing dictated phonemes, delete syllables, repeat words and name and write dictated letters. They also completed the PPVT and the Boston Naming Test. Liberman et al. found that of these tests, three explained significant proportions of the variance in students' spelling performance: the phoneme segmentation test (67%), students' ability to write letters representing dictated phonemes (20%), and the phoneme deletion task (6%). However, given that the researchers did not control for variables which may have effected the results, such as cognitive, verbal and reading ability, no definitive conclusions can be drawn from these results.

Griffith (1991) investigated the relationship between phonemic awareness and spelling, including the relationship between phonemic awareness and students' acquisition of conventional orthographic representations in spelling, which she refers to as "word-specific information." As part of her study, she assessed students in grades one and three using a dictated spelling test consisting of regular and irregular words, which was scored according to the number of consonant sounds the students correctly represented in their spellings. The students were also administered phonological awareness tasks, taken from the GKR Test of Phonemic Awareness, including tests of phonemic segmentation, blending, deletion of first or final phoneme, and substitution of first or final phoneme. In addition, students were given a test of their "word-specific information." For this measure, students had to choose which

of two phonetically equivalent spellings was the correct representation of a word.

Based on her analysis of the results, Griffith (1991) suggests that significant amounts of variance in spelling can be explained by the measures of phonemic awareness and word-specific information. However, she notes that this relationship is different for students in grade one and grade three, with phonemic awareness appearing as a more significant factor for grade one students, and word-specific information appearing as a more significant factor for students in grade three. Griffith noted that students with poorer phonological awareness skills tended to represent fewer consonant sounds in their spellings than children with greater skill in phonological awareness, and that overall, although the relationship was more significant for first grade than third grade children, students in each grade with greater skill in phonological awareness were better spellers than those with less skill. Griffith suggests that there are "three possible ways phonemic awareness affects spelling development. First, it enables beginners to segment a word into its constituent phonemes as they invent spellings. Additionally, it facilitates the acquisition of letter-sound representations that can later be used to generate spellings. Finally, during reading it aids in the storage of spellings for equivocal phonemes in specific words" (p. 218).

However, in this study as well, variables such as cognitive, verbal and reading ability, which may have influenced the results, were not taken into consideration. It is also unfortunate that, although a range of phonological awareness tasks were administered, the analysis of results did not appear to include an investigation into the relative significance of the various tasks. Therefore, although it appears from these studies that a significant relationship exists between students' development of phonological awareness

and spelling skills, the study designs do not make it possible to make such a conclusion based on these results.

Intervention training studies. Intervention training studies have also been conducted by a few researchers interested in investigating the relationship between phonological awareness and spelling. Tangel and Blachman (1992) conducted such a study with kindergarten children in order to determine if the invented spelling of children trained in phoneme awareness would differ from the invented spelling of children who did not have this training. Prior to the intervention, the students in this study were matched in terms of age, sex, race, and performance on measures of phoneme segmentation, letter name and sound knowledge, and performance on the PPVT-R and the Word Identification subtest of the Woodcock Reading Mastery Tests-Revised (WRMT-R). During the second half of the kindergarten year, treatment children were provided with 11 weeks of phoneme awareness training, including phoneme segmentation activities involving manipulatives, and instruction in letter names and letter sounds. Control children received instruction only in letter names and letter sounds. At the end of the training period, the researchers re-assessed the students using the measures previously mentioned, and this time adding an assessment of spelling ability, using a developmental spelling test specifically developed, scored taking both phonological and orthographic factors into consideration, and informal measures of students' ability to read phonetically regular words and nonwords.

Tangel and Blachman (1992) found that the children who had participated in the phoneme awareness intervention activities performed better than the control children on the measures of phoneme segmentation, knowledge of letter names and sounds, and some of the measures of beginning word recognition, and produced spellings that were rated superior to those of the control children.

In a follow-up study, Tangel and Blachman (1995) re-evaluated the same children during their grade one year, during which treatment children continued to receive phonological awareness instruction and instruction in grapheme-phoneme correspondence as part of their reading program. The researchers found that the treatment children continued to produce developmentally superior spellings compared to students who had not received the phonological awareness training. These results lead them to conclude that instruction in phoneme awareness, which incorporates instruction in letter sounds, and the alphabetic code, increases students' awareness of the internal structure of words, which results in students producing significantly better spelling than students who do not receive similar training. However, it should be noted that in this study students' spelling ability was not assessed prior to the intervention, therefore, it is possible that some of the differences in spelling ability are not the result of the training in phoneme awareness given to students in the treatment group.

Castle, Riach and Nicholson (1994) also investigated the effects of training in phonological awareness on kindergarten students' early spelling development. In their study, they controlled for the effect of intelligence by administering the PPVT-R, and students were matched, before being assigned to control and experimental groups, based on their performance on measures of phonemic awareness, including segmentation, blending, deletion of initial and final phoneme, and substitution of initial and final phoneme tasks. Students also completed the Spelling subtest of the Wide Range Achievement Test (WRAT), Clay's (1985) dictation, word writing and letter identification subtests, and an informal spelling dictation test consisting of regular, irregular and pseudowords, scored according to the number of phonemes students were able to represent correctly. During the 10-week intervention, students in the

experimental group received training in phonological awareness, including phoneme segmentation, substitution, deletion and rhyme, and they also received instruction in sound-letter associations. Students in the control group participated in process writing activities.

After the intervention, the students were re-assessed and results indicated that the students in the experimental group scored significantly better on both the WRAT and informal spelling dictation test. The researchers believed that the students in the experimental group did not perform significantly better than the students in the control group on Clay's dictation and word writing measures due to ceiling effects. They concluded that their findings support the hypothesis that phonemic awareness is both causally related to and facilitates early spelling acquisition, by fostering students' development and use of phoneme-grapheme correspondence rules. However, these researchers did not analyze students' spelling in relation to the students' use of both phonological and orthographic strategies, and did not analyze the relationship between the between students' performance on the various phonological awareness tasks and their spelling development. Therefore, it remains unclear how students' spelling development relates to their development of specific types of phonological awareness.

In summary, results from concurrent correlational research studies, which have investigated the relationship between phonological awareness and spelling ability, suggest that a significant relationship exists between students' level of phonological awareness and their spelling competence (Griffith, 1991; Liberman, Rubin, Duques & Carlisle, 1985). In addition, the results from intervention training studies appear to indicate that students have been able to improve their competence in spelling through phonological awareness training, suggesting a causal relationship between phonemic

awareness and early spelling acquisition (Castle, Riach & Nicholson, 1994; Tangel & Blachman, 1992, 1995). However, it is important to note that the results from the concurrent correlational studies need to be treated with caution, as the researchers did not control for additional variables such as vocabulary, verbal memory and reading ability, which may have affected the results. It is also significant that few studies have analyzed students' spelling in terms of their use of phonological and orthographic strategies, and researchers have also not analyzed the relationship between different types of phonological awareness and students' development of early competence in spelling.

Summary: Theoretical Background to the Measurement of Phonological Awareness

In summary, a range of tasks have been used in research studies to measure phonological awareness. These tasks appear to tap different abilities, some of which are present before students begin formal literacy instruction, and some of which develop in a reciprocal manner, as students gain increased competence in reading and spelling (Juel, 1988). Research has indicated that phonological awareness tasks can span a range, from tasks conceived to be relatively simple to those that are more complex, varying both in terms of cognitive and linguistic complexity (Adams, 1990; Ball, 1993; Cole & Mengler, 1994; McBride-Chang, 1995; Schreuder & von Bon, 1989; Treiman, 1985; Yopp, 1988). It is therefore apparent that researchers should use carefully controlled or standardized phonological awareness tasks in their studies. In addition, research indicates that other factors, such as cognitive and verbal ability, including vocabulary and verbal memory, may also have an effect on students' performance and should also be controlled (Bradley & Bryant, 1985; Goswami & Bryant, 1990).

Some research has already been conducted to investigate the relationship

between phonological awareness and students' early spelling development. The results from these studies indicate that phonological awareness training provided in kindergarten and grade one, particularly training which includes instruction in letter-sound correspondences, has a positive effect on students' spelling achievement (Ball & Blachman, 1991; Castle, Riach & Nicholson, 1994; Ehri & Wilce, 1987; Tangel & Blachman, 1992, 1995; Uhry & Shepherd, 1993), supporting the hypothesis that there is a causal relationship between phonological awareness and spelling competence. In addition, the results of several other studies, that have investigated the importance of phonological awareness and students' overall early literacy development, suggest that phonological awareness ability is related to students' later success in both reading and spelling (Burns & Richgels, 1989; Griffith, Klesius & Kromrey, 1992; Lundberg, Olofsson & Wall, 1980; MacDonald & Cornwall, 1995; Stuart & Masterson, 1992; Vandervelden & Siegel, 1995). Given this apparent reciprocal relationship, between students' development of phonological awareness skills, their reading and their spelling, it appears that researchers should also control for students' reading ability when designing studies to investigate the specific relationship between phonological awareness and early spelling development.

