

**ANALYSIS OF THIRD- AND FIFTH-GRADE SPELLING ERRORS ON THE
TEST OF WRITTEN SPELLING – 4: DO ERROR TYPES INDICATE
LEVELS OF LINGUISTIC KNOWLEDGE?**

A Dissertation

by

BARBARA TENNEY CONWAY

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2011

Major Subject: Curriculum and Instruction

**ANALYSIS OF THIRD- AND FIFTH-GRADE SPELLING ERRORS ON THE
TEST OF WRITTEN SPELLING – 4: DO ERROR TYPES INDICATE
LEVELS OF LINGUISTIC KNOWLEDGE?**

A Dissertation

by

BARBARA TENNEY CONWAY

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Approved by:

Chair of Committee,
Committee Members,

Head of Department,

R. M. Joshi
Robert Hall
Erin McTigue
Deborah Simmons
Dennie Smith

August 2011

Major Subject: Curriculum and Instruction

ABSTRACT

Analysis of Third- and Fifth-Grade Spelling Errors on the Test of Written Spelling –

4: Do Error Types Indicate

Levels of Linguistic Knowledge? (August 2011)

Barbara Tenney Conway, B.S., The University of Texas;

M.Ed., The University of Houston

Chair of Advisory Committee: Dr. R. M. Joshi

A standardized test of spelling ability, *Test of Written Spelling – 4 (TWS-4)*, was used to explore the error patterns of Grade 3 and Grade 5 students in public and private schools in the southwestern region of the US. The study was for the purpose of examining the relationship between types of errors students make within a grade level (Grades 3 & 5 for this study), and the students' spelling proficiency. A qualitative analysis of errors on the TWS-4 resulted in distributions of errors categorized as *phonological*, *phonetic*, *orthographic*, *etymological*, and *morphological*. For both Grades 3 and 5, a higher proportion of phonological and phonetic errors were made by students in the lowest spelling achievement group. Students with higher standard spelling scores made a lower proportion of phonological and phonetic errors and a higher proportion of errors categorized as etymological and morphological. The Test of Silent Word Reading Fluency (TOSWRF) was also administered to the students to examine the relationship of these error types to literacy. The correlation between reading fluency (TOSWRF)

standard scores and phonological and phonetic errors was negative, whereas the correlation between reading fluency and orthographic, etymological, and morphological error types was positive. This study underscores the value of looking at spelling achievement as a part of students' literacy profiles. In addition, the study highlights the importance of making sure students beyond the years of very early reading and spelling development (Grades 3-5), especially those with low spelling proficiency, have the basic skills of phonological awareness and basic sound/symbol correspondences in place to support their ability to spell and to read, and that spelling must be taught in such a way as to meet students' individual student needs.

DEDICATION

I dedicate this dissertation to my family: My husband, who has given me coffee, clean laundry, tasty meals, and emotional support beyond measure for five years, waiting for me to once again have time to make popcorn and watch a movie; my children, who stood by and believed I could do this when I didn't believe it myself; and my parents, whose pride in me still matters.

ACKNOWLEDGEMENTS

I would like to acknowledge and thank my dissertation committee: my chair, Dr. R. M. Joshi, for his expertise, humor, and cheerful encouragement throughout my graduate experience; Dr. Robert Hall for his patient statistical explanations; Dr. Erin McTigue for her expertise and attitude that is ever cheerful, positive, and encouraging; and Dr. Deborah Simmons for her keen and professional eye for detail and kind suggestions.

I would also like to acknowledge the following people who have been a part of this late-in-life endeavor. Thank you to Dr. Suzanne Carreker, whose vast knowledge of literacy I continue to admire; To Suzanne's son, James, for helping me conceptualize; Mary Lou Slania, who helped me sort my thoughts about spelling; Dr. Regina Boulware-Gooden who helped me sort my thoughts about statistical design; and Ingrid and Gail, who on long walks at 5 AM listened to me chronicle my journey.

TABLE OF CONTENTS

	Page
ABSTRACT	iii
DEDICATION	v
ACKNOWLEDGEMENTS.....	vi
TABLE OF CONTENTS.....	vii
LIST OF FIGURES	ix
LIST OF TABLES	x
NOMENCLATURE.....	xi
 CHAPTER	
I INTRODUCTION	1
Theories of Spelling Development.....	2
Are Spelling Stages Distinct?	7
Error Analysis for Spelling Instruction.....	11
Implications for Instruction.....	19
The Purpose of the Present Study.....	22
The Organization of the Present Study.....	23
II DO THIRD GRADE ERROR TYPES INDICATE LEVELS OF LINGUISTIC KNOWLEDGE?	24
Method	24
Participants.....	24
Materials and Procedures.....	25
Rationale for Using the TWS-4.....	26
Error Analysis	27
Results	31
Discussion	40
Limitations of the Study	43

CHAPTER	Page	
III	DO FIFTH GRADE ERROR TYPES INDICATE LEVELS OF LINGUISTIC KNOWLEDGE?.....	45
	Method	45
	Participants	45
	Materials and Procedures	46
	Rationale for Using the TWS-4	47
	Error Analysis	48
	Results	50
	Discussion	61
	Limitations	65
IV	CONCLUSION	66
	Third Grade	66
	Fifth Grade	69
	REFERENCES	73
	APPENDIX A	81
	APPENDIX B	83
	VITA	85

LIST OF FIGURES

FIGURE		Page
1	Phonological and Phonetic Error Type Proportions at Three Spelling Achievement Levels (Grade 3)	34
2	Orthographic, Etymological, and Morphological Error Type Proportions at Three Spelling Achievement Levels (Grade 3)	35
3	Phonological and Phonetic Error Type Proportions at Three Spelling Achievement Levels (Grade 5)	54
4	Orthographic, Etymological, and Morphological Error Type Proportions at Three Spelling Achievement Levels (Grade 5)	55
5	Comparison of Means of Morphological Error Types by Achievement Group (Grade 5)	61

LIST OF TABLES

TABLE		Page
1	Categories of Error Types (Grade 3).....	30
2	Means and Standard Deviations of Error Type Proportions (Grade 3).....	32
3	Means of Error Types for Total Grade 3 Participants (N = 89)	33
4	One-Way ANOVA Summary Table of Error-Type Proportions Grade 3	36
5	Multiple Comparisons among Three Achievement Groups ..	37
6	Correlations: Error Proportions with TWS-4 Standard Score (N = 89)	39
7	Pearson Correlations: Error Type Proportions (N = 89)	40
8	Categories of Error Types	51
9	Grade 5 Means and Standard Deviations of Error Type Proportions for Groups I, II, and III	53
10	Means of Error Type Proportions for Total Grade 5 Participants	53
11	One Way ANOVA Summary Table of Error Type Proportions	56
12	Multiple Comparisons of Error Types	58
13	Pearson Correlations: Mean Error Proportions on the TWS-4 (N = 105) and TOSWRF (N = 103).....	60
14	Pearson Correlations among Error Types	60

NOMENCLATURE

Phonological	sounds of oral language such as sentences, words, syllables, and phonemes
Phonemes	individual sounds in spoken language, that make a difference in the pronunciation and meaning of words like <i>pat</i> and <i>bat</i>
Orthographic	spellings that utilize regular patterns; irregular spellings that require orthographic memory
Etymological	spelling derived from another language, such as <i>ph</i> for the sound /f/
Morphological	meaning units of words and their influence on spelling
//	symbol indicating the sound of a phoneme (e. g. /d/ in duck)

CHAPTER I

INTRODUCTION

Spelling error analyses have added to growing knowledge about how spelling develops in children and have the ultimate goal of making classroom spelling instruction rich and precise (Ganske, 2000; Schlagal, 2002). The development of spelling over a child's school life-time is a subject of mild controversy. Researchers who have observed children's writing examine whether or not spelling stages exist, how these stages are distinct from one another, and whether or not elements of each stage can be seen throughout a child's spelling development. General observations from children's writing can be made about what children know about language as they progress through grade levels in school. *Stage theory* of spelling development has provided a solid structure upon which spelling curricula can be designed, and spelling error analysis serves as the foundational screening component for planning of instruction (Bear & Templeton, 1998; Bear, Invernizzi, Templeton, & Johnston, 2008). Stages or phases of spelling development mirror the incremental nature of reading development. The stages or phases represent knowledge of the linguistic properties of language children gain that contribute to the spelling, and ultimately, the meaning of words.

This dissertation follows the style of *Scientific Studies of Reading*.

Theories of Spelling Development

Children are meaning-driven, at first, in their attempts to spell, often writing longer strings of letters to match something that is physically large, such as writing a long string of letters for “*bear*” and one letter for “*mouse*” because a bear is the larger animal. The awareness that writing represents ideas and is distinguishable from pictures is apparent in the scribbles of children as young as three years old (Ferreiro & Teberosky, in Treiman & Bourassa, 2000a, 2000b). At this *pre-phonetic or emergent stage*, when scribbles and loosely identifiable pictures represent written messages, the child has grasped the concept of print as a means to communicate, but the relationship of symbol to sound has not yet developed. At this stage, children are logographic (symbols for whole words) in their thinking about writing, and they do not know to rely on letters and letter sounds as a means for spelling (Apel, Masterson, & Niessen, 2004). As students learn letters and letter names, they begin to use them in written messages that are as yet unreadable because of the lack of knowledge of sound-symbol correspondence and lack of the use of word boundaries, or spaces between words (Henderson, 1985, as cited in Bear et al., 2008; Lavine, as cited in Treiman & Bourassa, 2000b; Moats, 1995).

In the stage called *semi-phonetic* by Moats (1995), the concept that letters represent speech sounds directly supports the development of reading. Writing letters in association with their sounds in words influences the development of phonological awareness, the ability to rhyme, segment, and blend the sounds and syllables in words, which, in turn, contributes greatly to learning to recognize

words automatically (Cataldo & Ellis, 1998; Ehri, 1989). Around the beginning of formal school, the letter names become well established and make a significant contribution to the spelling of words. Children now begin to develop an awareness of the representation of sound by letters, which is enhanced by auditory and manipulative phonemic awareness activities (Castiglioni-Spalten & Ehri, 2003; Tangel & Blachman, 1992). This is the phase of development, observed first by Read (1975), when the child sometimes represents the letter name for the sound of the letter. The use of letter names for sounds sometimes appears to be erratic, but most of the time is reserved for the phonological sounds the child is trying to produce (Treiman & Bourassa, 2000a, 2000b). These errors show that children at this phase of development are fine-tuning their awareness of language sounds. Letter names which do not include the corresponding letter sound, such as *y* and *h*, (letter names which sound more like they might bear the sounds of letters *w* and *ch*), might produce spellings like *YT* (*white*), or *HU* (*chew*) (Bear et al., 2008; Moats, 1995).

Knowledge of the “alphabetic principle” (the principle that sounds in an alphabetic language are represented by symbols, which can be combined into words) becomes apparent when children begin to associate finer grains of sound with symbols that represent them, albeit often the wrong ones. Attempts to spell at this stage are often entirely phonetic, lacking in orthographic spelling conventions, which reinforces the learning and blending of letter sounds for reading at a very basic level (Ehri & Soffer, 1999; Moats, 2000; Treiman, Zulkowski, & Richmon-Welty, 1995). As proficiency with letter sounds increases, errors are often made

because of the reliance on phonology to spell, and the tendency to represent every sound in a word in which the spelling might actually be unconventional (Bear & Templeton, 1998; Bear et al., 2008; Moats, 1995; Treiman, Berch, & Tincoff, 1993). At this point in development, children often omit the second letter of an initial consonant blend or the first letter of a final blend in a word. Most common is the omitting of a vowel before liquid consonants, such as *r* or *l* as in the words *dark* or *salt* (Treiman et al., 1993). Vowel spellings are often single letters for both the lax (short) and tense (long) vowels (Moats 1995). Children at this stage, referred to as the *phonetic stage* (Moats, 1995), or *letter-name-alphabetic stage* (Bear, Invernizzi, Templeton, & Johnston, 2008), use the phonetic spelling of sounds they *perceive*. An example is the use of letters *g* or *j* in place of the *d* in the blend *dr* because the common pronunciation often sounds like /*jr*/ as in *dress*. Similar errors include using *ch* instead of *t* in the blend *tr* as in *truck* (*lchruckl*), and spelling sounds following *s* with the voiced cognate of the letter as in *sky* (*sgie*). Children sometimes omit vowels before /*r*/ because of the interference of the letter name (*car* spelled *cr*), or because of the unexpectedness of the vowel sound when followed by letter *r* as in *stir* spelled *str* (Treiman & Bourassa, 2000a, 2000b). Vowel spellings are usually represented with one letter that is closest in sound, as children have not yet had exposure to vowel patterns representing variations in sound (Moats, 1995).

Increasing experience with print exposes children to orthography, so the total reliance on phonology, along with the errors that reliance causes, is gradually relinquished. New error patterns often arise at this time because of children's

awareness of new orthographic spelling alternatives (Ehri, 2000). When short and long vowel patterns and more complex consonant combinations make their appearance in children's writing, there is less reliance on the single phonetic properties of words, which at this point also have less influence over reading. As spelling ability improves, so does the confidence to take the risk of using harder words, and writing samples gradually become longer and more complex (Bear & Templeton, 1998; Bear, et al., 2008; Ehri & Soffer, 1999). Children in this *Within Word Pattern Spelling* stage or *Transitional stage* (Bear, et al., 2008; Moats, 1995) begin to take more risks with spelling, using a wider variety of orthographic representations for tense (long) vowels and complex consonant combinations. Unlike in the previous stage, spellings may become less phonetically accurate because of a tendency for more liberal experimentation with letter combinations encountered while reading (Bear et al., 2008; Moats, 1995). The tense (long) vowels may be represented with more than one letter, or double letters may be added. This stage lasts through the years of early reading instruction and as late as early fourth grade. Evidence of the progression of orthographic awareness was shown by Ehri and Soffer (1999) in the aforementioned study of students in Grades 2, 3, 5, and 6 who were asked to divide given words into graphophonemic (letter groupings that matched phonemes) units. The younger students tended to circle every letter, middle grade level students began to circle two and three letter groups, and accuracy increased with grade level, which lends support to the idea of stages of spelling development and corresponds to development of decoding skill for reading. Good spellers are better than poor spellers with the use of both

phonological processes and complex orthographic patterns, not because they are better at memorizing strings of letters, but because of proficiency with basic phonological skill and wide exposure to the patterns of the language through reading (Burt & Butterworth, 1996).