Statement of Purpose

For the present study, research in the areas of developmental spelling and phonological awareness was merged for the purpose of investigating interrelationships in students' early development of competence in these two areas more closely. For example, given that researchers believe that beginning spellers construct spellings in a methodical though unconventional way, using their developing knowledge of standard spelling, and their

knowledge of the phonetic features of the language, letter names and letter sounds (Burns & Richgels, 1989; Read, 1986; Tangel & Blachman, 1995), one of the questions investigated in this study, in an attempt to validate the theoretical model, was: how much of the variance in apparent spelling ability can be accounted for by students' knowledge of letter sounds and letter names, knowledge of the orthographic structure of English words, and phonological awareness?

In addition, although it is now recognized that students develop different types of phonological awareness as they improve their literacy skills, and some research has studied the significance of phonological awareness and spelling competence, little attention has been paid to the specific types of phonological awareness skills students typically possess during their early spelling development. Of interest then are the kinds of phonological awareness skills that one could expect students who demonstrate varying degrees of spelling competence through their early developmental spelling to possess. In particular, how is young students' development of spelling competence related to their development of different kinds of phonological awareness skills?

Research questions

1) Given that researchers believe that beginning spellers construct spellings in a methodical though unconventional way, using their developing knowledge of standard spelling, and their knowledge of the phonetic features of the language, letter names and letter sounds (Burns & Richgels, 1989; Read, 1986; Tangel & Blachman, 1995), how much of the variance in apparent spelling competence can be explained by students' knowledge about the orthographic structure of English words, overall phonological awareness, and knowledge of

letter names and letter sounds?

2) Based on previous research, it was hypothesized that students with greater spelling competence would also demonstrate greater overall phonological awareness. However, previous research also suggests the need to control for related variables. Would a significant relationship be found between students' overall phonological awareness and their spelling ability with cognitive and verbal ability, such as vocabulary and verbal memory, and word recognition ability held constant?

In addition, several questions were explored during the course of this investigation:

3a.) Research studies conducted to date have involved the use of different numbers and kinds of phonological awareness tasks, with several only using one measure. While the majority of the analyses to be conducted in this study involve the use of an overall phonological awareness score, students' performance on specific phonological awareness tasks, in relation to their spelling ability, is also of interest. What is the relationship between students' spelling ability and their performance on specific measures of phonological awareness?

3b.) Research has indicated that beginning spellers may use both phonological and orthographic spelling strategies, and that phonological awareness skills increase as students develop their literacy skills, such as spelling. Therefore, students with more advanced spelling skills may also be expected to be more advanced in their use of the different spelling strategies typically demonstrated by beginning spellers (i.e., phonological and orthographic), and in their phonological awareness. Do students who

demonstrate greater use of both phonological and orthographic spelling strategies also demonstrate greater ability with more advanced phonological awareness tasks, such as the ability to delete and substitute phonemes?

3c.) Several researchers have proposed that research should concentrate on studying both the range and relative use of spelling strategies by students as they gain overall competence in spelling. In addition, as previously noted, previous research has also suggested the need to control for related variables. Of interest then is: With vocabulary, verbal memory, and word recognition ability held constant, does students' overall performance on phonological awareness tasks account relatively better for their use of phonological or orthographic strategies when spelling?

4.) Previous research suggests that in general, over time, students develop more advanced phonological awareness skills. In addition, students' spellings develop from being less to more complete representations of words. However, the interrelationships between these abilities are less clear. For example:

- a.) Do students who demonstrate the ability to segment the initial phonemes of words, also demonstrate the ability to accurately represent at least the initial phonemes of words in their spelling?
- b.) Do students who demonstrate the ability to segment all of the phonemes in words, also demonstrate the ability to accurately represent all the phonemes in words they spell?

Significance of the Study

I argue that in order to fully appreciate the interrelationship of phonological awareness and spelling development, research must specifically investigate the kinds of phonological awareness skills demonstrated by

students at early points in their spelling development. Such an investigation may help to clarify the reciprocal nature of skill development in both areas. In addition, the delineation of such relationships may be of benefit to individuals performing assessments, as an analysis of young students' developmental spelling may also be able to serve as an indirect measure of students' phonological awareness skill development.

Chapter 2

MethodParticipants

As this research project focused on students at the beginning stages of spelling competence, participants included students enrolled in kindergarten and grade one (see Table 2.1). Participants were recruited from two

TABLE 2.1
Age and Instructional Environment by Grade

Group	N	Mean age	<u>Instructional Environment</u>	
			single-grade	split
	(M,F)	in months	N (%)	N (%)
		(Range)		
Kindergarten	49	69	39 (80%)	10 (20%)
Students	(25,24)	(65-75)		
Grade One	32	83	12 (37%)	20 (63%)
Students	(18,14)	(74-87)		
Total	81	75	51 (63%)	30 (37%)
Population	(43,38)	(65-87)		

elementary schools, one a public school in a rural community approximately 25 miles outside of Vancouver, and the other a private Catholic school within the city of Vancouver, both serving lower-middle to middle class neighborhoods. Although the participants were enrolled in programs characterized by their teachers as being more traditional (i.e., skills-based), or whole language (i.e., skills taught in context), all of the programs included instruction in letters and letter sounds, and encouraged students to use "invented spelling" when writing. Participants were enrolled in a range of instructional environments including single-grade (i.e., kindergarten or grade one), and split or mixed-grade classes (i.e., a mixture of kindergarten and grade one, or grade one and grade two students, or kindergarten, grade one and grade two students). Only students who could speak English and did not have identified disabilities were included in the sample.

Procedure, Materials and Measures

Students who received parent permission and who themselves agreed to participate in the study were involved in a single 45-60 minute individual testing session (or two 30 minute sessions). These sessions were held during May and June in a quiet room at their respective schools, at a time coordinated with the classroom teacher in order to minimize children's absence from critical class lessons. All participants completed the same assessments in the same order, and their results were merged to form one group representing a range of spelling competence.

1) Control measures: Three standardized tests were used as control measures, each of which have demonstrated good reliability and validity and are frequently used with this population.

a. Students' "vocabulary" was assessed using the Peabody Picture Vocabulary Test-Revised (PPVT-R) (Dunn & Dunn, 1981). Students were required to indicate which one of four pictures represented a word that was spoken to them. Students' raw scores (i.e., the total number correct) were used for data analysis.

b. "Verbal memory" was assessed using the Sentence Imitation subtest of the Test of Language Development, Primary 2 (TOLD-2P) (Hammill & Newcomer, 1991). Students were required to repeat back verbatim up to 30 sentences of increasing length and complexity. Students' raw scores (i.e., the total number of correctly repeated sentences) were used for data analysis.

c. Students' "word recognition ability" was assessed using the Word Identification and Word Attack subtests of the Woodcock Reading Mastery Test-Revised (WRMT-R) (Woodcock, 1987), which require students to read real and nonwords presented in isolation. Students' raw scores (i.e., the total number of correctly identified words and nonwords) were used for data analysis.

2) Spelling measures: Spelling was assessed using two different standardized measures of spelling competence, so that students' ability to spell both words and nonwords could be evaluated. As these tests are designed for or typically used with students aged 6-0 and above, some modifications to the typical individual test administration procedures outlined in the test manuals were made. Prior to dictation, the students received the following instructions: "I am going to ask you to write some words. You may not be exactly sure how to spell some of them, but that's okay. I just want you to do your best and write the letters that you think are in each of the words." For the TWS-3, spelling words up to approximately a mid-grade-two to grade three level were dictated to all students (i.e., 15 predictable words and 15 unpredictable

words). The first 15 items of the Spelling of Sounds subtest, up to approximately an early grade two level, were also dictated to each of the students. However, so as not to overly frustrate students, dictation was stopped if a student failed to produce a written response to three spelling words in a row. In addition, spellings that included a mixture of uppercase and lowercase letters, and unambiguous letter reversals were not scored as errors.

a. "Spelling competence" was assessed in part using the Test of Written Spelling, Third Edition (TWS-3) (Larsen & Hammill, 1994), a standardized test of spelling dictation. This test includes real words that are considered to be "predictable" and "unpredictable" in their spelling, and should therefore elicit students' use of both phonological and orthographic spelling strategies. This is significant because researchers have proposed that studies of students' spelling competence should include an analysis of their relative use of such spelling strategies. Therefore, in addition to raw scores (i.e., the total number of correctly spelled words), students' spelling was analyzed and rated in terms of the phonological and visual/orthographic similarity of their spelling to the target words:

1. Based on the unconstrained phonological similarity scoring system designed by Bruck and Waters (1988), the phonological similarity of students' spelling was judged by considering if their spellings sounded like the target words through the application of grapheme-phoneme conversion rules. Students' phonological similarity scores were determined by considering the maximum number of phonemes that were represented accurately phonologically in the correct order in relation to the total number of phonemes in the words. For example, the spelling "hm" for "him" would receive a score of 2/3 or .67, because two

of the three phonemes are represented accurately phonologically.

Phonological accuracy was evaluated using the possible spellings for the various phonemes as outlined by Phenix (1996) and Powell and Hornsby (1993). Students' mean phonological similarity score was used for analysis procedures.

Additional scoring guidelines:

- extra letters which created consonant or vowel digraphs, diphthongs, or double or silent letter combinations were scored as such (e.g., "seop" for "stop", assess "s", "eo" and "p")
- for words with short vowel sounds: final "e"s were scored in relation to the vowel preceding in "v+c+e" spelling patterns (e.g., "sope" for "stop" would receive a score of 2/4)
- one point was taken off the phonological similarity score for spellings which represented all phonemes accurately, but included additional unnecessary letters (e.g., "spering" for "spring" would receive a score of 4/5) and classified as a "minus" error (see below)
- the phonological similarity of vowels was assessed in the order in which they were written (e.g., for "siage", assess "ia" before "a-e")
- any attempted spellings which contained twice as many phonemes, or more, as the target word, were automatically given no score and classified as "other"

2. Visual/orthographic similarity was evaluated using the visual similarity scoring system designed by Bruck and Waters (1988). This scoring system considers the percentage of bigrams (letter pairs) and letters that students' spelling and target words have in common. For example, the word "him" has two bigrams ("hi" and "im") and three letters, for a total of five. The spelling "hm" has no bigrams and two

letters that match the target word, for a total of two. Therefore, the accuracy score for "hm" is 2/5 or .40. The mean visual similarity score was used for analysis procedures.

Additional scoring guidelines:

- one point was taken off the visual similarity score for spellings which contained all the correct letters in sequence, but also contained extra letters at the beginning or end of the word (e.g., "use" for "us") and classified as a "minus" error (see below)
- unnecessary punctuation marks were scored as if they were letters (e.g., "my-self" would receive a score of 10/11)
- any attempted spellings which contained twice as many phonemes, or more, as the target word, were automatically given no score and classified as "other"

3. Based on a classification system developed by Chiappe and Siegel (1997), students' spellings were also analyzed and classified as being "correct", or "phonetically possible", "minus", "initial", "other" and "no response" errors. These classifications were used in analyses investigating apparent general developmental trends in students' spelling abilities. Although these classifications do not necessarily represent an ordinal scale of decreasing spelling skills, they are ordered with respect to the degree of initial and additional phonemes that students represent in their spellings. "Phonetically possible" spellings are defined as responses which represent possible phonetic spellings of words (e.g., "cat" spelled "kat"). "Minus" errors are defined as spellings which are partially phonologically accurate, and contain the initial and some (i.e., more than one) but not all of the letters necessary to represent the phonemes in a word in the correct

order (e.g., "cat" spelled "kt"), or more than all of the letters necessary to represent the phonemes in a word in the correct order (e.g., "cat" spelled "katg"). "Initial" errors are responses that only represent the initial phoneme accurately with the first letter written (e.g., "cat" spelled "k"). "Other" errors are spellings that could not be classified into any of the other categories, and "no responses" are defined as non-responses. The modal (most frequent) classification was used for analysis procedures for the TWS-3, and Spelling of Sounds. In some cases ($n = 19$ out of 324) where bi-modal classification frequencies were obtained, the higher classification was used.

Additional scoring guidelines:

- spellings which contained all the correct letters or phonemes in sequence, but also contained extra letters were classified as "minus" errors
- any attempted spellings which contained twice as many phonemes, or more, as the target word, were automatically given no score and classified as "other"

b. Students' "spelling competence" was further assessed by investigating their ability to spell nonwords, a process thought to elicit students' use of phonological spelling strategies. This was measured using the Spelling of Sounds dictation spelling subtest of the Goldman-Fristoe-Woodcock Auditory Skills Test Battery (Goldman, Fristoe, & Woodcock, 1974). On this subtest, students were asked to spell nonwords two to five phonemes in length, such as "ag" and "unfip". Raw scores based on standard test procedures were used in test interpretation, as the norms do not extend down to the kindergarten level. Students' spellings were also classified (e.g., "correct", "phonetically possible", "minus", "initial", "other", and "no response") as

previously described for the TWS-3.

Inter-rater reliability was established for the phonological similarity, visual similarity, and classification scoring systems by having a second rater assess 25% of the sample of students' spellings and computing percent agreement. Although the sample evaluated by the second rater was randomly chosen, it was also representative of the various ages and school populations. As noted in Table 2.2, a high degree of inter-rater reliability was established for each scoring system for the TWS-3 and Spelling of Sounds.

TABLE 2.2
Inter-rater Reliability Estimates

Measure	Phonological Similarity	Visual Similarity	Classification
TWS-3	97%	93%	93.5%
Spelling of Sounds	--	--	98%

3) Phonological awareness measure:

a. "Phonological awareness" was measured using the phoneme level segmentation, initial, medial, final, deletion, substitution and blending subtests of The Phonological Awareness Test (Robertson & Salter, 1997) using the procedures outlined in the test manual. This assessment was recently developed, standardized and normed for use with students aged five to nine, and it includes a range of phonological awareness tasks which previous research suggests may be good predictors of spelling ability. Examiner

discretion regarding whether to complete a subtest was based on a student's apparent inability to complete a task (e.g., three consecutive nonresponses) as outlined in the manual.

Students' overall raw scores, their total score on each of the seven phonological awareness tasks (i.e., segmentation, initial, medial, final, deletion, substitution and blending), were used for most of the data analysis procedures, to represent students' phonological awareness abilities. In addition, students' raw scores on each of the phonological awareness tasks were also calculated and used for some additional data analyses which focussed on students' abilities on particular tasks. Each of the tasks consisted of 10 items, for a possible total score of 70, with higher scores representing greater overall phonological awareness.

The seven tasks were consistently presented in the following order:

1. segmentation (e.g., tell me each sound in "on")
2. initial (e.g., what's the beginning sound in the word "bit"?)
3. final (e.g., what's the ending sound in the word "big"?)
4. medial (e.g., what's the middle sound in the word "cap"?)
5. deletion (e.g., say "man", say it again, but don't say /m/)
6. substitution (e.g., say "how", change /h/ to /k/)
7. blending (e.g., what word is this? /f-i-t/)

4) Measures of additional requisite skills: These measures were used in analyses designed to assess the validity of the theoretical model which suggests that, in addition to phonological awareness, beginning spellers construct spellings using their knowledge of letter names and letter sounds, and their developing knowledge of standard spelling (i.e., the orthographic structure of English words).

a. Students' "knowledge of letter names" was assessed using the Letter Identification subtest of the Woodcock Reading Mastery Test - Revised (WRMT-R) (Woodcock, 1987), which requires students to identify 51 uppercase and lowercase letters that are printed and written in a range of fonts. The subtest was administered following the procedures outlined in the test manual. Students' raw scores (i.e., the total number of correctly identified letters) were used for data analysis.

b. Students' "knowledge of letter sounds" was assessed using the Graphemes subtest of The Phonological Awareness Test (Robertson & Salter, 1997), an assessment recently developed, standardized and normed for use with students aged five to nine. Students were shown 20 consonants (e.g., b, c, d), 10 vowels (e.g., a, e, i), 10 consonant blends (e.g., bl, gr), 4 consonant digraphs (e.g., sh, th), 5 r-controlled vowels (e.g., ar, er), 5 vowel digraphs (e.g., ee, oe) and 4 diphthongs (e.g., ou, oi) in isolation and asked to tell what sound each letter or group of letters makes. Alternate sounds for letters were accepted, and examiner discretion regarding whether to complete a subtest was based on a student's apparent inability to complete a task (e.g., three consecutive nonresponses), as outlined in the manual. Students' raw scores (i.e., the total number of correct items on all tasks) were used for data analysis.

c. "Knowledge about the orthographic structure of English words" was assessed using Treiman's Orthographic Constraints Test (1993), which was developed by Treiman to assess students' developing knowledge about the orthographic structure of English words. This measure was administered following the directions outlined by Treiman. Students were shown 16 pairs of nonwords (e.g., "moil"/"moyl", "gri"/"gry", "ffeb"/"beff", "yinn"/"yikk", "ckun"/"nuck", "vadd"/"vaad", "awt"/"aut", "ib"/"yb", "dalled"/"ddaled",

"vayying"/"vadding", "dacker"/"ckader", "muun"/"munt", "bei"/"bey", "chim"/"chym", "iit"/"ist", "daw"/"dau") in a consistent order and asked to indicate which word in each pair "looked more like it could be a real word", in that it conforms to the orthographic patterns of English. Students' raw scores (i.e., the total number of correctly identified nonwords) were used for data analysis.

All participants completed the same assessments in the same order:

1. vocabulary: PPVT-R
2. spelling competence (real words): TWS-3
3. spelling competence (nonwords): Spelling of Sounds
4. knowledge of letter names: Letter Identification (WRMT-R)
5. word recognition ability:
 - a. Word Identification (WRMT-R)
 - b. Word Attack (WRMT-R)
6. phonological awareness: Segmentation, Initial, Medial, Final, Deletion, Substitution and Blending (The Phonological Awareness Test)
7. knowledge of letter sounds: Graphemes (The Phonological Awareness Test)
8. knowledge about the orthographic structure of English words: Treiman's Orthographic Constraints Test
9. verbal memory: Sentence Imitation (TOLD-2P)

Chapter 3

Results

Initially, preliminary analyses were conducted to determine the means and standard deviations achieved by the students on each of the measures. Table 3.1 displays the means and standard deviations for each of the spelling variables used in analyses. The means and standard deviations for the requisite skills (knowledge of letter names, knowledge of letter sounds, knowledge about the orthographic structure of English words), including phonological awareness, and the control variables (vocabulary, word recognition ability [word identification and word attack] and verbal memory are displayed in Table 3.2, and the means and standard deviations for each of the phonological awareness tasks are displayed in Table 3.3.