The recognition of word parts as units of meaning (morphological units), such as the –ed suffix for past tense, -s and –es for plurality, represents a distinct movement beyond phonology. The awareness of syllables in words, and the rules for adding affixes while preserving pronunciation (*stopping* vs. *stoping*) are special challenges at this time in spelling development, as are homonyms differentiated by inflectional, meaning-based affixes such as *hire/higher*; or *guest/guessed* (Bear & Templeton, 1998; Bear et al., 2008, Moats, 1995). The spelling of prefixes and suffixes in unaccented syllables is aided by knowledge of meaningful units, even though the vowel sound is dissolved into a schwa, or neutral vowel sound. For example, the spelling *mestake* for *mistake* will be corrected when the child learns the meaning of the prefix *mis-* and how other words like *misshapen*, *mishap*, and *misuse* are derived from it. Bear et al. (2008) differentiated this stage from the one that comes after as the *Syllables and Affixes stage*, although this stage and the subsequent stage both involve knowledge of morphological units.

Bear et al. (2008), described the latter stage of spelling development as the *Derivational Relations Spelling Stage*, one in which derivational roots come into play in the reading and writing of words in different content areas. In this stage, which can last from Grade 4 throughout a person's life, the use of Latin and Greek bases and roots opens the door for developing a wide vocabulary (Bear et al.,

2008; Joshi, Treiman, Carreker, & Moats, 2009). The knowledge of morphemes (meaning units) is essential for students at all ages but particularly at upper elementary grades when word length and complexity increases in content area classes. For example, the Latin root *port*, meaning to carry, in combination with meaningful prefixes or suffixes, aids in the understanding of *export*, *import*, *portable*, *deport*, *portal*, and *important* (Henry, 2003). Errors at this stage might reflect lack of knowledge of the part that these base and root meanings play in spelling. For example, Nicole, a fifth grader, wrote in her essay on drug use, about the evils of “ciggarette” smoking. Knowledge of doubling consonants after a short vowel in many words likely prompted the doubling of the medial *g*, whereas the knowledge of the base, *cigar*, and the convention of retaining spellings in derivational words in addition to etymological influences of other languages in English spelling will eventually help her form the correct spelling, *cigarette*.

Are Spelling Stages Distinct?

Other research has demonstrated that although general characteristics of writing sophistication are developmental or at least, as Moats says, “broadly predictable,” (1995, p.33), distinct descriptors of spelling stages may be too rigid to accurately portray the amorphous nature of language knowledge acquisition (Treiman & Bourassa, 2000a, 2000b). One alternate model representing the nature of this eclectic accumulation of language knowledge has been described by Apel, Masterson, & Nessen (2004) in their *repertoire theory*. Repertoire theory postulates that changes in spelling sophistication are measured by the *degree* to

which levels of language knowledge appear in children's writings at any one given age or grade, and that many linguistic elements can be observed throughout spelling development.

Treiman and Bourassa (2000a) also observed that knowledge of the phonological, orthographic, and morphological aspects of language are apparent to varying degrees at even the earliest stages of literacy, although with different dominance at different levels. Children at very early ages exhibit signs of reliance on orthography and morphology as well as phonology. Treiman surmised that because orthographic knowledge exists at early stages, error patterns should reflect this also. She studied error patterns of first graders and found that they over-generalized patterns, such as *ck*, but almost never used it to begin a word, indicating that they had become aware of this English orthographic generalization. In another example, Tolchinsky-Landsmann and Levin (1985) showed that children at a very young age are able to distinguish between print and pictures. Children who are exposed to print begin to be able to recognize English print conventions in non-words. Treiman, Berch, and Tincoff (1993) used non-words that followed pronounceable patterns and were able to show that children in grades kindergarten through second were able to pick out non-words that looked more like real words based on their orthographic patterns. For example, *fubb* looks more like a real word than *ffub*. Cassar and Treiman (1997) tested students' knowledge of double letters and found that as early as kindergarten, children were able to use conventional rules of letter position. They identified non-words as being closer to "real words" when the double letters appeared in the medial or final

position, but not if they appeared at the beginning, which is the rule in English orthography. By first grade, they demonstrated knowledge that some letters do not double in English words, such as *V* and *X*. A study conducted later by Wright and Ehri (2007) confirmed this. Kindergarten and first grade children were taught non-words and later asked to write them. Some of the non-words contained letter combinations that were highly uncommon in English orthography. When asked to write the words after learning them, the children were more likely to change an illegal double at the beginning of a word to a legal position (medial or final). It took fewer trials for the children to learn non-words with legally positioned double letters than for illegal ones.

The use of morphology is more difficult to acquire and is thought to come later in spelling development. At the most complex end of the spectrum, Treiman (2000) used the example of the retention of the silent *g* in *sign* because of its morphological relationship to the word *signal*, which is more likely to be spelled *s-i-n* by beginning students and *s-i-n-e* by students in a more transitional phase. Another example is the phenomenon that affixes in words are not always recognized as separate, meaningful parts from the base or root; for example, spelling “*closlay*” for *close**ly*, shows a lack of recognition that the *-ly* was added to the word *close* to create an adverb. Another complex example of morphological spelling sophistication involves the addition of affixes which change the accented emphasis on a syllable such as changing *magic* to *magician*. However, some morphological influence shows up even in young children’s spelling. In a study carefully observing the spellings of words containing “flaps” (words with a medial *t*

that causes a brief touch of the tongue to the roof of the mouth, resulting in a /d/ sound as in *attic* or *dirty*), Treiman, Cassar, and Zukowski (1994) found that even kindergarteners were able to make fewer errors when there was a base word to guide their spelling such as the *dirt* in *dirty*. The morphological clue - adding the ending *-y* to the familiar word *dirt* - aided in the correct spelling. *Attic* was more likely to be spelled with *d*'s in place of *t*'s, because it "sounded that way" and contains no morphological clues. Children in Grades 1, 2, and 4 all showed a tendency to use morphology in spelling in Treiman and Cassar's 1996 study of single word spellings. Treiman and Cassar observed that leaving off the first letter of an ending consonant blend was more common in one-morpheme words than in two-morpheme words. Though the fourth graders did make better use of morphology, even the first graders were more likely to be observant of the /n/ in *tuned* than in *brand*, because addition of the past tense morpheme *-ed* made the students more conscious of the base word, *tune*.

Repertoire Theory (Apel, Masterson, & Niessen, 2004) serves somewhat as a compromise between the stair-step nature of the stage theory (e.g. Bear & Templeton, 1998) and observations of less systematic appearance of orthographic knowledge at early ages (e.g. Treiman et al., 1994). *Repertoire Theory* allows for progressive development of skills, yet takes into account that a variety of linguistic skills are applied to spelling at all stages, including phonological, orthographic, morphological and semantic. Apel et al. proposed error analysis as a way to tap into the linguistic knowledge of students to inform instruction using writing samples and a word inventory, SPELL (Apel, Masterson, & Niessen, 2004). SPELL

assesses linguistic knowledge at developmental levels such as consonant digraphs, nasal clusters, s- clusters, silent –e, the schwa sound in unstressed syllables, inflected words and derived words. Error analysis based on Repertoire Theory is presented as a problem-solving model using the Spelling Assessment Flowchart (SAF). Rather than placing students within a stage according to the specific error types which represent skills (e.g., Ganske, 2000), this model analyzes each error as to the linguistic skills that underlie the spelling error. For example, an error in a base word would first be analyzed as to whether a deficit in phonemic awareness was the cause of the error. If not, was it a legal orthographic spelling, yet still an error? If yes, then work is needed to develop correct mental orthographic images (MOIs).

Error Analysis for Spelling Instruction

The evidence that the beginnings of orthographic and morphological awareness make their appearance in earlier stages of spelling development (Bourassa & Treiman, 2008; Treiman & Bourassa, 2000a; Treiman, Cassar, and Zukowski, 1994) may have implications for instruction. The more students know about words, roots, affixes and the meanings of all of these, the larger the vocabulary available for recognition in reading and expression in writing. The spellings of approximately 84% of words in the English language are orthographically predictable in some way (Carreker, 2005). Some are predictable because of a one-to-one correspondence between letters and sounds. Other words are predictable because of spellings which are held over from original

languages (Etymological) and others because of consistent syllable patterns and rules for adding meaningful parts such as prefixes and suffixes (Carreker, 2005; Henry, 2003; Joshi, Treiman, Carreker, & Moats, 2009). It makes sense to teach these predictable patterns throughout teaching of spelling and also to incorporate etymological, orthographic and morphological information all through the developmental years.

A variety of methods of conducting a spelling error analysis have added to a growing knowledge base about children's spelling development, with the ultimate result of making the planning of classroom spelling instruction rich and precise (Ganske, 2000; Schlagal, 2002). The finding that children make use of their phonological knowledge to spell is generally credited to the work of Read (1975). Read's research included studies of spellings that children "invented" based on their phonological knowledge and inferences they make from partial knowledge of standard spellings. An example of Read's categorization of errors might be a child's spelling *m-y-t* for the word *meat*, based on the student's phoneme knowledge and the generalization of the sound that letter *y* makes as an ending in the word *happy*. Letter-name spelling, using the phonological properties of letter names in attempts to spell, was also observed by Read in his studies, and confirmed later by Treiman (1993). For example, the name of letter *n* is utilized by many beginning spellers for both the vowel sound /ĕ/ and consonant sound /n/, resulting in a spelling like *wnt* for *went* or *frnd* for *friend*. The qualitative differences of errors at varying levels of literacy observed by Manolakes (1975) led to the notion that spelling instruction for one student may not be appropriate for

another. In his frustration over the lack of progress of some of his sixth grade students, Manolakes conducted a study using word lists created for the study, and he compared the spellings of low, average, and above average spellers, discovering an interesting phenomenon. Students in the upper third spelling level often made one common misspelling per word. As the spelling scores decreased, the number and variety of misspellings increased, with the lower third exhibiting the most varied and bizarre spellings. This discovery, that the quality of the error may be as important and informative for a teacher as the score on a spelling test, started a ripple of interest in a different type of spelling instruction in classroom settings.

More studies of children's writing began to show that errors made by children are not random, that children at different ages and grade levels show fairly predictable patterns in their misspellings and make different kinds of errors (Beers, Strickland, & Grant, 1977; Zutell, 1980). Henderson & Beers (1980) observed first graders' spelling attempts throughout a six month period and chronicled the students' learning of spelling patterns. Again, the letter name strategy was observed, followed by the students' awareness that letters make sounds, the appearance of vowels in students' writing, and students' transition into the use of orthographic markers for long vowels. An example illustrating this progression might be the initial reliance on articulation of the sounds in the word *gate* with the spelling *g-a-t*, then the addition of the more complex marker for the long sound *ā* with *g-a-y-t*, and finally, the correct spelling using the vowel-consonant-e pattern. At this phase, the authors saw budding evidence that syntax

played a part in some but not all of the first graders' spellings of words with affixes. More evidence for patterns of development in spelling were observed by Jorm (1977), who studied the spellings of older students in third, fourth, and fifth grades. He designed a spelling list with words chosen specifically to detect the degree of difficulty students experience making transitions from one letter to the next when spelling. Comparing good and poor spellers, his analysis revealed that making a spelling transition to a vowel was more difficult than transition to a consonant, particularly in unstressed syllables. Poor and younger spellers had more difficulty with vowels than did better spellers who were older.

The 1980s and 1990s brought an increase of interest in spelling research, much of which involved analysis of errors. The work of Gentry and Henderson (in Bear, Invernizzi, Templeton, & Johnston, 2008) and Henderson & Beers (1980) involved examining consistencies in spelling errors across large groups of students and grouping those error patterns into defined stages of spelling behavior, establishing a foundational concept of spelling development. Building on this principle, Morris, Nelson, and Perney (1986) developed a system of scoring the quality of spelling errors with three categories: *pre-conventional phonetic* (no letter/sound correspondence), *conventional phonetic* (letter/sound correspondence), and *morphemic* spellings (e.g. *sreem* for *scream*; *chane* for *chain*). With a sample of 252 children in grades 2-5, the authors observed that the higher the value, or "power" of errors, the higher the quartile score on the spelling test. Holligan and Johnston (1991) used three categories of error types coined by Morris and Perney (in Holligan & Johnston, 1991). They used the terms *pre-*

phonetic, phonetic, and transitional to define evidence of stages of spelling development. Participants in this study were 20 poor readers and spellers matched with 20 normal readers and spellers aged 8 years and 6 months, matched with 20 normal readers and spellers aged 7 years 2 months. Better spellers made errors classified as phonetic because they contained readable representations of language sounds. High level spellers made errors that were classified as “transitional” because they contained elements of more complex orthography, such as adding the long vowel marker *e* in the spelling *grene* for *green*.

Since the 1990’s, researchers have explored the hierarchical nature of the acquisition of spelling knowledge in a variety of ways. Research began to focus on specific aspects of spelling. Nunes, Bryant, and Bindman (1997) examined the morphological spelling of the past tense *-ed* pattern using a list of 30 words designed specifically to test this knowledge. They observed that, over time, children progressed through stages of learning this spelling generalization. At first, the children were unsystematic. As the children learned new spelling generalizations, they were observed to apply these generalizations to the point of over-use, such as adding suffix *-ed* to all words ending in */d/*, including present-tense words. The developmental phenomenon was supported differently in 1999 by Ehri and Soffer in a study of second through sixth grade children who were asked to circle graphophonemic segments of words according to their sounds. Younger, beginning spellers were more likely to circle every letter, an indication of their reliance on single letter-sound correspondence; whereas better, older

spellers circled more clusters of blends and complex vowel combinations, indicating a growing awareness of how English words are spelled because of continuing exposure to it through reading.

Errors occur with some letters more often than others because they are more difficult to detect and, therefore, to learn (Moats, 1993). The aforementioned work of Treiman and colleagues has shed light on how students refine their ability to manipulate sounds when spelling. Younger, less proficient spellers often omit the vowel that comes before the liquid letter *r*, for example, and are more likely to reverse vowel-consonant combinations that contain *r* sound (Treiman, Berch, & Tincoff, 1993). In another example, the sound of letter *t* in the medial position of a word often sounds like /d/ as in the word *city*. Called a “flap” (of the tongue upon the roof of the mouth), this example of place of articulation of letter sounds affects beginning phonetic spelling (Treiman, Cassar, & Zukowski, 1994). Different dialects cause articulation differences which also result in errors (Treiman, Goswami, Tincoff, & Leevvers, 1997). One of two letters in consonant blends are often omitted by younger spellers, particularly at the end of words, as shown in a study by Treiman and Cassar (1996) using spelling words dictated to kindergarten and first graders. In addition, Treiman and Cassar found that attending to morphological structure of words helps with students’ attention to the ending sounds. An example of this might be the higher likelihood of omitting the *d* in the word *brand* than in the word *branded*.