TABLE 3.1
Means and Standard Deviations of Spelling Variables

<u>Variable</u>	<u>Mean</u>	<u>Standard Deviation</u>
	(N = 81)	
TWS-3	4.28	5.39
TWS-3 Phonological Similarity	.52	.31
TWS-3 Visual Similarity	.34	.26
Spelling of Sounds	3.85	4.95

TABLE 3.2

Means and Standard Deviations of Requisite and Control Variables

Variable	Mean	Standard Deviation
(N = 81)		
Phonological Awareness	24.27	17.68
Letter Names	31.32	6.83
Letter Sounds	23.79	13.40
Orthographic Structure	8.57	2.56
Vocabulary	71.21	16.66
Word Identification	16.22	16.98
Word Attack	4.80	7.67
Verbal Memory	13.20	6.21

TABLE 3.3

Means and Standard Deviations of the Phonological Awareness Tasks

Variable	Mean	Standard Deviation
(N = 81)		
Segmentation	2.31	2.46
Initial	7.26	3.27
Medial	2.60	3.13
Final	3.69	4.09
Deletion	3.05	3.13
Substitution	1.35	1.70
Blending	3.99	3.19

Additional preliminary analyses were conducted to determine the intercorrelations among the variables. All correlations reported are one-tailed and are based on the entire sample of students ($N = 81$). Intercorrelations among the spelling measures are displayed in Table 3.4. Although these measures may appear redundant, given the high intercorrelations, they are conceptually distinct and therefore considered independently in subsequent analyses.

TABLE 3.4
Intercorrelations Among Spelling Variables

Variable	1	2	3	4
($N = 81$)				
1. TWS-3	--	.82*	.93*	.90*
2. TWS-3 Phonological Similarity		--	.97*	.82*
3. TWS-3 Visual Similarity			--	.89*
4. Spelling of Sounds				--

* $p < .001$

Table 3.5 displays the intercorrelations among the requisite skills, including phonological awareness, and the control variables, and Table 3.6 displays the intercorrelations among each of the phonological awareness tasks. As the relationships between most of these variables indicate moderate, but not complete overlap, the relative contribution of each variable was considered in subsequent analyses.

TABLE 3.5

Intercorrelations Among Requisite and Control Variables

Variable	1	2	3	4	5	6	7	8
(N = 81)								
1. Phonological Awareness	--	.69**	.90**	.34**	.51**	.77**	.73**	.53**
2. Letter Names		--	.78**	.35**	.27**	.66**	.52**	.40**
3. Letter Sounds			--	.37**	.45**	.82**	.74**	.46**
4. Orthographic Structure				--	.35**	.59**	.50**	.21*
5. Vocabulary					--	.49**	.38**	.54**
6. Word Identification						--	.83**	.37**
7. Word Attack							--	.39**
8. Verbal Memory								--

* $p < .05$; ** $p < .001$

TABLE 3.6

Intercorrelations Among Phonological Awareness Task Variables

Variable	1	2	3	4	5	6	7
(N = 81)							
1. Segmentation	--	.57*	.72*	.63*	.76*	.61*	.77*
2. Initial		--	.48*	.52*	.54*	.43*	.60*
3. Medial			--	.86*	.79*	.68*	.68*
4. Final				--	.79*	.64*	.64*
5. Deletion					--	.67*	.73*
6. Substitution						--	.66*
7. Blending							--

* $p < .001$

Subsequently, a series of regression analyses were used to further investigate the contribution of various requisite and control variables to spelling competence. Hierarchical multiple regression analyses were used to determine the amount of variance which could be accounted for by a group of variables, and to determine the amount of variance which could be accounted for by a variable, above and beyond that accounted for by other factors. Unless otherwise specified, all analyses were conducted using the entire sample ($N = 81$), and all of the Pearson Product-Moment one-tailed correlations reported in the text are significant ($p < .001$).

Researchers have outlined a theoretical model which suggests that beginning spellers use a number of different skills when they spell words, including their: a) phonological awareness, b) knowledge about the orthographic structure of English words, c) knowledge of letter sounds, and d) knowledge of letter names (Burns & Richgels, 1989; Read, 1986; Tangel & Blachman, 1995). In order to assess the validity of this model, analyses were conducted to examine the associations between these various skills and spelling competence. Specifically, Pearson Product-Moment correlations were conducted to examine the relationship between overall spelling competence (as measured by students' total scores on the TWS-3 and Spelling of Sounds) and each of these four hypothesized requisite skills: overall phonological awareness (as measured by The Phonological Awareness Test), knowledge about the orthographic structure of English words (as measured by Treiman's Orthographic Constraints Test), knowledge of letter sounds (as measured by the Graphemes subtest of The Phonological Awareness Test), and knowledge of letter names (as measured by the Letter Identification subtest of the WRMT-R). Students' spelling competence, as measured by the TWS-3, was significantly and positively related to all four of these requisite skills. Strong positive

relationships were found between students' performance on the TWS-3 and their overall phonological awareness (.83), knowledge of orthographic structure (.48), knowledge of letter sounds (.82), and knowledge of letter names (.58).

Of interest then was the amount of the variance in apparent spelling competence that could be accounted for through assessments of these four variables. To this end, a hierarchical multiple regression analysis was conducted. Each of the variables outlined in the theoretical model (phonological awareness, knowledge of orthographic structure, knowledge of letter names, knowledge of letter sounds) was available for entry from the outset, and was entered according to the default stepwise criteria ($p \leq .05$ for entry and $p \leq .10$ for removal). As noted in Tables 3.7 and 3.8, the results of the hierarchical multiple regression indicated that, for this sample, phonological awareness, knowledge of orthographic structure, knowledge of letter sounds, and knowledge of letter names, together accounted for 77% of the variability in students' TWS-3 scores, $F(4,76) = 61.76$, $p < .001$.

TABLE 3.7

Summary of Requisite Variable Hierarchical Regressions on TWS-3

Step	Variable(s) Entered	R ²	R ² Change	Adjusted R ²	df	F Value
1	Phonological Awareness	.69	.69***	.68	1,79	174.02***
2	Orthographic Structure	.73	.05**	.73	2,78	106.81***
3	Letter Sounds	.75	.02*	.74	3,77	77.61***
4	Letter Names	.77	.01*	.75	4,76	61.76***

* $p < .05$; ** $p < .01$; *** $p < .001$

TABLE 3.8
Results of Requisite Variable Hierarchical Regressions on TWS-3

Predictor variable	B	b	SE _b
Step 1			
Phonological Awareness	.83	.25	.02***
Step 2			
Phonological Awareness	.75	.23	.02***
Orthographic Structure	.23	.47	.13**
Step 3			
Phonological Awareness	.47	.14	.04**
Orthographic Structure	.20	.43	.13**
Letter Sounds	.32	.13	.05*
Step 4			
Phonological Awareness	.46	.14	.04**
Orthographic Structure	.22	.46	.13**
Letter Sounds	.48	.19	.06*
Letter Names	-.19	-.15	.07*

* $p < .05$; ** $p < .01$; *** $p < .001$

A similar analysis was then conducted using Spelling of Sounds as the measure of spelling competence. Students' scores on Spelling of Sounds were also found to be significantly and positively related to all four variables. Strong positive relationships were found between students' performance on Spelling of Sounds and their overall phonological awareness (.85), knowledge

of orthographic structure (.41), knowledge of letter sounds (.80), and knowledge of letter names (.55).

In order to determine the amount of the variance in apparent spelling competence that could be accounted for through assessments of these four variables, a hierarchical multiple regression analysis was conducted. Each of the variables outlined in the theoretical model (phonological awareness, knowledge of orthographic structure, knowledge of letter sounds, knowledge of letter names) was available for entry from the outset, and was entered according to the default stepwise criteria ($p \leq .05$ for entry and $p \leq .10$ for removal). Then, any remaining requisite variable(s) which did not meet this criteria were entered. The results of the analysis indicated that altogether these four variables accounted for a total of 75% of the variability in students' Spelling of Sounds scores, $F(4,76) = 56.92$, $p < .001$ (see Tables 3.9 and 3.10).

TABLE 3.9

Summary of Requisite Variable Hierarchical Regressions on Spelling of Sounds

Step	Variable(s) Entered	R ²	R ² Change	Adjusted R ²	df	F Value
1	Phonological Awareness	.72	.72***	.71	1,79	198.02***
2	Orthographic Structure	.73	.02*	.73	2,78	106.75***
3	Letter Sounds	.74	.00	.73	3,77	71.54***
4	Letter Names	.75	.01*	.74	4,76	56.92***

* $p < .05$; ** $p < .01$; *** $p < .001$

TABLE 3.10

**Results of Requisite Variable Hierarchical Regressions on Spelling
of Sounds**

Predictor variable	B	b	SE _b
Step 1			
Phonological Awareness	.85	.24	.02***
Step 2			
Phonological Awareness	.80	.22	.02***
Orthographic Structure	.14	.27	.12*
Step 3			
Phonological Awareness	.68	.19	.04***
Orthographic Structure	.13	.26	.12*
Letter Sounds	.14	.05	.05
Step 4			
Phonological Awareness	.66	.19	.04***
Orthographic Structure	.15	.28	.12*
Letter Sounds	.30	.11	.06
Letter Names	-.19	-.14	.07*

* $p < .05$; ** $p < .01$; *** $p < .001$

Previous research has indicated that a significant relationship exists between beginning spellers' spelling competence and their phonological awareness. Consistent with these findings, Pearson Product-Moment

correlations previously reported in this study also indicate that a significant relationship exists between beginning spellers' spelling competence and their phonological awareness. However, a second major question not adequately addressed in the literature is whether the substantial association between spelling and phonological awareness would remain if related variables were controlled.

For example, various researchers and research studies have suggested the need to control for students' performance on measures of vocabulary, verbal memory, and word recognition ability, when conducting research involving phonological awareness. To address this question, hierarchical multiple regression analyses were conducted to determine if significant relationships would be found between students' phonological awareness and their spelling ability, as measured by their overall scores on the TWS-3 and Spelling of Sounds, with their performance on measures of vocabulary (as measured by the PPVT-R), verbal memory (as measured by the Sentence Imitation subtest of the TOLD-2P), and word recognition ability (as measured by the Word Identification and the Word Attack subtest of the WRMT-R) held constant. As previously reported, positive and significant relationships existed between both of the measures of spelling competence and phonological awareness, and phonological awareness and each of the control variables. Significant relationships were also found between students' scores on the TWS-3 and their word identification (.84), word attack (.85), vocabulary (.50) and verbal memory (.46) skills, and between students' scores on Spelling of Sounds and their word identification (.73), word attack (.86), vocabulary (.43), and verbal memory (.46) skills.

A hierarchical multiple regression analysis was then conducted to determine if a significant relationship would be found between students' phonological awareness and their TWS-3 spelling ability, above and beyond that

accounted for by their vocabulary, verbal memory, and word recognition ability. Each of the control variables (vocabulary, verbal memory, word recognition [word identification and word attack]) was available for entry from the outset, and was entered according to the default stepwise criteria ($p \leq .05$ for entry and $p \leq .10$ for removal). Then, any remaining control variable(s) which did not meet this criteria were entered. Phonological awareness was entered last. The results of the hierarchical multiple regression (see Tables 3.11 and 3.12) indicated that phonological awareness was a significant predictor of students' spelling competence, as measured by the TWS-3, above and beyond students' vocabulary, verbal memory, and word recognition ability. Altogether 84% of the variability in students' scores on the TWS-3, $F(5,75) = 76.71$, $p < .001$, was accounted for by these variables. Phonological awareness accounted for an additional 3.41% of the variability in students' scores on the TWS-3 above and beyond that explained by the other variables.

TABLE 3.11
Summary of Hierarchical Regressions on TWS-3

Step	Variable(s) Entered	R ²	R ² Change	Adjusted R ²	df	F Value
1	Word Attack	.73	.73***	.72	1,79	209.97***
2	Word Identification	.79	.06***	.78	2,78	142.19***
3	Verbal Memory	.80	.01*	.79	3,77	101.42***
4	Vocabulary	.80	.00	.79	4,76	77.14***
5	Phonological Awareness	.84	.03***	.83	5,75	76.71***

* $p < .05$; ** $p < .01$; *** $p < .001$

TABLE 3.12
Results of Hierarchical Regressions on TWS-3

Predictor variable	B	b	SE _b
Step 1			
Word Attack	.85	.60	.04***
Step 2			
Word Attack	.50	.35	.07***
Word Identification	.43	.14	.03***
Step 3			
Word Attack	.47	.33	.07***
Word Identification	.41	.13	.03***
Verbal Memory	.13	.11	.05*
Step 4			
Word Attack	.48	.34	.07***
Word Identification	.37	.12	.03***
Verbal Memory	.09	.08	.05
Vocabulary	.09	.03	.02
Step 5			
Word Attack	.40	.28	.06***
Word Identification	.22	.07	.03*
Verbal Memory	.01	.01	.05
Vocabulary	.06	.02	.02
Phonological Awareness	.33	.10	.03***

* $p < .05$; ** $p < .01$; *** $p < .001$

A similar hierarchical multiple regression analysis was then conducted to determine if significant relationships would be found between students'

phonological awareness and their spelling ability, as measured by Spelling of Sounds, with vocabulary, verbal memory, and word recognition ability held constant. Once again, each of the control variables (vocabulary, verbal memory, word recognition [word identification and word attack]) was available for entry from the outset, and was entered according to the default stepwise criteria ($p \leq .05$ for entry and $p \leq .10$ for removal). Then, any remaining control variable(s) which did not meet this criteria were entered. Phonological awareness was entered last. As noted in Tables 3.13 and 3.14, the results of the hierarchical multiple regression indicated that phonological awareness was also a significant predictor of students' performance on Spelling of Sounds, above and beyond students' vocabulary, verbal memory, and word recognition ability. Altogether 85% of the variability in students' scores on Spelling of Sounds, $F(5,75) = 84.16$, $p < .001$, was accounted for by these variables. Phonological awareness accounted for an additional 10% of the variability in students' scores on Spelling of Sounds above and beyond that explained by the other variables.

TABLE 3.13

Summary of Hierarchical Regressions on Spelling of Sounds

Step	Variable(s) Entered	R ²	R ² Change	Adjusted R ²	df	F Value
1	Word Attack	.73	.73***	.73	1,79	214.64***
2	Verbal Memory	.75	.02*	.74	2,78	116.47***
3	Vocabulary	.75	.00	.74	3,77	78.14***
4	Word Identification	.75	.00	.74	4,76	57.85***
5	Phonological Awareness	.85	.10***	.84	5,75	84.17***

* $p < .05$; ** $p < .01$; *** $p < .001$

TABLE 3.14

Results of Hierarchical Regressions on Spelling of Sounds

Predictor variable	B	b	SEb
Step 1			
Word Attack	.86	.55	.04***
Step 2			
Word Attack	.80	.52	.04***
Verbal Memory	.15	.12	.05*
Step 3			
Word Attack	.78	.50	.07***
Verbal Memory	.11	.09	.06
Vocabulary	.07	.02	.02
Step 4			
Word Attack	.64	.41	.05***
Verbal Memory	-.02	-.01	.05
Vocabulary	.04	.01	.02
Word Identification	.01	.03	.03
Step 5			
Word Attack	.64	.41	.05***
Verbal Memory	-.02	-.01	.05
Vocabulary	.04	.01	.02
Word Identification	-.24	-.07	.03*
Phonological Awareness	.55	.15	.02***

* $p < .05$; ** $p < .01$; *** $p < .001$

Several additional questions were also explored during the course of this investigation. For example, research studies conducted to date have involved the use of different numbers and kinds of phonological awareness tasks, with several studies using only one measure. In order to determine the relationship between students' performance on a wider range of phonological awareness tasks and their spelling ability (as measured by their overall scores on the TWS-3 and Spelling of Sounds), Pearson Product-Moment correlations were calculated between their spelling scores and performance on specific measures of phonological awareness: segmentation, initial, medial, final, deletion, substitution and blending.

High positive relationships were found between students' scores on both the TWS-3 and Spelling of Sounds, respectively, and each of the phonological awareness tasks: segmentation (.81, .81), medial (.73, .78), final (.72, .73), deletion (.82, .79), and blending (.71, .77). In addition, substantial correlations were found between students' performance on both the TWS-3 and Spelling of Sounds, respectively, and the initial (.44, .45) and substitution (.69, .68) tasks. Thus, each of the phonological awareness tasks is a significant predictor of students' spelling competence as measured by the TWS-3 or Spelling of Sounds.

The relationship between phonological awareness and students' use of different spelling strategies was also explored. Based on previous research, it was hypothesized that students with more advanced phonological awareness skills would also be more advanced in their use of the different spelling strategies typically demonstrated by beginning spellers (i.e., phonological and orthographic). Therefore, Pearson Product-Moment correlations were calculated between students' phonological and visual similarity scores on the overall TWS-3 and each of the various phonological awareness tasks

(segmentation, initial, medial, final, deletion, substitution, and blending) to determine if students who demonstrated relatively greater ability on the more complex or advanced phonological awareness tasks, involving the deletion and substitution of phonemes, also demonstrated greater use of both phonological and orthographic spelling strategies.

Positive relationships were found between students' phonological and visual similarity scores and each of the phonological awareness tasks, suggesting that each of the phonological awareness tasks is a significant predictor of students' phonological and visual similarity scores. High correlations were found between students' phonological similarity and visual similarity scores, respectively, and their performance on the segmentation (.84, .86), medial (.75, .78), final (.77, .79), deletion (.81, .86) and blending (.78, .80) tasks. Substantial correlations were found between students' phonological similarity and visual similarity scores and their performance on the initial (.67, .60) phonological awareness task. Students' performance on the substitution task showed a substantial correlation (.65) with their phonological similarity and a high correlation (.72) with their visual similarity scores. These results suggest that students who demonstrated a greater ability on all of the phonological awareness tasks, including those that may be considered more complex (deletion and substitution) also tended to demonstrate greater use of both phonological and orthographic spelling strategies. Perhaps not surprisingly, relatively lower (although still high or substantial) relationships were found between students' phonological and visual similarity scores and the phonological awareness tasks which may be considered to be the simplest (initial) or the most complex (substitution) of those used in this study. In addition, students' phonological similarity and visual similarity scores were found to

be very highly correlated (.97), suggesting that there is a strong relationship between students' use of phonological and orthographic spelling strategies.