Studies of the spelling errors of students with disabilities have also added to recent refinement of our understanding of spelling development. Stillman, Bahr,

and Peters (2006) analyzed the spellings of a group of language and learning disabled (LLD) children compared to a chronological-aged-matched group and a spelling-age matched group, and divided the errors into three categories: *phonological*, *orthographic*, and *morphological*. The phonological errors were divided further into constrained (requiring markers for long vowels for example) and unconstrained (representation of all sounds, as in the spelling p-e-k for *peek*). Stillman et al. found that the LLD group performed similarly to the younger, spelling-age matched group, indicating that the stages LLD children go through are as sequential as the developmental stages of typically developing children, simply delayed. This has been confirmed by other studies (Bourassa & Treiman, 2003, 2008; Cassar, Treiman, Moats, Pollo, & Kessler, 2003; Invernizzi & Worthy, 1989; Varnhagen & Varnhagen, 1988). However, Stillman et al. did observe particular difficulties with error types within each group. The LLD group had more difficulty with phonological errors, and the spelling-age matched group had more difficulty with complex orthographic patterns. Perhaps this latter observation was because the students in the control group were younger and had not had enough spelling instruction or experience with reading to demonstrate knowledge of as many orthographic patterns. Vowel errors made by children with dyslexia was the focus of a study by Bernstein (2009), who categorized the vowel substitutions as *phonologic* (*han* for *hen*), *alphabetic* (*cr* for *car*), or *orthographic* (*lain* for *lane*). In this study, phonology accounted for the majority of the vowel errors of students with dyslexia.

In the last ten years, spelling error analysis studies have continued to refine our knowledge of what children know as they progress toward spelling proficiency. In a study using both words and non-words which contained double letters, Wright and Ehri (2007) built on Treiman's (1993) work by showing that when small children (kindergarten and first grade) are exposed to more and more print, they begin to conform to legal orthography in their spelling. In the analysis of their errors, even with non-words older spellers, who were at the beginning reading stage, placed double letters in the middle and end of words, as opposed to the beginning. Double letters in initial position of a word is rare in the English language. The observation in the study indicated to the authors that even when children cannot read, they gain awareness through visual exposure to print that certain conventions exist in written language. A study that contributed to the idea that reading and print exposure influences spelling, was an error analysis study with English and Portuguese-speaking children, who were pre-phonological spellers. This study showed that children in each language used letters in their spellings which were proportional to those in spoken language. For example, the Portuguese speaking children used more vowels than did the English-speaking children, mirroring Portuguese orthography with its abundance of vowels (Pollo, Kessler, & Treiman, 2009).

Phoneme awareness in the native language transfers to learning English phonemes and spellings. Yeong and Liow (2010) explored this in a spelling analysis study of 50 ethnic Chinese kindergarten students, who spoke either English or Mandarin as their native language. In high frequency words, there were

no differences in the two groups, indicating that exposure to orthography helped with spelling. However, with low frequency words, there was a statistically significant difference with spelling phonemes that exist in English but not in Mandarin, specifically the /b/ and /v/ sounds.

Spelling error analysis research has supported stages of development (Bear & Templeton, 1998; Bear, Invernizzi, Templeton, & Johnston, 2008; Ganske, 2000; Moats, 1995; Read, 1975). Spelling analysis research has also supported that the progression of spelling knowledge is not rigid or entirely predictable and that elements from later stages can be seen in the early years of literacy development (Apel, Masterson, & Nessen 2004; Sharp, Sinatra, & Reynolds, 2008; Treiman & Bourassa, 2000a; Treiman, Cassar, and Zukowski, 1994).

Implications for Instruction

Spelling instruction and process did not begin to appear in the field of psycholinguistics (the study of the cognitive behaviors and structures that affect language) until the 1980s (Perfetti, 1997). The result of this long neglect is that now there is much variety in the way spelling is taught, if it is given any curricular emphasis at all. Specifically, the attention to the properties of words is often not the focus of spelling instruction, and the task is even now often reduced to the memorization of letters (Schlagal, 2002). Based on the surge of research in the 1980's and 90's, a new way of looking at spelling instruction emerged, known as *developmental word study*, which is matched to what some researchers have identified as developmental spelling *stages* (Frith, in Perfetti, 1997; Ganske, 1999;

Henderson & Beers, 1980; Moats, 1995; Schlagal, 2002). Though the descriptive qualities of the stages of spelling development vary according to the researcher, it is clear that the more exposure to print, the more proficient spelling becomes. In addition, there are observable consistencies in what skills emerge and when they begin to appear in children's writing (Moats, 2000). Spelling inventories, which classify student spelling errors for the purpose of informing instruction, such as the *Qualitative Inventory of Word Knowledge* (Henderson, in Moats, 1995), the *Developmental Spelling Analysis* (Ganske, 2000), and *Words Their Way Spelling Inventories* (Bear, Invernizzi, Templeton, & Johnson, 2008) are used by teachers who are teaching spelling using word study in their classrooms.

Masterson and Apel (2000) provided a similar but alternative way to evaluate spelling errors; spelling involves the "active consideration of the sounds, patterns and meaning of written language" (p. 186). To assess the linguistic knowledge children have acquired, Masterson and Apel recommended using at least 50 words for analysis from children's writings or from formal or informal tests, in which both phonological and morphological knowledge should be observed. Masterson and Apel highly recommended assessing morphological knowledge evident in children's spellings as they mature because of the influence of meaning units in more complex words, and because a weakness in morphological awareness could reflect weakness in reading skill (Carlisle, 2010). It is important for children to acquire knowledge of spelling alternatives. These alternatives might be learned as predictable patterns (letter *c* /k/ usually precedes *a*, *o*, *u*, or a consonant; letter *k* /k/ usually precedes *i*, *e*, or *y*), less predictable graphemes that

simply have to be remembered from repeated exposure, or spellings affected by constraints such as position in the word that give cues for correct spelling (Treiman & Bourassa, 2000a).

Many studies since Read (1971) have focused on spelling development as children grow and read. Fewer studies have examined the variance in performance within one grade level to see if there is a difference in quality of spelling revealed by student errors. In the present study, the linguistic knowledge of children in third grade is examined through analysis of spelling errors on a standardized test.

As evidenced above, some spelling error analysis research has supported stages of development, and other research has shown that the progression of spelling knowledge is not rigid or entirely predictable and that elements from later stages can be seen in the early years of literacy development. Perhaps Sharp, Sinatra, and Reynolds (2008) were correct when they proposed that spelling development be described as a progression or “layering.” What is clear is that as children learn to spell, it is important to know what they do know and what they do not know, to hone in on the properties of words which are within what Vygotsky called the “zone of proximal development” (Gunning, 2006, p. 63), and teach spelling in such a way as to support the growth of literacy. It is clear that on all levels of literacy, some awareness of the complexity of English orthography exists (Treiman & Bourassa, 2000a, 2000b). It is also clear that spelling and literacy develop incrementally as students are exposed to print.

The Purpose of the Present Study

In the present study, the linguistic knowledge of children in Grades 3 and 5 is examined through analysis of spelling errors on a standardized test. The purpose of the study is to determine if poor spellers, average spellers, and high achieving spellers within a given grade level (Grade 3 or 5) show a tendency to make particular types of errors which represent particular levels of linguistic knowledge. Within the context of historical to current theories of spelling development, is it possible that evidence of levels, or stages, of linguistic knowledge exist within one classroom where all students have presumably been exposed to roughly equivalent reading and spelling instruction? In this study the issue of individual differences in spelling skill within the context of the layers, stages, or phases of spelling development is addressed. The Test of Written Spelling-4 (TWS-4) (Larsen, Hammill, & Moats, 1999) and the Test of Silent Word Reading Fluency (TOSWRF) (Mather, Allen, Hammill, & Roberts, 2004) were used to answer the following research questions. Error analysis was used as a means of determining students' use of English phonological, phonetic, orthographic, etymological, and morphological information in the spelling of words:

1. Do students within one grade level who score on varying levels of spelling proficiency on a standardized test make specific types of errors?
2. What is the relation between spelling proficiency and the types of errors students make?

3. Is there a relation between the types of errors students make and their level of word reading fluency?

The Organization of the Present Study

Chapter II is a manuscript that details the results of an error analysis of third-grade students on the TWS-4 (Larsen et al., 1999). Chapter III is a second manuscript that details the error analysis of fifth-grade students on the TWS-4. Chapter IV presents further discussion and conclusions.

CHAPTER II

DO THIRD-GRADE ERROR TYPES INDICATE LEVELS OF LINGUISTIC KNOWLEDGE?

Method

Participants

Data for this study were drawn from performance of 91 Children in Grade 3 attending two public elementary school districts in the southwestern region of the US. The mean age was 9 years and 4 months (SD = .39), with a minimum age of 8 years and 8 months, and maximum age of 10 years and 7months. There were 42 girls and 49 boys. Ethnicity information was obtained for 76 children. Of those participants that yielded the information, 19% of the total sample was of Asian origin; 10% African or African American; 22% Hispanic; and 30% Caucasian. The State of Texas ethnicity report for the above listed ethnicities were as follows: 3% Asian, 13% Black or Black American, 51% Hispanic, 30% Caucasian. Results from 89 participants were included in the analysis. Two students were not included because they did not complete the test. No exclusions from testing were made for any exceptionality or eligibility for special school services because research supports the idea that students identified with disabilities in literacy skills are delayed in development and are progressing on the same skill hierarchy (Bourassa & Treiman, 2008; Cassar, Treiman, Moats, Pollo, & Kessler, 2005;

Invernizzi & Worthy, 1989; Stillman, Bahr, & Peters, 2006). Participation in the study was dependent upon signed parent permission.

Materials and Procedures

TWS-4 (Larsen et al., 1999) and the Test of Silent Word Reading Fluency (TOSWRF; Mather, Allen, Hammill, & Roberts, 2004) were administered to students in their classrooms on a regular school day with their teacher in the classroom.

The TWS-4 was normed in 1993 with a sample of 4,952 students from 23 states who were demographically consistent with the regions in which they lived. The test-retest reliability for form A ranged from .94-.97. Words on the tests were checked by the test authors for instructional relevance and were found to be present in five current spelling basal series. The Pearson correlation index was used for item analysis in choosing the words for the test. The average index for Form A words on the test was .53. Items that were not discriminating were eliminated from the test. Criterion predictive validity tests which correlated scores on the TWS-4 with four other spelling tests yielded a mean coefficient of .88. Construct validity was established by showing that items on the TWS-4 differentiate groups based on age, spelling ability, intellect or aptitude, and special instruction, and that it correlates well with other subjects taught in school. Scores on the test were shown to increase with age, as expected. Scores from a group of identified learning disabled students yielded results 20 points lower (80) than the mean for a sample of scores for average spellers (100). The mean correlation coefficient between the TWS-4 and three achievement tests of reading, math, and

language was .55. The correlation between the TWS-4 and a test of intelligence was .56, a strong indication of the relationship of spelling to basic aptitude.

The tests were administered for one school in late spring near the end of school and in the other in early fall before formal instruction had begun. Therefore, all participants were considered to be third graders for this study. The TWS-4 consists of 50 words which were dictated, used in a sentence, and then repeated following the prescribed protocol from the test publisher. The test ceiling was ignored because of the group administration and because all of the errors would be analyzed for quality above as well as below the ceiling. The TWS-4 was administered first to all children to avoid fatigue on the test which was the main focus of this study. The test score reliability for the present sample was estimated to be .886 (Cronbach's Alpha). The TOSWRF is a short, timed test that requires participants to identify and place slash marks between words in lines with no spaces. Using the Kuder-Richardson -21 formula, score reliability for the TOSWRF for the present study was estimated to be .94.

Rationale for Using the TWS-4. Norm-referenced tests are not typically used to assess and isolate skill difficulties in spelling because they were not designed for this purpose (Larsen et al., 1999). Researchers use normative data for comparison of achievement from one group to another. Criterion referenced tests are used in many classrooms and in research studies to assess spelling skills. Writing samples are also considered good sources for spelling assessment (Apel, Masterson, & Niessen, 2004). The TWS-4 (Larsen et al., 1999) is comprised of words which can be found in spelling texts in the grade levels upon

which the test was normed, and would therefore be words that could be used by children in their writing at each grade level. For this reason, and because the test contains words considered both regular and irregular, the author considered lists on this normed test as natural a selection of words for error analysis as are student writing samples. Additionally, using words above students' ceiling level of spelling provides the opportunity to observe through their errors what generalizations students can make about English orthography, whether or not they are familiar with the words. The words on lists A and B were examined by the author for observable linguistic properties prior to the study to determine if there were enough opportunities for error in the five error categories developed for the study (Word list A analysis is presented in Appendix A).

Error Analysis. A template for analysis of the errors was created by dividing the words into phonemes. Some word parts which would usually be taught as units were maintained as units in the analysis and scored as one, for example the syllable *-ture* in *agriculture*. A scoring guide for error analysis was developed to increase consistency and reliability of categorization of errors. The guide is found in Appendix B.

Inter-rater reliability for the spelling analysis was established with test results from 18 participants and a total of 242 phonemes per test scored by three inter-raters for a total of 4,356 phonemes scored. All three raters including the principle investigator were dyslexia and language therapists certified by the Academic Language Therapy Association. Two raters were qualified instructors through Academic Language Therapy Association, and all three raters were

licensed dyslexia therapists in the State of Texas. Each rater followed the scoring guide (found in Appendix B). Prior to testing for inter-rater reliability, all words that contained no errors were eliminated. Inter-rater reliability was established by determining the percentage agreement of assigned error category between each pair of raters and averaged .94. For the analysis of student errors, each phoneme error was categorized as one of five mutually exclusive categories. Phonological error types were defined as those for which the phoneme is not represented by any symbol, such as the word *linguistic* spelled *ligist*. The phonemes /w/, /i/, and /k/ that were missing from the word would total 3 phonological errors. Phonetic error types were defined as those that are represented by a symbol, but not a legal one for the sound; for example, *fountain*, spelled *fentfd*, would result in three phonetic errors for the illegal representation of /ou/, /ə/, /n/. Orthographic errors had a legal representation of the phoneme, but the incorrect alternative, such as *tranquil* spelled *trankwill*, which resulted in 3 orthographic errors for phonemes /k/, /w/, and /l/. Etymological errors were those spellings influenced by the knowledge of other languages, such as the /n/ phoneme in *knew*, which could be more easily remembered with knowledge of the Anglo-Saxon contribution of silent letters that once were pronounced. Other examples of etymological influence were the soft c and y for the first two phonemes in *cyst*, letter representations contributed by Greek spelling. The awareness of the influence of meanings of word parts characterized morphological categorizations in this study. Examples of morphological errors were the suffix *-ity* spelled *-ety* in *continuity* (*continuety*). In this case, knowledge of the meaning of *-ity* (property or quality of being) as it

applies to words like continuity, enormity, conformity, would be helpful in remembering the spelling of the suffix. ...unless information from the contribution of a language might aid in the correct spelling. If so, the error might be etymological. The following questions aided in category selection for each error:

1. Is the phoneme represented? If not, it is categorized as a phonological error.
2. Is the phoneme represented by grapheme that is legal for the sound? If not it is categorized as a phonetic error.
3. Is the phoneme represented by a legal grapheme but an incorrect one? If so, the error is probably identified as orthographic,
4. If the error is represented by a legal grapheme which is incorrect, could meaning play a part in aiding memory for the correct spelling? If so, this might be a morphological error.