Students' range and relative use of spelling strategies was further studied in relation to previous research which has suggested the need to control for related variables. Of interest then was whether or not, with vocabulary, verbal memory, and word recognition ability held constant, overall performance on phonological awareness tasks was a relatively better predictor of students' use of phonological or orthographic strategies when spelling (as measured by students' phonological and visual similarity scores on the TWS-3).

Initially, Pearson Product-Moment correlations were calculated to determine the relationships between students' phonological and visual similarity scores, and phonological awareness, vocabulary, verbal memory and word recognition ability. Positive and significant correlations existed between the criterion variables and each of the predictor variables. Specifically, high correlations were found between students' phonological similarity scores and their phonological awareness (.90), and word recognition ability (word identification [.80] and word attack [.71]). In addition, substantial correlations were found between students' phonological similarity scores and their vocabulary (.44) and verbal memory (.36). Similarly, high correlations were found between students' visual similarity scores and their phonological awareness (.92), and word recognition ability (word identification [.87] and word attack [.82]), and substantial relationships were found between students' visual similarity scores and their vocabulary (.48) and verbal memory (.43).

A hierarchical multiple regression analysis was then conducted to determine if phonological awareness was a significant predictor of students'

phonological similarity scores, above and beyond students' vocabulary, verbal memory, and word recognition ability. Each of the control variables (vocabulary, verbal memory, word recognition [word identification and word attack]) was available for entry from the outset, and was entered according to the default stepwise criteria ($p \leq .05$ for entry and $p \leq .10$ for removal). Then, any remaining control variable(s) which did not meet this criteria were entered. Phonological awareness was entered last. As shown in Tables 3.15 and 3.16, results indicated that, altogether 85% of the variability in students' scores, $F(5,75) = 86.12$, $p < .001$, was accounted for by these variables. Results also indicated that phonological awareness was a significant predictor of students' scores, above and beyond that accounted for by the other variables, in that phonological awareness explained an additional 19.48% of the variability in students' phonological similarity scores.

TABLE 3.15
Summary of Hierarchical Regressions on TWS-3
Phonological Similarity

Step	Variable(s) Entered	R ²	R ² Change	Adjusted R ²	df	F Value
1	Word Identification	.65	.65***	.64	1,79	144.55***
2	Vocabulary	.65	.00	.64	2,78	72.22***
3	Word Attack	.66	.01	.64	3,77	48.77***
4	Verbal Memory	.66	.00	.64	4,76	36.37***
5	Phonological Awareness	.85	.19***	.84	5,75	86.12***

* $p < .05$; ** $p < .01$; *** $p < .001$

TABLE 3.16
Results of Hierarchical Regressions on TWS-3
Phonological Similarity

Predictor variable	B	b	SE _b
Step 1			
Word Identification	.80	.01	.00***
Step 2			
Word Identification	.78	.01	.00***
Vocabulary	.06	.00	.00
Step 3			
Word Identification	.66	.01	.00***
Vocabulary	.06	.00	.00
Word Attack	.14	.01	.00
Step 4			
Word Identification	.67	.01	.00***
Vocabulary	.04	.00	.00
Word Attack	.12	.00	.01
Verbal Memory	.05	.00	.00
Step 5			
Word Identification	.31	.01	.00**
Vocabulary	-.01	.00	.00
Word Attack	.07	.00	.00
Verbal Memory	-.13	-.01	.00*
Phonological Awareness	.78	.01	.00***

* $p < .05$; ** $p < .01$; *** $p < .001$

A hierarchical multiple regression analysis was then conducted to determine if significant relationships would be found between students' phonological awareness and their TWS-3 visual similarity scores, with vocabulary, verbal memory and word recognition ability held constant. Once again, each of the control variables was available for entry from the outset, and was entered according to the default stepwise criteria ($p \leq .05$ for entry and $p \leq .10$ for removal). Then, any remaining control variable(s) which did not meet this criteria were entered, and phonological awareness was entered last. As noted in Tables 3.17 and 3.18, the results of the hierarchical multiple regression indicated that phonological awareness was a significant predictor of students' visual similarity scores above and beyond students' vocabulary, verbal memory, and word recognition ability. Altogether 91% of the variability in students' scores, $F(5,75) = 152.06$, $p < .001$, was accounted for by these variables. Phonological awareness accounted for an additional 11.78% of the variability in students' visual similarity scores above and beyond that explained by the other variables.

TABLE 3.17

Summary of Hierarchical Regressions on TWS-3 Visual Similarity

Step	Variable(s) Entered	R ²	R ² Change	Adjusted R ²	df	F Value
1	Word Identification	.75	.75***	.75	1,79	237.18***
2	Word Attack	.78	.03**	.78	2,78	140.35***
3	Vocabulary	.79	.01	.78	3,77	95.63***
4	Verbal Memory	.79	.00	.78	4,76	72.53***
5	Phonological Awareness	.91	.12***	.90	5,75	152.06***

* $p < .05$; ** $p < .01$; *** $p < .001$

TABLE 3.18

Results of Hierarchical Regressions on TWS-3 Visual Similarity

Predictor variable	B	b	SE _b
Step 1			
Word Identification	.87	.01	.00***
Step 2			
Word Identification	.60	.01	.00***
Word Attack	.32	.01	.00**
Step 3			
Word Identification	.55	.01	.00***
Word Attack	.33	.01	.00**
Vocabulary	.09	.00	.00
Step 4			
Word Identification	.56	.01	.00***
Word Attack	.30	.01	.00**
Vocabulary	.05	.00	.00
Verbal Memory	.08	.00	.00
Step 5			
Word Identification	.29	.00	.00***
Word Attack	.15	.01	.00*
Vocabulary	.01	.00	.00
Verbal Memory	-.06	-.00	.00
Phonological Awareness	.61	.01	.00***

* $p < .05$; ** $p < .01$; *** $p < .001$

In summary, phonological awareness was found to be a significant predictor of students' visual similarity scores above and beyond students' vocabulary, verbal memory, and word recognition ability, accounting for an additional 11.78% of the variability in students' visual similarity scores above and beyond that explained by the other variables. However, phonological awareness was also found to be a significant predictor of students' phonological similarity scores, above and beyond students' vocabulary, verbal memory, and word recognition ability. Phonological awareness accounted for an additional 19.48% of the variability in students' phonological similarity scores above and beyond that explained by the other variables. Therefore, in relative terms, given that phonological awareness accounted for a greater proportion of students' phonological than visual similarity scores, these results suggest that performance on phonological awareness tasks appears to be a stronger predictor of students' use of phonological than orthographic spelling strategies when students' vocabulary, verbal memory, and word recognition ability are controlled.

Of additional interest was previous research which has suggested that in general, over time, students develop more advanced phonological awareness skills, and their spellings develop from being less to more complete representations of words. However, the interrelationships between these abilities are less clear. For example, could one expect students who demonstrate the ability to segment the initial phonemes of words, also expect them to demonstrate the ability to accurately represent at least the initial phonemes of words in their spelling (as measured by their overall scores on the TWS-3 and Spelling of Sounds)? In addition, could one expect students who demonstrate the ability to segment all of the phonemes in words to also accurately represent all the phonemes in words they spell (as measured by

their overall scores on the TWS-3 and Spelling of Sounds)?

In order to determine the possible existence of such relationships, students were initially grouped as to the level of spelling they demonstrated on both the TWS-3 and Spelling of Sounds, based on their modal classification scores. Group One consisted of students with "other" and "no response" modal spelling scores, suggesting that their spellings tended not to represent the initial phoneme. Group Two consisted of students with "initial" and "minus" modal spelling scores, suggesting that their spellings tended to represent at least the initial phoneme accurately with the first letter written, but not all of the letters necessary to represent the phonemes in a word in the correct order. Group Three consisted of students with "phonetically possible" and "correct" modal spelling scores, suggesting that their spellings tended to be accurate or represent possible phonetic spellings of words.

Tables 3.19 and 3.20 demonstrate a consistent pattern in the mean scores achieved on the "initial" phonological awareness task by students in Groups One, Two and Three on both the TWS-3 and Spelling of Sounds. Students in Groups Two and Three, whose spellings tended to represent at least the initial phoneme accurately with the first letter written, also tended to score 8/10 or above on the "initial" task, suggesting that they are able to segment the initial phonemes of words.