The error categories can be seen in Table 1.

TABLE 1

Categories of Error Types (Grade 3)

<i>Phonological Errors</i>	<i>Phonetic Errors</i>	<i>Orthographic Errors</i>	<i>Etymological Errors</i>	<i>Morphological Errors</i>
Phoneme or syllable is not represented by any symbol	Phonemes are represented with graphemes or other symbols, but illegal ones for the sound.	Phoneme is legal for the sound but is not the correct grapheme, requiring knowledge of a spelling pattern or memorization of an MOI.	Phoneme is represented with legal grapheme but not the correct alternative. In addition, the correct spelling is influenced by spellings derived from Latin, Greek or French which can be taught and generalized to a substantial number of words. (soft <i>ch</i> and <i>gne</i> in <i>champagne</i> influenced by French, <i>k</i> in <i>knife</i> , and <i>knew</i> influenced by Anglo-Saxon).	Phoneme is part of a morpheme which changes or influences the meaning and spelling of the word derived from Greek, Latin, or other language which can be learned and applied a substantial number of other words. (-ous ending in luminous which creates adjectival form and means "quality of").
	Phonemes are added to the word. The phonetic error is assigned to an adjacent grapheme. (example: <i>requisite</i> spelled <i>redquisit</i> ; error is assigned to the /k/ and is phonetic).	Phoneme is represented correctly but is out of order by only one letter (example: <i>tardy</i> – <i>trady</i>).	Student chooses a legal grapheme for which etymological information would aid in correct spelling (example: /f/ in <i>finesse</i> spelled <i>phaness</i> ; knowledge that /f/ spelled <i>ph</i> is Greek and the word is French would aid in choice of the correct spelling for /f/).	Confusion of homophones, correctly spelled: based for baste
	Phoneme is present in the letter string but is out of order by more than one letter		When a word is derived from another word which would aid in correct spelling. (example: schwa vowel in the second syllable of continuity would be clarified by knowledge that the word was derived from <i>continue</i> , in which the second syllable is accented and vowel sound audible)	

Results

Participants were each assigned to one of three achievement groups based on the TWS-4 (Larsen, et al, 1999) standard scores. Group I, with a standard score of 89 or below, was considered in this study to be low (n=12); Group II, with a standard score between 90-110, was considered to be average (n=46); Group III, with a standard score of 111 and above, was considered high (N=31). The validated interpretation of standard scores for the TWS-4 are as follows: < 70 – very poor; 70-79 – poor; 80-89 – below average; 90-110 – average; 111-120 – above average; 121-130 – superior; > 130 – very superior.

Errors were analyzed using the scoring guide (found in Appendix B). Frequency totals were obtained for each error type. Within each error type, the proportion of errors to total errors was calculated for each participant. Proportions, or the proportion of each error type to each student's total errors, rather than frequency of errors, were used in all analyses for this study in order to answer the research question, "Are there predominant types of errors made by students within one grade level at low, average, and high levels of spelling achievement?"

Mean proportions of phonological errors were greater in the low spelling group than phonological means in the average and high achieving groups. Phonetic errors followed the same downward trend from high in the low achieving group to lower in the average and high achieving groups. Orthographic errors, on the other hand, followed the opposite trend, as did etymological and morphological errors, with the lower proportions of errors observed in the low achieving group

and higher proportions seen with the average and high achieving groups. Means and standard deviations are presented in Table 2.

TABLE 2

Means and Standard Deviations of Error Type Proportions

<i>Error Type</i>	<i>Group</i>	<i>Mean</i>	<i>(SD)</i>
Phonological	Group I	.26	(.11)
	Group II	.19	(.11)
	Group III	.10	(.06)
Phonetic	Group I	.31	(.11)
	Group II	.21	(.08)
	Group III	.17	(.10)
Orthographic	Group I	.23	(.08)
	Group II	.26	(.07)
	Group III	.31	(.06)
Etymological	Group I	.09	(.05)
	Group II	.16	(.04)
	Group III	.20	(.06)
Morphological	Group I	.15	(.07)
	Group II	.20	(.06)
	Group III	.21	(.06)

Note. Group I = standard scores of 89 or below (n=12); Group II = standard scores 90-110 (n=42); Group III = standard scores of 113 and above (N=31).

For comparison, means of error types for the total sample of Grade 3 students are in Table 3. Students in the lowest performing group had higher proportions of phonological, phonetic, and orthographic errors than the Grade 3 total group. Conversely, the low achieving spellers had lower proportions of etymological and morphological errors than the total group of third graders

TABLE 3

Means of Error Types for total Grade 3 participants (N = 89)

Error Type	Mean	(SD)
Phonological	.17	(.11)
Phonetic	.22	(.10)
Orthographic	.28	(.18)
Etymological	.16	(.06)
Morphological	.18	(.07)

As can be seen in the following graphs of mean error proportions, error types follow a continuum along the line of achievement. Phonological errors, presented in Figure 1, are proportionally more numerous at lower spelling achievement levels and less numerous at higher levels. Students with average spelling scores have lower proportions of phonological errors, and the highest level spelling group had the lowest proportion of phonological errors. Phonetic errors, such as shown by the dotted line in Figure 1, are also proportionally more predominant in low-achieving spellers than average-achieving spellers, with the highest achievers having the lowest proportion of phonetic errors.

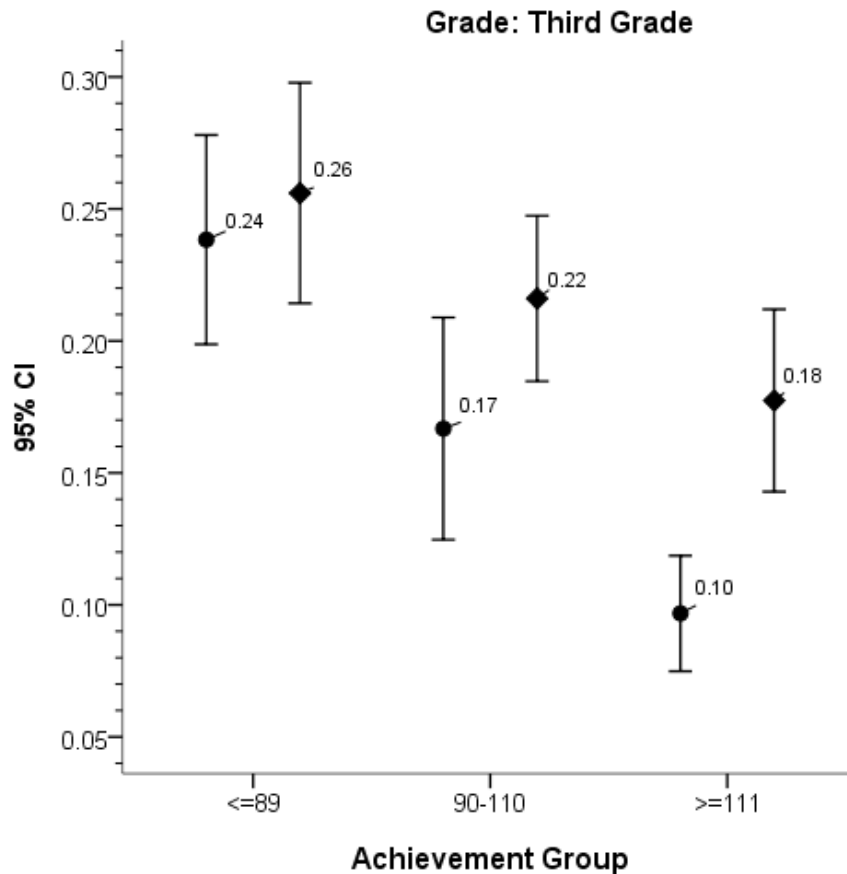


FIGURE 1 Phonological and Phonetic Error Type Proportions at Three Spelling Achievement Levels. ● = phonological; ◆ = phonetic.

However, orthographic errors, as presented in Figure 2, those that would require the learning of a spelling pattern or a mental orthographic image, are proportionally fewer in the spellings of low achievers and higher as spelling achievement scores increase. Likewise, etymological errors, as presented in Figure 2, which depend upon knowledge of the contribution of language to English spelling, are more numerous among high achievers. Morphological errors (as presented in Figure 2), those that are influenced by knowledge of morphemes or meaning units of language, followed the same pattern. These error types were

proportionally less numerous in the spellings of low achievers than those of high achievers.

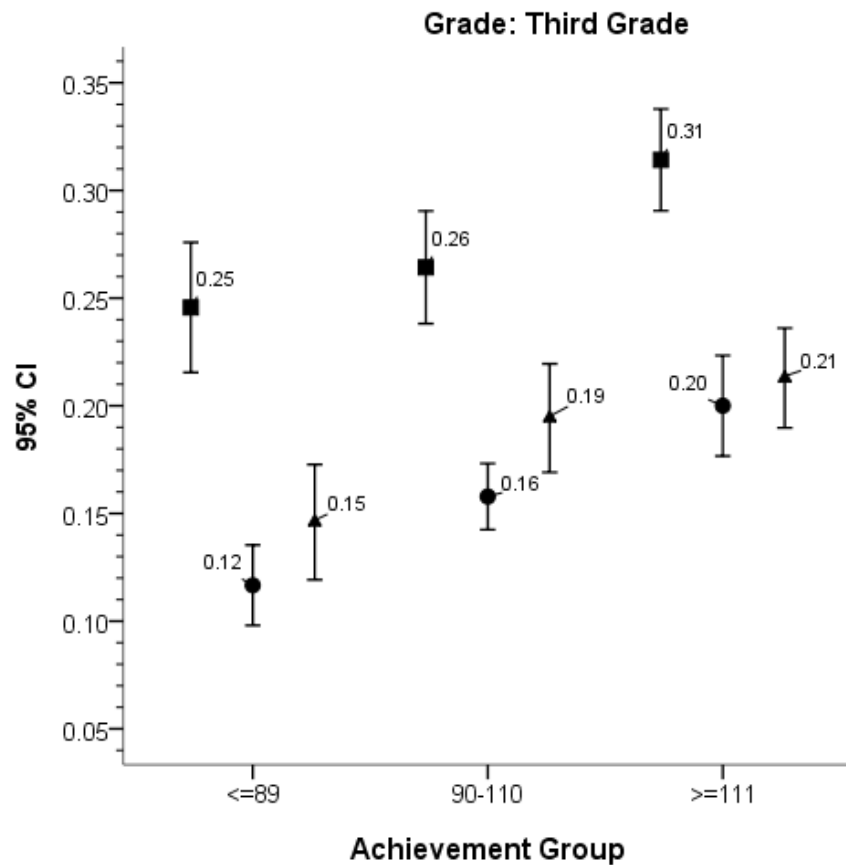


FIGURE 2 Orthographic, Etymological, and Morphological Error Type Proportions at Three Spelling Achievement Levels. ■ = orthographic; ▲ = etymological; ● = morphological.

Levine's test was used to show homogeneity of variances for all error type proportions. There was statistically significant difference in variance of phonological and etymological error types. Results of a one-way ANOVA showed

statistically significant differences in proportions for all five error types and are shown in Table 4.

TABLE 4
One-Way ANOVA Summary Table of Error-Type Proportions Grade 3

		<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
Phonological	Between	.272	2	.136	16.92	.000
	Within	.785	86	.009		
	Total	1.057	88			
Phonetic	Between.	.152	2	.076	5.358	.000
	Within	.747	86	.009		
	Total	.900	88			
Orthographic	Between	.083	2	.041	8.139	.001
	Within	.431	86	.005		
	Total	.514	88			
Etymological	Between	.107	2	.054	18.595	.000
	Within	.235	86	.003		
	Total	.342	88			
Morphological	Between	.086	2	.043	8.054	.000
	Within	.369	86	.004		
	Total	.455	88			

Due to the differences in group size and lack of homogeneity of variance assumption, a Tukey post hoc test with a Bonferroni correction was used to show differences of error type proportions among achievement groups. Results showed statistically significant differences in proportion of phonological errors between achievement Groups I and III (low and high), and between Groups II and III (average and high), but not between Groups I and II. Phonetic proportions were statistically significant between the lowest and average achieving groups, and also

between the lowest and highest groups, but not between average and high-level spellers. Orthographic proportions were statistically significantly different between low spellers and high spellers, between average spellers and high spellers, but there was no significant difference between low and average spellers. Proportions of etymological errors were statistically significantly different among all groups. Morphological error proportions were statistically significantly different for low spellers in comparison to both average and high level groups, but average spellers and high level spellers did not show significant difference. Table 5 shows post hoc comparisons.

TABLE 5
Multiple Comparisons among Three Achievement Groups

Error Type	Achievement Group		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
Phonological	I	II	.066	.031	.111	-.010	.141
	I	III	.159 *	.032	.000	.079	.238
	II	III	.093 *	.022	.000	.039	.148
Phonetic	I	II	.092 *	.030	.009	.186	.166
	I	III	.133 *	.032	.000	.055	.210
	II	III	.040	.022	.201	-.013	.093
Orthographic	I	II	-.034	.023	.418	-.090	.022
	I	III	-.087 *	.024	.002	-.146	-.028
	II	III	-.052 *	.016	.006	-.093	-.012
Etymological	I	II	-.052 *	.017	.008	-.094	-.011
	I	III	-.105 *	.018	.000	-.148	-.062
	II	III	-.053 *	.012	.000	-.082	-.023
Morphological	I	II	-.070 *	.021	.004	-.122	-.019
	I	III	-.099 *	.022	.000	-.154	-.045
	II	III	-.029	.015	.180	-.066	.008

* difference is significant at the .05 level.

To determine if there was a relationship between error type and spelling achievement level, a Pearson product-moment correlation analysis was performed, using the proportion of total errors for each of the five error types and the TWS-4 standard scores. The TOSWRF (Mather et al., 2004) was included as a variable in order to see the relationships of spelling achievement and error type with a literacy measure for this sample of participants. Correlations for all five error type proportions with TWS standard scores were statistically significant at the .01 level. Phonological and Phonetic errors were negatively correlated with spelling achievement ($r^2 = -.582$ and $-.453$, respectively), whereas orthographic, etymological, and morphological errors were positively correlated with spelling achievement ($r^2 = .464$, $.610$, and $.495$, respectively). The TOSWRF (Mather, et al., 2004) correlated negatively with phonological and phonetic errors and positively with orthographic, etymological, and morphological errors although the correlation was only statistically significant for etymological errors. This test of reading fluency had a correlation with the TWS-4 of $.393$ which was statistically significant ($p < .01$). Correlations can be seen in Table 6.

TABLE 6

Correlations: Error Proportions with TWS-4 Standard Score (N = 89)

Standard Scores	Phono.	Phonet.	Ortho.	Etym.	Morph.	TWS
TWS	-.582**	-.453**	.464**	.610**	.495**	
TOSWRF	-.090	-.187	.120	.225*	.084	.393**

Note. Phono = Phonological; Phonet = Phonetic; Ortho = Orthographic; Etym = Etymological; Morph = Morphological;

** Correlation is significant at the 0.01 level (2-tailed) ;

* Correlation is significant at the 0.05 level (2-tailed).

A Pearson Product Moment Correlation using error type proportions as variables showed a positive, statistically significant relationship between phonological and phonetic errors ($p < .01$). There was a negative correlation between phonological errors and the three higher level errors, orthographic, etymological, and morphological ($p < .01$). Phonetic errors showed a similar pattern, with a negative correlation with these three higher level error types. Orthographic, etymological, and morphological errors were statistically significantly correlated with each other ($p < .01$). Correlations can be seen in Table 7.

TABLE 7
Pearson Correlations: Error Type Proportions (N = 89)

	Phonological	Phonetic	Orthographic	Etymological
Phonetic	.41**			
Orthographic	-.77**	-.66**		
Etymological	-.64**	-.74**	.55**	
Morphological	-.72**	-.69**	.55**	.56**

Note. ** correlation is significant at the 0.01 level (2-tailed)

Discussion

Third grade students in this study were administered the TWS-4 (Larsen, et al., 1999) and the TOSWRF (Mather, et al, 2004) on a school day by the principal investigator. Errors on the TWS-4 were categorized as to the level of linguistic knowledge required for correct spelling. Phonological errors were defined as phonemes not represented. Phonetic errors were defined as phonemes represented by a grapheme that was an illegal representation of the phoneme. Orthographic errors were defined as legal representations of a phoneme that are incorrect and that would require either the teaching of a regular spelling pattern or a mnemonic for remembering an irregular spelling. Etymological errors were legal representations of a phoneme, though incorrect, and those for which knowledge of the contribution of language would aid in the spelling of the word, such as the Greek contribution of *ph* for the phoneme /f/. Finally, Morphological errors were legal representations of phonemes for which linguistic knowledge of morphemes

would be helpful in correct spelling, such as the spelling of the suffix *-ous* in a word which would change the form and meaning of the word to the adjectival form of the word. Errors were categorized as morphological if the morpheme was a common one which could be applied to a large number of words and therefore be useful to teach.

Low achieving spellers, those defined in the present study as having a standard scores on the TWS-4 (Larsen, et al., 1999) of less than 89, made proportionally more phonological and phonetic errors than those with average (standard scores of 90-110) or high (standard scores of 111 and above) spelling achievement. Students in the low spelling achievement group made proportionally fewer orthographic, etymological, and morphological type errors than did average and high achieving spellers. The proportion of error types in each category correlated either positively or negatively with standard scores on the TWS - 4. Phonological and phonetic errors correlated negatively with TWS-4 standard scores, indicating that the higher level the spelling achievement, the lower the proportion of these basic types of errors. Etymological errors followed the opposite trajectory and correlated positively with TWS-4 standard scores, indicating a positive correlation between spelling achievement and linguistic knowledge of the meaning contribution of other languages to complex English spellings. The differences among all achievement groups were statistically significantly different for etymological errors.

The low achieving group consistently differed from the high achieving group in all error categories. The low and average groups did not differ statistically

significantly in the phonological and orthographic categories. For phonetic errors, the average and high group means differed, but not statistically significantly.

These results are possibly a result of the fact that in third grade some phonological, phonetic and orthographic information is still being emphasized in spelling instruction at this age. For morphological errors, the average and high groups differed, but not statistically significantly, possibly because this is an area of linguistics that is not usually emphasized as much in third grade to the extent that it would have affected performance on this test. Morphological instruction typical for third grade would be more geared toward inflectional endings and changes in spelling and accent as a result of adding these endings. There were no inflectional morphemes represented on the test, and the words that contained teachable morphemes were beyond the ceiling for average standard scores.

The phonological and phonetic properties of words are those that are learned in earlier stages of reading and spelling development in Grades K-2. Exposure to more complex spellings increases orthographic awareness of more complex spellings, and the readiness for information about the contribution of other languages to English spelling, such as Latin and Greek, and the contribution of meaning to spelling, such as the learning of meaningful affixes. The fact that low-level spellers in Grade 3 in this study were still struggling with a high proportion of phonological, phonetic, and orthographic errors indicated that there was still a need to make sure these skills are in place with students who score low on a spelling achievement test.

These data indicated that teachers of students who perform poorly on standardized tests of spelling would be wise to screen further for basic phonological and phonetic spelling skills, as well as make use of systematic instruction in regular orthographic spelling patterns. Screenings do not have to be time-consuming and could include observations of writing assignments, observational analyses of errors on weekly spelling tests, and informal screenings and formative assessments of phonological and phonetic skill with spelling. By third grade, isolated phonemic awareness activities without the teaching of spelling patterns would not be time efficient. However, it would be advisable to equip students with a method for assuring that they are representing every phoneme when spelling, such as un-blending the word carefully. In addition, direct and systematic instruction of the spelling patterns that are regular in the English language would be preparatory to the additional knowledge of Greek, Latin, and French contributions and the spellings of morphemes (Berninger & Wolf, 2009; Carlisle, 2000; Carreker, 2005; Henry, 2003).

Limitations of the Study

The orthographic error category remained the highest category of error even for the highest achieving spellers. It is possible that utilizing more morphological information in the analysis would have increased morphological errors and decreased orthographic proportions. In this study a morphological error was defined as such if it applied to a large number of words and therefore would serve to widen vocabulary in a time-efficient manner. But examining words

for morphological properties and teaching more morphology would certainly not be harmful and would reduce even further the necessity for memorization. It is possible that with a larger sample size, grouping of students into achievement levels that were closer to the actual TWS-4 (Larsen et al., 1999) normed scores would have been possible, and achievement group differences even greater. However, this study did show that error type proportions do follow a trend that mirrors spelling stages/ phases, even within one class grade level. Morphological information and etymological information are close in content and would most likely be taught in tandem. Therefore, it might have been appropriate in this study to collapse these two categories for analysis.

The reading fluency standard scores on the TOSWRF (Mather et al., 2004) were correlated with error type means from the entire TWS-4, which would have included words that were above the students' ceiling and therefore, out of the range of words that are familiar to them. Correlations between reading and spelling error type would perhaps be more accurate if they included only means of error type proportions from the words that were at or below a typical ceiling level for a Grade 3 student.

CHAPTER III
DO FIFTH-GRADE ERROR TYPES INDICATE
LEVEL OF LINGUISTIC KNOWLEDGE?

Method

Participants

Data for this article were drawn from the performance of 107 children in Grade 5 attending public schools and private schools in the southwestern region of the US. Participants were of average age 11 years 5 months, and ages ranged from 10 years 0 months to 12 years 10 months. Two students were not included because they did not complete the test, and so a total of 105 student responses were included in the analysis of the TWS-4. For correlations with the reading fluency measure, TOSWRF, 103 students completed the test. There were 45 girls and 60 boys included in the spelling study. Ethnicity information was obtained for 83 of the children. Of those participants from schools that yielded the information, 3.6% were of Asian origin; 9.6% African or African American; 25% Hispanic; and 57.8% Caucasian. This ethnicity breakdown compares to that of the Texas Education Agency report for 2010-2011 as follows: 3.5% Asian, 13% Black or Black American, 50% Hispanic, 31% Caucasian. No exclusions from testing were made for any exceptionality or eligibility for special school services based on research supporting the idea of learning delays among children who struggle with spelling (Bourassa & Treiman, 2008; Cassar, Treiman, Moats, Pollo, & Kessler, 2003; Invernizzi & Worthy, 1989; Stillman, Bahr, and Peters, 2006).

Materials and Procedures

TWS-4 (Larsen et al., 1999) and TOSWRF (Mather, et al., 2004) were administered by the PI to students in their classrooms on a regular school day with their teacher in the classroom. The TWS-4 was normed in 1993 with a sample of 4,952 students from 23 states who were demographically consistent with the regions in which they lived. The test-retest reliability for form A ranged from .94-.97. Words on the tests were checked by the test authors for instructional relevance and were found to be present in five current spelling basal series. The Pearson correlation index was used for item analysis in choosing the words for the test. The average index for Form A words on the test was .53. Items that were not discriminating were eliminated from the test. Criterion predictive validity tests which correlated scores on the TWS-4 with four other spelling tests yielded a mean coefficient of .88. Construct validity was established by showing that items on the TWS-4 differentiate groups based on age, spelling ability, intellect or aptitude, and special instruction, and that it correlates well with other subjects taught in school. Scores on the test were shown to increase with age, as expected. Scores from a group of identified learning disabled students yielded results 20 points lower (80) than the mean for a sample of scores for average spellers (100). The mean correlation coefficient between the TWS-4 and three achievement tests of reading, math, and language was .55. The correlation between the TWS-4 and a test of intelligence was .56, a strong indication of the relationship of spelling to basic aptitude.

The tests were administered in late spring of the fifth grade year for some participants and for other participants in early fall before formal instruction had begun. Therefore, all participants were considered to be fifth graders. The TWS-4 consists of 50 words which were dictated, used in a sentence, and then repeated following the prescribed protocol from the test publisher. The test ceiling was ignored because of the group administration and because all of the errors would be analyzed for quality, above, as well as below the ceiling. The TOSWRF is a timed, three-minute test in which the students examine lines of print with no spaces and place a slash between real words. Test score reliability for the present sample on the TWS-4 was estimated to be .924 (Cronbach's Alpha). Using the Kuder-Richardson-21 formula, test score reliability for the present study on the TOSWRF was estimated to be .95.

Rationale for Using the TWS-4. Norm-referenced tests are not typically used to assess and isolate skill difficulties in spelling because they were not designed for this purpose. Researchers use normed data for comparison of achievement from one group to another. Criterion referenced tests are used in many classrooms and in research to assess spelling skills. Writing samples are also considered good sources for spelling assessment (Apel, Masterson, & Niessen, 2004). The TWS-4 (Larsen et al., 1999) is comprised of words which can be found in spelling texts in the grade levels upon which the test was normed, and therefore would be composed of words potentially used by children in their writing at each grade level. For this reason, and because it contains words considered both regular and irregular, the author considered lists on this normed test as

natural a selection of words for error analysis as were student writing samples. Additionally, using words above students' ceiling level of spelling provides the opportunity to observe through their errors what generalizations students can make about English orthography, whether or not they are familiar with the words. The words on lists A and B were examined by the PI for their linguistic properties prior to the study to determine if there were enough opportunities for error in the five error categories developed for the study (see word list A analysis in Appendix A).

Error Analysis. A template for analysis of the errors was created by dividing the words into phonemes. Some word parts which would usually be taught as units were maintained as units in the analysis and scored as one, for example, the *-ture* in *agriculture*. Inter-rater reliability for the spelling analysis was established with test results from 18 participants and a total of 242 phonemes per test scored by three inter-raters. All three raters, including the PI, were dyslexia and language therapists certified by the Academic Language Therapy Association and licensed by the State of Texas as Dyslexia Therapists. Each rater followed a detailed scoring guide (see Appendix B). Inter-rater reliability was established by determining the percentage agreement of assigned error category between each pair of raters and averaged .94. For the analysis, each phoneme error was categorized as one of five mutually exclusive categories outlined in Table 6. Phonological error types were defined as those for which the phoneme is not represented by any symbol, such as the word *linguistic* spelled *ligist*. The phonemes /w/, /i/, and /k/ that were missing from the word would total 3

phonological errors. Phonetic error types were defined as those that are represented by a symbol, but not a legal one for the sound; for example, *fountain*, spelled *fentfd*, would result in three phonetic errors for the illegal representation of /ou/, /ə/, /n/. Orthographic errors had a legal representation of the phoneme, but the incorrect alternative, such as *tranquil* spelled *trankwill*, which resulted in 3 orthographic errors for phonemes /k/, /w/, and /l/. Etymological errors were those spellings influenced by the knowledge of other languages, such as the /n/ phoneme in *knew*, which could be more easily remembered with knowledge of the Anglo-Saxon contribution of silent letters that once were pronounced. Other examples of etymological influence were the soft *c* and *y* for the first two phonemes in *cyst*, letter representations contributed by Greek spelling. The awareness of the influence of meanings of word parts characterized morphological categorizations in this study. Examples of morphological errors were the suffix *-ity* spelled *-ety* in *continuity* (*continuety*). In this case, knowledge of the meaning of *-ity* (property or quality of being) as it applies to words like continuity, enormity, conformity, would be helpful in remembering the spelling of the suffix.

Results

Students were assigned to one of three achievement groups based on TWS-4 (Larsen et al., 1999) standard scores. Group I, students with a standard score of 89 or below, were considered in this study to be low spellers (n=28); Group II, participants with standard scores of 90-110, were considered to be average spellers (n=42); Group III, participants with standard scores of 111 and above, were considered high-average-to-high-level spellers (N=34). The interpretation of standard scores for the TWS-4 are as follows: < 70 – very poor; 70-79 – poor; 80-89 – below average; 90-110 – average; 111-120 – above average; 121-130 – superior; >130 – very superior.

Errors were analyzed using the scoring guide that is found in Appendix B and in Table 6. Frequency totals were obtained for each error type. Within each error type, the proportion of errors to total errors was calculated for each participant. Proportions, the proportion of each error type to each student's total errors, rather than frequency of errors, were used in all analyses for this study in order to answer the research question: "Are there predominant types of errors made by students within one grade level at low, average, and high levels of spelling achievement?"