TABLE 3.19

Means and Standard Deviations of TWS-3 Groups on "Initial"

Variable	N	Mean (Range)	Standard Deviation
TWS-3 Group One	25	4.04 (0-10)	3.55
TWS-3 Group Two	37	8.32 (1-10)	2.06
TWS-3 Group Three	19	9.42 (8-10)	.70

TABLE 3.20

Means and Standard Deviations of
Spelling of Sounds Groups on "Initial"

Variable	N	Mean (Range)	Standard Deviation
Spelling of Sounds Group One	34	5.32 (0-10)	3.77
Spelling of Sounds Group Two	18	8.06 (1-10)	2.53
Spelling of Sounds Group Three	29	9.03 (5-10)	1.26

A One-Way Anova was then conducted to compare the differences in the means of the three groups on the "initial" phonological awareness task. However, the Levene Test for Homogeneity of Variances was failed. Therefore, the Kruskal-Wallis test, a non-parametric analog to a One-Way Anova, was used to test for differences among the three groups. The results indicated that the three TWS-3 groups differed significantly on the "initial" phonological awareness task were significantly different, $H(2) = 32.39$, $p < .0001$, as did the three Spelling of Sounds groups, $H(2) = 19.56$, $p < .001$.

Further post-hoc analysis was then conducted to determine where

significant differences existed between the groups. Accordingly, the Kruskal-Wallis test was repeated for pairs of groups, with the criteria for significance increased to $p < .01$ to make the test more stringent. Significant differences were found between the TWS-3 students in Groups One and Two on the "initial" task, $H(1) = 21.28$, $p < .001$, but not between students in Groups Two and Three, $H(1) = 4.30$, $p > .01$. Similarly, significant differences were found between the Spelling of Sounds students in Groups One and Two on the "initial" task, $H(1) = 7.06$, $p < .01$, but not between students in Groups Two and Three, $H(1) = 1.61$, $p > .01$. These significant differences between groups indicate that students who are better able to segment the initial phonemes of words are also better able to represent at least the initial phonemes in words that they spell.

Similar procedures were then used to explore possible relationships between students' spelling and their performance on the "segmentation" phonological awareness task. Students were grouped as to the level of spelling they demonstrated on both the TWS-3 and Spelling of Sounds, based on their modal classification scores, and a One-Way Anova was conducted to compare the differences in the means of the three groups on the "segmentation" phonological awareness task. However, the Levene Test for Homogeneity of Variances was failed. Therefore, a non-parametric analysis was conducted.

Tables 3.21 and 3.22 demonstrate a consistent pattern in the mean scores achieved on the "segmentation" phonological awareness task by students in Groups One, Two and Three on both the TWS-3 and Spelling of Sounds. Students in Group Three, who tended to be able to spell accurately or produce possible phonetic spellings of words, also demonstrated the greatest ability to segment all of the phonemes in words (approximately 5/10 correct).

TABLE 3.21

Means and Standard Deviations of TWS-3 Groups on "Segmentation"

Variable	N	Mean (Range)	Standard Deviation
TWS-3 Group One	25	.24 (0-3)	.72
TWS-3 Group Two	37	2.16 (0-7)	1.91
TWS-3 Group Three	19	5.32 (3-9)	1.83

TABLE 3.22

Means and Standard Deviations of
Spelling of Sounds Groups on "Segmentation"

Variable	N	Mean (Range)	Standard Deviation
Spelling of Sounds Group One	34	.65 (0-4)	1.2
Spelling of Sounds Group Two	18	1.56 (0-5)	1.79
Spelling of Sounds Group Three	29	4.72 (1-9)	1.96

The Kruskal-Wallis test, a non-parametric analog to a One-Way Anova, was used to test for differences among the three groups. This results indicated significant differences across the three TWS-3 groups on the "segmentation" phonological awareness task, $H(2) = 46.12$, $p < .0001$. Similarly, the three Spelling of Sounds groups were also found to differ significantly, $H(2) = 46.02$, $p < .0001$, on these segmentation tasks.

Further post-hoc analyses was then conducted to determine where significant differences existed between the groups. Specifically, the Kruskal Wallis test was repeated for pairs of groups, with the criteria for

significance increased to $p < .01$ to make the test more stringent.

Significant differences were found between the TWS-3 students in Groups One and Two on the "segmentation" task, $H(1) = 18.98$, $p < .001$, and between students in Groups Two and Three, $H(1) = 21.07$, $p < .001$. Significant differences were not found between the Spelling of Sounds students in Groups One and Two on the "segmentation" task, $H(1) = 3.775$, $p > .01$, but were found between students in Groups Two and Three, $H(1) = 18.376$, $p < .001$. These significant differences between groups indicate that students who are better able to segment the phonemes in words are also better able to represent the majority of the phonemes in words that they spell.

Chapter 4

Discussion

This study focussed on the development of phonological awareness and spelling competence in beginning spellers. Therefore, research in the areas of developmental spelling and phonological awareness was investigated for the purpose of studying interrelationships in students' early development of competence in these two areas.

Of initial interest was the largely untested theoretical model relating to children's early attempts at spelling, which suggests that beginning spellers' spelling ability is dependent on students' phonological awareness, knowledge about the orthographic structure of English words, and knowledge of letter names and sounds. High correlations were found between students' ability to spell real words and nonwords, respectively, and their phonological awareness (.83,.85), and knowledge of letter sounds (.82,.80), and substantial correlations were found between their ability to spell real words and nonwords, respectively, and their knowledge of orthographic structure (.48,.41), and knowledge of letter names (.58,.55). In addition, it was found that, consistent with the theoretical model, a large proportion of the variance in these kindergarten and grade one students' spelling of real words (77%) and nonwords (75%) could in fact be accounted for altogether by measuring these requisite skills (phonological awareness, knowledge of orthographic structure, knowledge of letter names, and knowledge of letter sounds). It should be noted, however, that these variables were significantly related to one another, and that these significant intercorrelations may reduce the generalizability of the results by altering the apparent relative effect of the individual variables. Nevertheless, according to Pedhazur (1982), the presence of such interrelationships does not effect the

determination and interpretation of the overall variance (i.e., the amount of spelling competence which can be accounted for) by these variables.

Therefore, it can be concluded that assessments of students' phonological awareness, knowledge about the orthographic structure of English word, and knowledge of letter names and letter sounds, may be useful in explaining a large proportion of the overall variability in young students' spelling abilities.

Some researchers have suggested that related factors, such as vocabulary, verbal memory and reading ability, may influence students' performance and therefore need to be controlled in studies involving phonological awareness. Therefore, of additional interest in this study was whether or not a significant relationship would be found between students' phonological awareness and ability to spell real words and nonwords if these factors were held constant. Despite significant intercorrelations between variables and controlling for differences in students' vocabulary, verbal memory, word recognition ability (word identification and word attack), phonological awareness was still found to be a significant predictor of young students' spelling competence.

Previous research studies have involved the use of different numbers and kinds of phonological awareness tasks, with several studies using one measure. In this study, a range of standardized phoneme-level phonological awareness tasks, including segmentation, initial, medial, final, deletion, substitution and blending tasks were used. High correlations (.71 to .82) were found between students' spelling performance and their performance on the segmentation, medial, final, deletion, and blending phonological awareness tasks, and substantial correlations (.44 to .69) were found between their spelling performance and the initial and substitution phonological awareness

tasks. Thus it appears that each of these phonological awareness tasks could be considered to be significant predictor of students' beginning spelling competence.

Also of interest was the relationship between phonological awareness tasks and students' use of beginning spelling strategies (i.e., phonological and orthographic). As may be expected, students who demonstrated a greater ability on all of the phonological awareness tasks, including those that may be considered more complex (deletion and substitution) also tended to demonstrate greater use of both phonological and orthographic spelling strategies. Perhaps not surprisingly, relatively lower (although still high or substantial) relationships were found between students' phonological and visual similarity scores and the phonological awareness tasks which may be considered to be the simplest (initial) or the most complex (substitution) of those used in this study. It is likely that these relatively lower correlations were due at least in part to the restricted range of scores students received on these measures.

In addition, students' phonological similarity and visual similarity scores were found to be very highly correlated (.97), suggesting that there is a strong relationship between the development and use of phonological and orthographic spelling strategies by beginning spellers. This result is consistent with the findings of several researchers which have indicated that beginning spellers are able to use both phonological and orthographic spelling strategies (Lennox & Siegel, 1994); Snowling, 1994; Treiman, 1993, 1994; Varnhagen, 1995), but contrasts with Gentry's (Gentry & Gillet, 1993) theory that students only begin to pay attention to the orthographic features of the language and use visual/orthographic spelling strategies when they have moved beyond the phonetic stage (i.e., consistently represent all of the sounds in

words) and reach the transitional stage of spelling development. According to Gentry, beginning spellers assign letters "strictly on the basis of sound, without regard for acceptable English letter sequence or other conventions of English orthography" (p. 30). If this theory were correct, then such a strong correlation between the beginning spellers' phonological similarity and visual similarity scores would not have been found.

Students' relative use of spelling strategies was also studied in relation to previous research which has suggested the need to control for related variables. Of interest then was whether or not, with vocabulary, verbal memory, and word recognition ability held constant, students' overall performance on phonological awareness tasks was a relatively better predictor of their use of phonological or orthographic strategies when spelling. Phonological awareness was found to be a significant predictor of both students' visual similarity and phonological similarity scores, above and beyond their vocabulary, verbal memory, and word recognition ability. Phonological awareness accounted for an additional 11.78% of the variability in students' visual similarity scores, and an additional 19.48% of the variability in students' phonological similarity scores above and beyond that explained by the other variables. Given that phonological awareness accounted for a greater proportion of students' phonological than visual similarity scores, performance on phonological awareness tasks appears to be a relatively stronger predictor of students' use of phonological than orthographic spelling strategies, when differences in students' vocabulary, verbal memory, and word recognition ability are controlled.