TABLE 8

Categories of Error Types

Phonological Errors	Phonetic Errors	Orthographic Errors	Etymological Errors	Morphological Errors
Phoneme or syllable is not represented by any symbol	Phonemes are represented with graphemes or other symbols but illegal ones for the sound.	Phoneme is present in the letter string but is out of order by more than one letter	Phoneme is represented with legal grapheme but not the correct alternative. In addition, the correct spelling is influenced by spellings derived from Latin, Greek or French which can be taught and generalized to a substantial number of words. (soft <i>ch</i> and <i>gne</i> in <i>champagne</i> influenced by French, <i>k</i> in <i>knife</i> , and <i>knew</i> influenced by Anglo-Saxon).	Phoneme is part of a morpheme which changes or influences the meaning and spelling of the word derived from Greek, Latin, or other language which can be learned and applied a substantial number of other words. (-ous ending in luminous which creates adjectival form and means "quality of").
	Phonemes are added to the word. The phonetic error is assigned to an adjacent grapheme. (example: <i>requisite</i> spelled <i>redquisit</i> ; error is assigned to the /k/ and is phonetic).	Phoneme is present in the letter string, but is out of order by more than one letter Phoneme is represented correctly but is out of order by only one letter (example: <i>tardy</i> – <i>trady</i>).	Student chooses a legal grapheme for which etymological information would aid in correct spelling (example: /f/ in <i>finesse</i> spelled <i>phaness</i> ; knowledge that /f/ spelled ph is Greek and the word is French would aid in choice of the correct spelling for /f/).	Confusion of homophones, correctly spelled: based for baste
	Phoneme is present in the letter string but is out of order by more than one letter		When a word is derived from another word which would aid in correct spelling. (example: schwa vowel in the second syllable of continuity would be clarified by knowledge that the word was derived from continue, in which the second syllable is accented and vowel sound audible)	

Means for proportions of phonological errors were greater in the low spelling group than phonological means in the average and high achieving groups. Phonetic errors followed the same downward trend from high in the low achieving group to lower in the average and high achieving groups. Orthographic errors, on the other hand, followed the opposite trend, as did etymological and morphological errors, with the lower proportions of errors observed in the low achieving group and higher proportions seen with the average and high achieving groups. Means and standard deviations for the error type proportions of each achievement group are recorded in Table 9. For comparison purposes, means for the entire sample of Grade 5 participants are found in Table 10. Students who score low on the spelling achievement test, Group I, have a higher proportion of phonological and phonetic errors than the grade mean of errors. Group I commits lower proportions of orthographic, etymological, and morphological errors than the Grade 5, as a whole. Etymological and morphological errors were proportionally less numerous in this low-achieving group. On the other hand, Group III, the high-level spellers, scored proportionally lower numbers of phonological and phonetic errors than the total group means and higher proportions of etymological errors than the total group means.

TABLE 9
*Grade 5 Means and Standard Deviations of Error Type Proportions for
 Groups I, II, and III*

<i>Error Type</i>	<i>Group</i>	<i>Mean</i>	<i>(SD)</i>
Phonological	Group I	.21	(.11)
	Group II	.08	(.07)
	Group III	.04	(.06)
Phonetic	Group I	.28	(.10)
	Group II	.17	(.09)
	Group III	.09	(.09)
Orthographic	Group I	.24	(.08)
	Group II	.33	(.06)
	Group III	.38	(.10)
Etymological	Group I	.12	(.06)
	Group II	.21	(.06)
	Group III	.32	(.10)
Morphological	Group I	.15	(.07)
	Group II	.21	(.06)
	Group III	.17	(.09)

Note. Group I = standard scores of 89 or below (n=28); Group II = standard scores between 90 and 110 (n=42); Group III = standard scores of 111 and above (N=34).

TABLE 10
 Means of Error Type Proportions for Total Grade 5 Participants

<i>Error Type</i>	<i>Mean</i>	<i>(SD)</i>
Phonological	.10	(.11)
Phonetic	.17	(.12)
Orthographic	.32	(.10)
Etymological	.22	(.11)
Morphological	.18	(.07)

Figure 3 illustrates the downward trend of phonological and phonetic error types as spelling achievement increases.

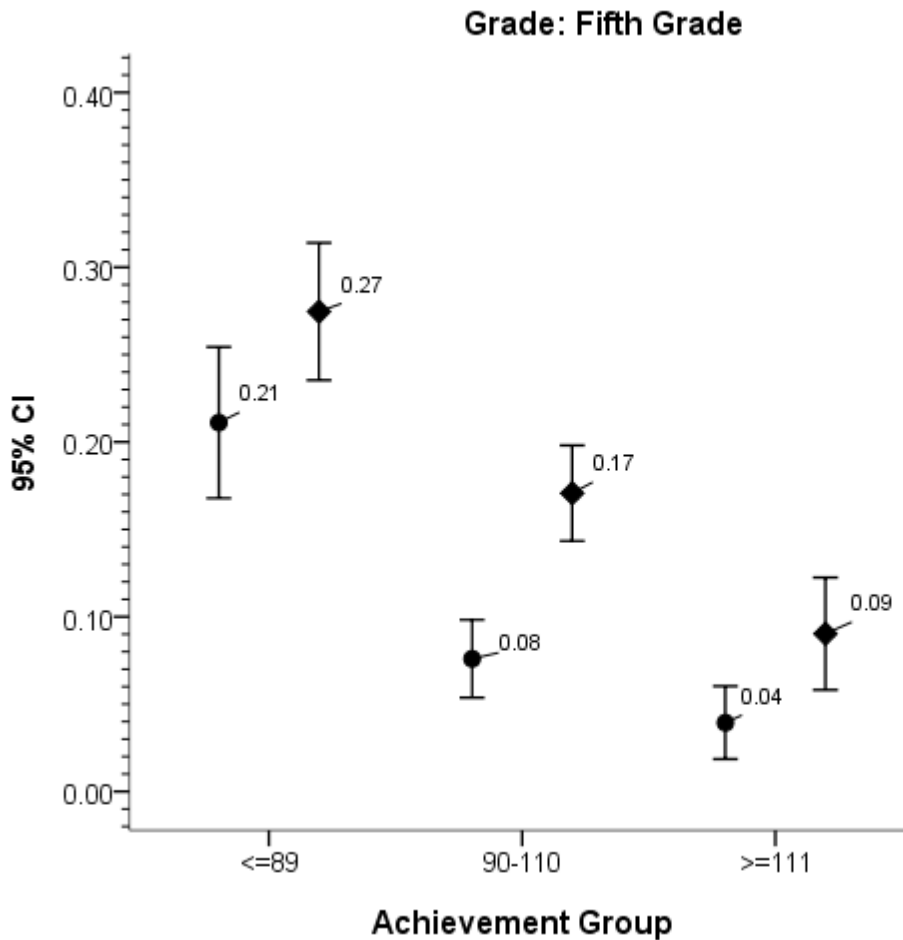


FIGURE 3 Phonological and Phonetic error Proportions at Three Achievement Levels.
 ● = phonological errors. ◆ = phonetic errors.

In Figure 4, the trending upward of higher-order errors (orthographic, etymological, and morphological) can be seen from low achievers to average achievers. However, the morphological error category in this fifth grade sample reduces with high level spelling achievement.

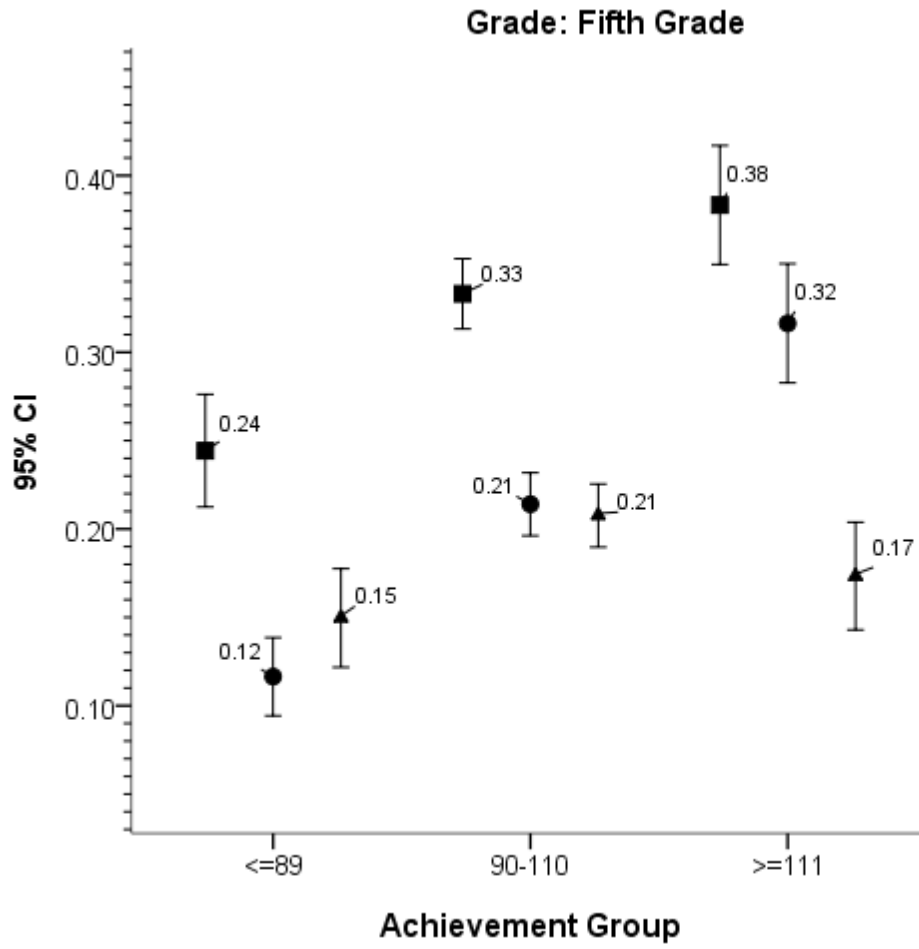


FIGURE 4 Orthographic, Etymological, and Morphological Error Proportions at Three Achievement Levels. ■ = orthographic; ● = etymological; ▲ = morphological.

Results of a one-way ANOVA showed statistically significant differences among the 3 groups for all five error types. Results are displayed in Table 11.

TABLE 11
One-Way ANOVA Summary Table of Error-Type Proportions

Error Type		<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
Phonological	Between	.491	2	.245	37.419	.000
	Within	.656	100	.007		
	Total	1.147	102			
Phonetic	Between	.515	2	.258	30.082	.000
	Within	.856	100	.009		
	Total	1.371	102			
Orthographic	Between	.297	2	.149	23.337	.000
	Within	.637	100	.006		
	Total	.935	102			
Etymological	Between	.608	2	.304	59.562	.000
	Within	.511	100	.005		
	Total	1.119	102			
Morphologic al	Between	.059	2	.030	5.793	.004
	Within	.511	100	.005		
	Total	.570	102			

Tukey Post Hoc test with a Bonferroni correction was used to show differences among the three achievement groups to correct for the different group sizes. Results showed statistically significant differences in proportion of

phonological errors between the low achieving spellers, Group I, and both of the other groups, but the average, Group II, and high achieving, Group III, did not differ statistically significantly. Phonetic proportions were statistically significantly different among all groups, as were orthographic and etymological error types. Morphological error proportions were statistically significantly different for low spellers in comparison to average spellers. There was no statistically significant difference between achievement Groups II and III. There was also no difference between Groups I and III, the lowest and highest achieving groups. Approximately half of the sample for the present study included students in a private school in which the principal reported the use of a spelling program that emphasized the use of morphemes. Therefore, it could be that groups I and III both made fewer morphological errors for different reasons – the low group was making errors in other categories, and the high group made fewer errors in this category because they spelled the morphemes correctly. Multiple Comparisons can be reviewed in Table 12.

Table 12

<i>Multiple Comparisons of Error Types</i>							
<i>Error Type</i>	<i>Group</i>		<i>Mean Diff.</i>	<i>Std. Error</i>	<i>Sig.</i>	<i>95% Conf. Int.</i>	
Phonological	I	II	.135	.019	.000	.089	.181
	I		.172	.020	.000	.123	.220
	III						
	II	III	.037	.018	.135	.007	.081
Phonetic	I	II	.104	.023	.000	.048	.160
	I		.184	.024	.000	.126	.243
	III						
	II	III	.080	.022	.001	.027	.134
Orthographic	I	II	-.088	.016	.000	-.129	-.049
	I		-.139	.017	.000	-.181	-.097
	III						
	II	III	-.050	.016	.006	-.088	-.012
Etymological	I	II	-.098	.016	.000	-.136	-.059
	I		-.200	.017	.000	-.240	-.159
	III						
	II	III	-.102	.015	.000	-.139	-.065
Morphological	I	II	-.058	.016	.002	.100	-.018
	I		-.024	.017	.500	-.065	.018
	III						
	II	III	.034	.015	.087	-.003	.072

To determine if there was a relationship between error type, spelling achievement level, and reading fluency, a Pearson product-moment correlation analysis was performed using the proportion of total errors for each of the five error types, TWS-4 (Larsen et al., 1999) standard scores, and the standard scores on the TOSWRF (Mather, et al., 2004). Pearson correlations for all five error type proportions with TWS standard scores were statistically significant at the .01 level. Phonological and Phonetic errors were highly negatively correlated with spelling

achievement ($r^2 = -.677$ and $-.640$, respectively, $p < .01$). Orthographic and etymological errors were positively correlated with spelling achievement ($r^2 = .624$, $.723$, respectively, $p < .01$). Morphological errors had a low but positive correlation with standard scores in spelling ($r^2 = .201$, $p < .05$).

Standard scores on the TOSWRF (Mather et al., 2004), the test of word reading fluency, correlated highly with TWS standard scores ($r^2 = .717$, $p < .01$) and followed a similar pattern with the spelling scores with respect to error type. Reading fluency scores had a negative correlation with proportions of phonological and phonetic error types ($r^2 = -.507$, $-.416$ respectively, $p < .01$). However, orthographic and etymological error types had were positively correlated with word reading fluency scores ($r^2 = .540$, $.486$, respectively, $p < .01$). TOSWRF standard scores and morphological errors were not statistically significantly correlated ($r^2 = .05$, $p < .05$). Pearson correlations can be seen in table 13. In order to examine the relationships among error types, a Pearson Correlation was performed with only the error type proportions as variables. Phonological and phonetic error types have a moderate positive correlation but a negative correlation to the other three higher level error types. Correlations for the error types are presented in Table 14.

Table 13

Pearson Correlations: Mean Error Proportions on TWS-4 (N = 105) and TOSWRF (N= 103)

Standard Scores	Phono	Phonet	Ortho	Etym	Morph	TWS
TWS	-.677**	-.640**	.624**	.723**	.201*	
TOSWRF	-.507**	-.416**	.540**	.486**	.050	.717**

Note. Phono = Phonological; Phonet = Phonetic; Ortho = Orthographic; Etym = Etymology; Morph = Morphology; TWS = Test of Written Spelling Larsen et. al, 1999); TOSWRF = Test of Silent Word Reading Fluency, 2004); ** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed).

Table 14

Pearson Correlations among Grade 5 Error Types

	Phonological	Phonetic	Orthographic	Etymological
Phonological	1			
Phonetic	.53 **			
Orthographic	-.72 **	-.71 **		
Etymological	-.71 **	-.71 **	.54 **	
Morphological	-.42 **	-.41 **	.14	.06

**correlation is significant at the .01 level (2-tailed).

It is interesting to note that the morphological errors in this fifth grade sample decreased in frequency for the highest achieving spellers. Participants were from two schools, one public and one private school. Students in the private school ($N = 59$) comprised 56% of the sample and were reported by the principal to have been instructed by a spelling program that emphasized the spellings and

meanings of morphemes. A graph of the comparison of means for morphological error types can be found in Figure 5.

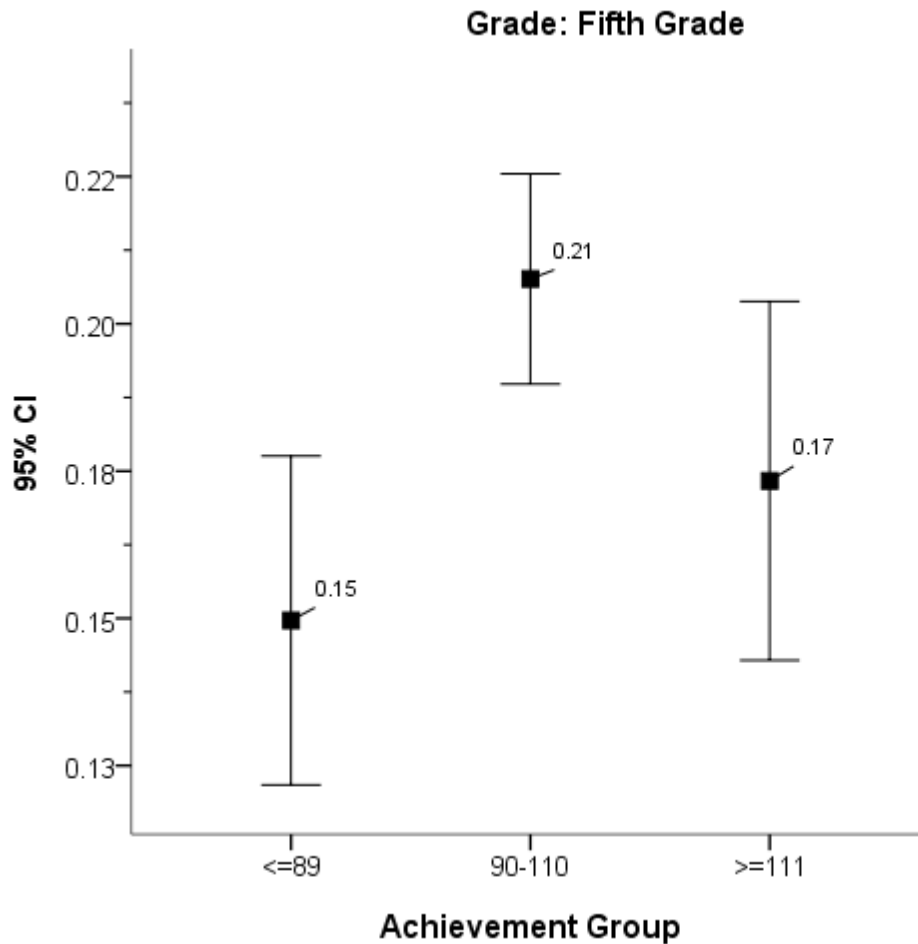


FIGURE 5 Comparison of Means of Morphological Error Types by Achievement Group.

Discussion

Fifth grade students in public and private schools in the southwestern region of the US were given the TWS-4 (Larsen, et al., 1999) and the TOSWRF (Mather, et al., 2004). The TWS-4 was scored according to the test directions and participants were divided into three achievement groups: low, average, and high,

according to their standard scores. Errors on the test were analyzed for quality and each error was placed in one of five mutually exclusive categories representing error types: phonological, phonetic, orthographic, etymological, and morphological. The proportion of total errors for each error type was used for all analyses in the present study. The error types followed a continuum along the line of achievement. Phonological errors were proportionally more numerous at lower spelling achievement levels and less numerous at higher levels. Students with average spelling scores made lower proportions of phonological errors. The highest level spelling group had the lowest proportion of phonological errors. Phonetic errors were also proportionally more predominant in low-to-low-average achieving spellers than higher achieving spellers, with the highest achievers having the lowest proportion of phonetic errors. Orthographic and etymological errors trended upward with achievement scores, with the lowest achieving spellers having the lowest proportion of orthographic and etymological error types and higher achievers committing more orthographic and etymological error types. Morphological error types were statistically significantly different for low and average spelling achievement groups (Group I and II).

The proportion of morphological errors is lowest in the low achievement group, but the highest spelling achievers made fewer morphological errors than did the average achievers. This was perhaps because of a spelling program that 56% of the children (N=59) in this study were using in the private school they were attending. It was reported by the school principal that they were using a spelling program that emphasized the spellings and meanings of morphemes. Therefore,

a possible conclusion is that low performers made morphological errors because their errors were recorded in a lower level category – phonological or phonetic. High performers on the other hand could have had lower numbers of morphological errors because they were simply spelling the morphemes correctly, an indication that teaching the structure of language is important in spelling, and that it works.

Correlation analyses using TWS-4 (Larsen, et al., 1999) standard scores, error types, and TOSWRF standard scores as variables showed that the proportions of phonological and phonetic errors correlated negatively with spelling achievement scores (-.677 and -.640, respectively, $p < .01$), whereas orthographic, etymological, and morphological errors correlated positively with spelling achievement scores (.624, .723, $p < .01$ and .201, $p < .05$). Results could mean that students with low spelling achievement scores should be assessed for more basic skills usually learned at earlier ages such as detecting phonemes in words, and attention to sound-symbol correspondence.

Results could also indicate that students within one grade level, in the case of this study, Grade 5, could be functioning at spelling developmental levels similar to those that children go through as they progress through spelling development at earlier grade levels. In addition, the results could show that error quality is a factor and that the quality of error increases with higher level spelling scores. The implication for instruction is that students in one class may have vastly different needs that need to be met for good spelling performance. Students with very low spelling achievement scores should be assessed for knowledge of the basic skills

of phonemic awareness and phoneme/grapheme matching so that these skills are in place. A frequency of errors that are etymological or morphological in nature could indicate that students have passed successfully through initial stages of spelling development and are now ready for learning the more complex linguistic properties of words. In this study, orthographic errors remained the highest in error frequency of all the error types. This could indicate a need for continued teaching of spelling patterns and mnemonics for remembering irregular spellings, but it is possible that a refinement of the scoring guide used in this study might have resulted in a decrease in errors defined as orthographic. For example, the *lumin* (originally *lumen*) in *luminous*, meaning related to or full of light, could be defined as a morpheme, which would provide more opportunity for the teaching morphemes in spelling lessons.

It is clear from the results of this study that teachers would be wise to examine the specific linguistic knowledge of their students, particularly low achievers, when planning spelling lessons. Low achievers could possibly still need instruction in detecting phonemes in words, sound-symbol correspondence instruction, and a good systematic spelling program through which they can learn regular spelling patterns. Higher achievers appear from this study to be ready for more information about the structure of language, such as the influence of other languages on English spelling, but this information can be incorporated into spelling lessons for students at any level (Berninger & Wolf, 2009; Carlisle, 2000; Carreker, 2005; Henry, 2003).

Limitations

It is possible that morphological and etymological error types could have been combined for analysis in this study, due to the fact that both categories involve the teaching of the influences that language has had on English. The orthographic category of errors increased in proportion as spelling proficiency increased in this study. This could possibly be due to the definitions in the scoring guide. It is possible that many of the errors categorized as orthographic in this study could be re-categorized as etymological or morphological. The implication for spelling instruction would be that more Greek, Latin, and other language information could be included in spelling lessons, which could contribute to stronger orthographic spelling.

The reading fluency standard scores on the TOSWRF (Mather et al., 2004) were correlated with error type means from the entire TWS-4, which would have included words that were above the students' ceiling and therefore, out of the range of words that are familiar to them. Correlations between reading and spelling error type would perhaps be more accurate if they included only means of error type proportions from the words that were at or below a typical ceiling level for a Grade 5 student.

CHAPTER IV

CONCLUSION

Analysis of the types of errors made on a test of spelling achievement within each of two school grade levels was the purpose of this study. Students in Grades 3 and 5 in public and private schools were given two standardized tests, one of spelling achievement, and one of reading fluency. Analysis of errors on the spelling test revealed that within each grade level, evidence of levels of linguistic knowledge existed and correlated with spelling achievement and reading achievement.

Third Grade

Third grade students in this study were given the Test of Written Spelling – 4 (TWS-4) and the Test of Silent Word Reading Fluency on a school day by the principal investigator. Errors on the TWS-4 were categorized as to the level of linguistic knowledge required for correct spelling. Phonological errors were defined as phonemes not represented. Phonetic errors were defined as phonemes represented by a grapheme that was an illegal representation of the phoneme. Orthographic errors were defined as legal representations of a phoneme that are incorrect and that would require either the teaching of a regular spelling pattern or a mnemonic for remembering an irregular spelling. Etymological errors were legal representations of a phoneme, though incorrect, and those which knowledge of the contribution of language would aid in the

spelling of the word, such as the Greek contribution of *ph* for the phoneme /f/. Finally, morphological errors were legal representations of phonemes for which linguistic knowledge of morphemes would be helpful in correct spelling, such as the spelling of the suffix *-ous* in a word which would change the form and meaning of the word to the adjectival form of the word. Errors were categorized as morphological if the morpheme was a common one which could be applied to a large number of words and therefore, be useful to teach. Complete descriptions of the scoring guide for error types are found in Appendix B and Table 1.

Low-to-low-average achieving spellers, those defined in this study as having a standard scores on the Test of Written Spelling – 4 of less than 98, made proportionally more phonological and phonetic errors than those with average (standard score of 99-112) or high (standard scores of 113 and above) spelling achievement. Students in the lower spelling achievement group made proportionally fewer orthographic, etymological, and morphological type errors than did average and high achieving spellers. The proportion of error types in each category correlated either positively or negatively with standard scores on the Test of Written Spelling - 4. Phonological and phonetic errors correlated negatively with TWS-4 standard scores, indicating that the higher level the spelling achievement, the lower the proportion of these basic types of errors. Etymological errors followed the opposite trajectory and correlated positively with TWS-4 standard scores, indicating a positive correlation between spelling achievement and linguistic knowledge of the language contribution and meaning contribution to complex English spellings. The differences among all achievement groups were

statistically significantly different for phonological and etymological errors. The low achieving group consistently differed from the high achieving group in all error categories. For phonetic and orthographic errors, the low and average group means differed, but not statistically significantly. This is perhaps because in third grade some phonetic and orthographic information is still being included in spelling instruction at this age. For morphological errors, the average and high groups differed, but not statistically significantly, possibly because this is an area of linguistics that has not been emphasized as much in third grade to the extent that it would have affected performance on this test. Morphological instruction typical for third grade would be more geared toward inflectional endings and changes in spelling and accent as a result of adding these endings. There were no inflectional morphemes represented on the test, and the words that contained teachable morphemes were beyond the ceiling for average standard scores.

The phonological and phonetic properties of words are those that are learned in earlier stages of reading and spelling development in Grades K-2. Exposure to more complex spellings increases orthographic awareness of more complex spellings, and the readiness for information about the contribution of other languages to English spelling, such as Latin and Greek, and the contribution of meaning to spelling such as the learning of meaningful affixes. The fact that low-level spellers in Grade 3 in this study were still struggling with a high proportion of phonological and phonetic errors to the exclusion of orthographic, etymological, and morphological errors, indicated that there was still a need to make sure these skills are in place. These data indicated that teachers of

students who perform poorly on standardized tests of spelling would be wise to screen further for basic phonological and phonetic spelling skills. Screenings do not have to be time-consuming and could include observations of writing assignments, observational analyses of errors on weekly spelling tests, and informal screenings and formative assessments of phonological and phonetic skill with spelling. By third grade, isolated phonemic awareness activities without the teaching of spelling patterns would not be time efficient. However, it would be advisable to equip students with a method for assuring that they are representing every phoneme when spelling, such as un-blending the word carefully. In addition, direct and systematic instruction of the spelling patterns that are regular in the English language would be preparatory to the additional knowledge of Greek, Latin, and French contributions and the spellings of morphemes (Berninger & Wolf, 2009; Carlisle, 2000; Carreker, 2002, 2005; Henry, 2003; Moats, 2009).

Fifth Grade

Fifth grade students in public and private schools in the southwestern region of the US were given the *Test of Written Spelling – 4* (TWS-4) (Larsen, Hammill, & Moats, 1999) and the *Test of Silent Word Reading Fluency* (TOSWRF) (Mather, Allen, Hammill, & Roberts, 2004). The TWS-4 was scored according to the test directions and participants were divided into three achievement groups: low, average, and high, according to their standard scores. Errors on the test were analyzed for quality and each error was placed in one of five mutually exclusive categories representing error types: phonological, phonetic,

orthographic, etymological, and morphological. The proportion of total errors for each error type was used for all analyses in the study. The error types followed a continuum along the line of achievement. Phonological errors were proportionally more numerous at lower spelling achievement levels and less numerous at higher levels. Students with average spelling scores made lower proportions of phonological errors. The highest level spelling group had the lowest proportion of phonological errors. Phonetic errors were also proportionally more predominant in low-to-low-average achieving spellers than higher achieving spellers, with the highest achievers having the lowest proportion of phonetic errors. Orthographic and etymological errors trended upward with achievement scores, with the lowest achieving spellers having the lowest proportion of orthographic and etymological error types and higher achievers committing more orthographic and etymological error types. Morphological error types were statistically significantly different for low and average spelling achievement groups (Group I and II). The proportion of morphological errors is lowest in the low achievement group, but the highest spelling achievers made fewer morphological errors than did the average achievers. This was perhaps because of a spelling program that 56% of the children (N=59) in this study were using in the private school they were attending. It was reported by the school principal that they were using a spelling program that emphasized the spellings and meanings of morphemes. Therefore, a possible conclusion is that low performers made morphological errors because their errors were recorded in a lower level category – phonological or phonetic. High performers on the other hand could have had lower numbers of morphological

errors because they were simply spelling the morphemes correctly, an indication that teaching the structure of language is important in spelling, and that it works.