Despite the fact that students' phonological similarity and visual similarity scores were found to be very highly correlated (.97), suggesting that students' skills in these areas tend to develop together, the relative

difference in the amount of variance in students' phonological and visual similarity scores accounted for by students' vocabulary, verbal memory, and word recognition ability is worthy of note. These control variables accounted for 79% of the variability in visual similarity scores, but only 66% of the variability in phonological similarity scores. In addition, each of these variables was found to be more highly correlated with students' visual similarity than their phonological similarity scores. These results suggest that each of these variables is relatively more related to students' development of visual/orthographic than phonological spelling strategies. Thus it appears that, consistent with Frith's theory (1985), there may be interrelationships in students' development and use of orthographic and phonological spelling strategies. However, distinct factors may also be associated with or influence their growth.

Apparent developmental trends in students' spelling and phonological awareness were also investigated. Previous research has suggested that in general, over time, students develop more advanced phonological awareness skills, and their spellings develop from being less to more complete representations of words. However, little is known about the interrelationships between these abilities. In order to investigate possible associations between students' ability to segment the phonemes of words and accurately represent phonemes in their spelling, students were grouped according to their modal classification scores on measures of their ability to spell real words and nonwords. Group One consisted of students with "other" and "no response" modal spelling scores, suggesting that their spellings tended not to represent the initial phoneme. Group Two consisted of students with "initial" and "minus" modal spelling scores, suggesting that their spellings tended to represent at least the initial phoneme accurately with the

first letter written, but not all of the letters necessary to represent the phonemes in a word in the correct order. Group Three consisted of students with "phonetically possible" and "correct" modal spelling scores, suggesting that their spellings tended to be accurate or represent possible phonetic spellings of words.

A consistent pattern in the mean scores achieved on the "initial" phonological awareness task was demonstrated by students in Groups One, Two, and Three on both the TWS-3 and Spelling of Sounds. Students in Groups Two and Three, whose spellings tended to represent at least the initial phoneme accurately with the first letter written, also tended to score 8/10 or above on the "initial" task, suggesting that they were able to segment the initial phonemes of words. The means of the three groups on the "segmentation" phonological awareness task were also compared and found to be significantly different, and a consistent pattern was found in the mean scores achieved on the "segmentation" phonological awareness task by students in Groups One, Two, and Three on both the TWS-3 and Spelling of Sounds. Students in Group Three, who tended to be able to spell accurately or produce possible phonetic spellings of words, also demonstrated the greatest ability to segment all of the phonemes in words, scoring an average of 5/10 on the "segmentation" task.

The patterns of these results suggest that there is a significant relationship between students' abilities on specific phonological awareness tasks and the spellings that they produce. That is, it appears reasonable to expect students who demonstrate the ability to segment the initial phonemes of words to also accurately represent at least the initial phonemes of words in their spelling. In addition, students who demonstrate the ability to segment all of the phonemes in words may also be expected to accurately represent the majority of the phonemes in words that they spell.

It should be noted, however, that although the scores achieved by the students in the three groups were significantly different, individual students within each group varied in their performance. It should also be noted that students' modal spelling classifications were used for this analysis. Consistent with the findings of researchers who currently question the appropriateness of delineating students' spelling abilities into discrete stages (Lennox & Siegel, 1994; Snowling, 1994; Treiman, 1993, 1994; Varnhagen, 1995), as Henderson (1990) and Gentry (1978, 1982; Gentry & Gillett, 1993) have done, students' abilities were seldom found to have developed systematically. That is, while a significant relationship was found between students' ability to represent the sounds in words they spelled, as represented by their modal spelling classifications, and their ability to segment sounds, a great deal of variability was also found, suggesting that this relationship is not absolute. As such, these results do not support a discrete stage model of students' spelling development.

Summary

The purpose of this study was to investigate the development of phonological awareness and spelling competence in beginning spellers. The results indicated that by measuring beginning spellers' developing knowledge of orthographic structure, phonological awareness, and their knowledge of letter names and letter sounds, as the theoretical model suggests, a large proportion of the variability in students' spelling could be explained.

Many of the variables used in this study were found to be highly correlated, significant predictors of spelling competence. Despite this, phonological awareness was found to be a significant predictor of students' spelling competence, even when differences in students' vocabulary, verbal memory, word identification and word attack skills were controlled. The

relationships between specific phonological awareness tasks and spelling competence were also explored. Each of the phonological awareness tasks (segmentation, initial, medial, final, deletion, substitution and blending) was found to be a significant predictor of students' spelling competence and use of phonological and orthographic spelling strategies.

However, the results of further analysis indicated that when differences in students' vocabulary, verbal memory, and word recognition ability were controlled, overall phonological awareness accounted for a greater proportion of the students' phonological (19.48%) than visual (11.78%) similarity scores. Thus, once students' vocabulary, verbal memory, and word recognition are controlled, phonological awareness appeared to be a relatively stronger predictor of young students' use of phonological than orthographic spelling strategies. Consistent with Frith's theory (1985), students' development of orthographic and phonological spelling strategies may be highly related, but different factors appear to be associated with their growth.

Finally, the results also indicated that students whose spellings tended to represent at least the initial phoneme accurately with the first letter written, also tended to score higher on the "initial" task, suggesting that they are able to segment the initial phonemes of words. Additionally, it was found that students who tended to be able to spell accurately or produce possible phonetic spellings of words, also demonstrated the greatest ability to segment all of the phonemes in words. However, while the results found a significant relationship between students' modal spelling classifications and their ability to segment the phonemes in words, a great deal of variability in students performance was also found, suggesting that a discrete stage model of spelling development is not appropriate.

Limitations

Several potential threats to the internal and external validity of this study need to be considered. For instance, the students who participated in this study were volunteers from seven different classrooms in two different schools. Some of the students were enrolled in single-grade and some in multi-grade learning environments. Although all students received instruction in letters and letter sounds, and were encouraged to use "invented spelling" when writing, it is unclear how other factors in their learning environments may have influenced the results.

In addition, the majority of the measures used in this study were traditional standardized tests. However, some of the measures (e.g., Treiman's Orthographic Constraints Test) or marking schemes were adapted from previous research, and are not standardized. Therefore, while they may have adequate face validity, their objectivity (the degree to which they are not influenced by the biases of the tester or scorer), validity and reliability for this population of students is not well-established.

All of the participants in this study completed the same assessments in the same order in a single 45-60 minute session. However, due to fatigue or other factors some students did complete the tasks over two 30 minute sessions. The order of the tasks was specifically chosen in an attempt to maximize students' attention and minimize potential "priming" effects (i.e., prompting students to respond in a particular manner). However, it is unclear how personal characteristics of the students, such as motivation, interest, task familiarity and fatigue may have had an impact on the results of this study.

Potential threats to external validity may also effect the generalizability of these results. As previously noted, the participants in

this study were volunteers from seven different classrooms in two different schools who were assessed during the last two months (i.e., May and June) of their kindergarten and grade one years. One of the schools was a private Catholic school within Vancouver, and the other was a public school in a rural community, both located in lower-middle to middle class neighborhoods. Only students who could speak English and did not have identified disabilities were included in the sample. Participants were enrolled in single-grade and multi-grade learning environments, characterized by their teachers as being traditional, balanced or whole language. However, all students received instruction in letters and letter sounds, and were encouraged to use "invented spelling" when writing. Any generalizations should be restricted to similar populations of kindergarten and grade one students.

It should also be noted that students were assessed individually in a quiet room at their respective schools, and the spelling competence measures that were used involved spelling dictation, not spontaneous writing samples. These factors, which differentiate the experimental environment from the typical classroom, may also limit the generalizability of the results obtained in this study.

In addition, issues of multicollinearity may restrict the potential application of the results obtained in this study to other populations. Pedhazur (1982) notes that multicollinearity does not effect the determination and interpretation of R^2 , that is, the overall variance which can be accounted for by particular variables. However, high multicollinearity can limit our ability to interpret regression coefficients as indices of effects, as the estimations of the magnitudes of regression coefficients and their signs may be influenced by the intercorrelations between variables. This suggests that results related to the apparent relative effect of individual

variables may not be generalizable to other populations.

Future Directions

The results of this study provide further support for the position that phonological awareness is a significant factor in students' early literacy development. They also suggest the importance of considering interrelationships in the development of phonological awareness and spelling competence in beginning spellers. As such, additional investigations designed to help clarify the reciprocal nature of skill development in these areas, and within the broader spectrum of students' development of early literacy skills, appear to be warranted.

Additional research is needed to replicate and extend the results of the current study. Therefore, researchers may wish to consider the following research topics:

- Which factors have the most influence on students' development of spelling competence at different ages, grade levels or phases of literacy development?
- Are particular variables differentially associated with students' development of phonological and visual/orthographic spelling strategies?
- Would there be a benefit in training students using different kinds of phonological awareness tasks at different phases of their spelling development? For example, should students, whose spellings indicate that they are not yet able to represent any of the phonemes in words, receive training in "initial" tasks, while students, who demonstrate the ability to represent some but not all of the phonemes in words, receive training in "segmentation" tasks?

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