Correlation analyses using TWS-4 standard scores, error types, and TOSWRF standard scores as variables showed that the proportions of phonological and phonetic errors correlated negatively with spelling achievement scores (-.677 and -.640, respectively, $p < .01$), whereas orthographic, etymological, and morphological errors correlated positively with spelling achievement scores (.624, .723, $p < .01$ and .201, $p < .05$). Results could mean that students with low spelling achievement scores should be assessed for more basic skills usually learned at earlier ages such as detecting phonemes in words, and attention to sound-symbol correspondence.

Results could also indicate that students within one grade level, in the case of this study, Grade 5, could be functioning at spelling developmental levels similar to those that children go through as they progress through spelling development at earlier grade levels. In addition, the results could show that error quality is a factor and that the quality of error increases with higher level spelling scores. The implication for instruction is that students in one class may have vastly different needs that need to be met for good spelling performance. Students with very low spelling achievement scores should be assessed for knowledge of the basic skills of phonemic awareness and phoneme/grapheme matching so that these skills are in place. A frequency of errors that are etymological or morphological in nature could indicate that students have passed successfully through initial stages of spelling development and are now ready for learning the more complex linguistic

properties of words. In this study, orthographic errors remained the highest in error frequency of all the error types. This could indicate a need for continued teaching of spelling patterns and mnemonics for remembering irregular spellings (Berninger, 2008), but it is possible that a refinement of the scoring guide used in this study might have resulted in a decrease in errors defined as orthographic. For example, the *lumin* (originally *lumen*) in *luminous*, meaning related to or full of light, could be defined as a morpheme, which would provide more opportunity for the teaching morphemes in spelling lessons (Nagy, Berninger, & Abbot, 2003; Nagy, Berninger, Abbot, Vaughn, & Vermeulen, 2003).

It is clear from the results of this study that teachers would be wise to examine the specific linguistic knowledge of their students, particularly low achievers, when planning spelling lessons. Low achievers could possibly still need instruction in detecting phonemes in words, sound-symbol correspondence instruction, and a good systematic spelling program through which they can learn regular spelling patterns. Higher achievers appear from this study to be ready for more information about the structure of language, such as the influence of other languages on English spelling. This information can be incorporated into spelling lessons for students at any level, and should include all students because of the influence of this information on vocabulary and general literacy development (Carlisle, 2010).

REFERENCES

- Apel, K., Masterson, J. J., & Niessen, N. L. (2004). Spelling assessment frameworks. In C. A. Stone, E. R. Silliman, B. J. Ehren, & K. Apel (Eds.) *The handbook of language and literacy: Development and disorders* (pp. 644-660). New York, NY: Guilford Press.
- Bear, D. R. & Templeton, S. (1998). Explorations in developmental spelling: Foundations for learning and teaching phonics, spelling and vocabulary. *The Reading Teacher, 52*, 222-242.
- Bear, D. R., Invernizzi, M., Templeton, S., & Johnston, F. (2008). *Words their way: Word study for phonics, vocabulary, and spelling instruction*. Upper Saddle River, NJ: Pearson Prentice Hall.
- Beers, J. W., Strickland, C., & Grant, K. (1977). The logic behind children's spelling. *The Elementary School Journal, 77*, 103-130.
- Berninger, V. W., & Wolf, B. J. (2009). *Teaching students with dyslexia and dysgraphia: Lessons from teaching and science*. Baltimore, MD: Paul H. Brookes Publishing.
- Berninger, V. W., Winn, W. D., Stock, P., Abbott, R. D., Eschen, K., Lin, S. J., Nagy, W. (2008). Tier 3 specialized writing instruction for students with dyslexia. *Reading and Writing: An Interdisciplinary Journal, 21*, 95-129.
- Bernstein, S. (2009). Phonology, decoding, and lexical compensation in vowel spelling errors made by children with dyslexia. *Reading and Writing, 22*, 307-331.

- Bourassa, D. C., & Treiman, R. (2003). Spelling in children with dyslexia: Analyses from the -Bourassa Early Spelling Test. *Scientific Studies of Reading, 7*, 309-333.
- Bourassa, D. C., & Treiman, R. (2008). Morphological constancy in spelling: A comparison of children with dyslexia and typically developing children. *Dyslexia, 14*, 155-169.
- Burt, J. S. & Butterworth, P. (1996). Spelling in adults: Orthographic transparency, learning new letter strings, and reading accuracy. *European Journal of Cognitive Psychology, 8*, 3-43.
- Carlisle, J. K. (1988). Knowledge of derivational morphology and spelling ability in fourth, sixth, and eighth grades. *Applied Psycholinguistics, 9*, 247-266.
- Carlisle, J. K. (2000). Awareness of the structure and meaning of morphologically complex words: Impact on reading. *Reading and Writing: An Interdisciplinary Journal, 12*, 169-190.
- Carlisle, J. K. (2010). Effects of instruction in morphological awareness on literacy achievement: An integrative review. *Reading Research Quarterly, 45*, 464-487.
- Carreker, S. (2002). *Scientific spelling*. Houston, TX: Neuhaus Education Center.
- Carreker, S. (2005). Teaching spelling. In J. R. Birsh (Ed.), *Multisensory Teaching of Basic Language Skills* (pp. 257-293). Baltimore, MD: Brookes Publishing.
- Cassar, M., & Treiman, R. (1997). The beginnings of orthographic knowledge: Children's knowledge of double letters in words. *Journal of Educational Psychology, 89*, 631-644.

- Cassar, M., Treiman, R., Moats, L., Pollo, T. C., & Kessler, B. (2005). How do the spellings of children with dyslexia compare with those of non-dyslexic children? *Reading and Writing: An Interdisciplinary Journal*, 18, 27-49.
- Castiglioni-Spalten, M. L., & Ehri, L. C. (2003). Phonemic awareness instruction: Contribution of articulatory segmentation to novice beginners reading and spelling. *Scientific Studies of Reading*, 7, 25-52.
- Cataldo, S., & Ellis, N. (1998). Interactions in the development of spelling, reading and skills. *Journal of Research in Reading*, 11, 86-109.
- Ehri, L. (1989). The development of spelling knowledge and its role in reading acquisition and reading disability. *Journal of Learning Disabilities*, 22, 356-365.
- Ehri, L. C. (2000). Learning to read and learning to spell: Two sides of a coin. *Topics in Language Disorders*, 2, 19-36.
- Ehri, L. C., & Soffer, A. G. (1999). Graphophonemic awareness: Development in elementary children. *Scientific Studies of Reading*, 3, 1-30.
- Ganske, K. (1999). The developmental spelling analysis: A measure of orthographic knowledge. *Educational Assessment*, 6, 41-70.
- Ganske, K. (2000). *Word journeys :Assessment-guided phonics, spelling, and vocabulary instruction*. New York: The Guilford Press.
- Gunning, T. G. (2006). *Assessing and correcting reading and writing difficulties*. Boston, MA: Pearson Education, Inc.
- Henderson, E. H., & Beers, J. W. (1980). *Developmental and cognitive aspects of learning to spell*. Newark, DE: International Reading Association.

- Henry, M. K. (2003). *Unlocking literacy: Effective decoding and spelling instruction*. Baltimore, MD: Brookes Publishing.
- Holligan, C., & Johnston, R. S. (1991). Spelling errors and phonemic segmentation ability: The nature of the relationship. *Journal of Research in Reading, 14*, 21-32.
- Invernizzi, M., & Worthy, M. J. (1989). An orthographic-specific comparison of the spelling errors of learning disabled and normal children across four grade levels of spelling achievement. *Reading Psychology: An International Quarterly, 10*, 173-188.
- Jorm, A. F. (1977). Children's spelling processes revealed by transitional error probabilities. *Australian Journal of Psychology, 29*, 125-130.
- Joshi, M., Treiman, R., Carreker, S., & Moats, L. (2009). How words cast their spell: Spelling is an integral part of learning the language, not a matter of memorization. *American Educator, 32*, 6-16, 42.
- Larsen, S. C., Hammill, D. D., & Moats, L. C. (1999). *Test of written spelling (4th ed.)*. Austin, TX: Pro-Ed.
- Manolakes, G. (1975). The teaching of spelling: A pilot study. *Elementary English, 52*, 243- 247.
- Masterson, J. J., & Apel, K. (2000). Spelling assessment: Charting a path to optimal intervention. *Topics in Language Disorders, 20*, 50-65.
- Mather, N., Allen, D. D., Hammill, E. A., & Roberts, R. (2004). *Test of silent word reading fluency*. Austin, TX: Pro-ed.
- Moats, L. C. (1993). Spelling error interpretation: Beyond the phonetic/dysphonetic

- dichotomy. *Annals of Dyslexia*, 43, 174-185.
- Moats, L. C. (1995). *Spelling: Development, disability, and instruction*. Timonium, MD: York Press, Inc.
- Moats, L. (2000). *Speech to print*. Baltimore: Brookes Publishing Co.
- Moats, L. (2009). Knowledge foundations for teaching reading and spelling. *Reading and Writing: An Interdisciplinary Journal*, 22, 379-399.
- Morris, D., Nelson, L., & Perney, J. (1986). Exploring the concept of "spelling instructional level" through the analysis of error types. *The Elementary School Journal*, 87, 180-200.
- Nagy, W., Berninger, V. W., & Abbot, R. D. (2006). Contributions of morphology beyond phonology to literacy outcomes of upper elementary and middle-school students. *Journal of Educational Psychology*, 98, 134-147.
- Nagy, W., Berninger, V. W., Abbott, R. D., Vaughn, K., & Vermeulen, K. (2003). Relationship of morphology and other language skills to literacy skills in at-risk second grade readers and at-risk fourth grade writers. *Journal of Educational Psychology*, 95, 730-742.
- Nunes, T., Bryant, P., & Bindman, M. (1997). Morphological spelling strategies: Developmental stages and processes. *Developmental Psychology*, 33, 637-649.
- Perfetti, C. A. (1997). The psycholinguistics of spelling and reading. In C. A. Perfetti, L. Rieben, & M. Fayol (Eds.), *Learning to spell: Research, theory, and practice across languages*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

- Pollo, T. C., Kessler, B., & Treiman, R. (2009). Statistical patterns in children's early writing. *Journal of Experimental Child Psychology, 104*, 410-426.
- Read, C. (1971). Preschool children's knowledge of English phonology. *The Harvard Educational Review, 41*, 1-34.
- Read, C. (1975). Children's categorization of speech sounds in English. *National Council of Teachers of English, Research Report 17, stock no. 06307*, 1-200.
- Schlagal, B. (2002). Classroom spelling instruction: History, research, and practice. *Reading Research and Instruction, 42*, 44-57.
- Sharp, A. C., Sinatra, G. M., & Reynolds, R. E. (2008). The development of children's orthographic knowledge: A microgenetic perspective. *Reading Research Quarterly, 43*, 206-226.
- Stillman, E. R., Bahr, R. H., & Peters, M. L. (2006). Spelling patterns in pre-adolescents with atypical language skills: Phonological, morphological, and orthographic features. *Developmental Neuropsychology, 29*, 93-123.
- Tangel, D. M., & Blachman, B. A. (1992). Effect of phoneme awareness instruction on kindergarten children's invented spelling. *Journal of Reading Behavior, 24*, 233-261.
- Tolchinsky-Landsmann, L., & Levin, I. (1985). Writing in preschoolers: An age related analysis. *Applied Psycholinguistics, 6*, 319-339.
- Treiman, R. (1993). *Beginning to spell*. New York: Oxford University Press.
- Treiman, R., Berch, D., & Tincoff, R. (1993). Phonology and spelling: The case of

- syllabic consonants. *Journal of Experimental Child Psychology*, 56, 267-290.
- Treiman, R., & Bourassa, D. C. (2000a). Children's written and oral spelling. *Applied Psycholinguistics*, 21, 83-204.
- Treiman, R., & Bourassa, D. C. (2000b). The development of spelling skill. *Topics in Language Disorders*, 20, 1-18.
- Treiman, R., & Cassar, M. (1996). Effects of morphology on children's spelling of final consonant clusters. *Journal of Educational Psychology*, 63, 141-170.
- Treiman, R., Cassar, M., & Zukowski, A. (1994). What types of linguistic information do children use in spelling: The case of flaps. *Child Development*, 65, 1318-1337.
- Treiman, R., Goswami, U., Tincoff, R., & Leevers, H. (1997). Effects of dialect on American and British children's spelling. *Child Development*, 68, 229-245.
- Treiman, R., Zukowski, A., & Richmon-Welty, E. D. (1995). What happened to the "n" of sink: Children's spelling of final consonant clusters. *Cognition*, 55, 1-38.
- Varnhagen, S., & Varnhagen, C. (1988). *Analysis of spelling errors made by average ability and reading disabled children: Evidence for a developmental lag?* Paper presented at the American Educational Research Association, New Orleans, LA.
- Wright, D-M., & Ehri, L. C. (2007). Beginners remember orthography when they learn to read words: The case of doubled letters. *Applied Psycholinguistics*, 28, 115-123.

Yeong, S. M., & Liow, S. J. (2010). Phonemic representation and early spelling errors in bilingual children. *Scientific Studies of Reading*, 14, 387-406.

Zutell, J. (1980). Children's spelling patterns and their cognitive development. In E. H. Henderson & J. W. Beers (Eds.), *Developmental and cognitive aspects of learning to spell* (pp. 52-72). Newark, DE: International Reading Association.

APPENDIX A

TEST OF WRITTEN SPELLING-4 Table of Phoneme Spellings by Linguistic Category

Word	Phonological/Phonetic	Orthographic	Etymological	Morphological
1. yes	y e s			
2. bed	b e d			
3. let	l e t			
4. ud	u s			
5. went	w e n t			
6. much	m u	ch		
7. next	n e x t	x(ks)		
8. spend	s p e n d			
9. who		o	wh	
10. shake	k	sh a-e		
11. eight	t		eigh	
12. strong	s t r o	ng		
13. pile	p l	i-e		
14. knife	f	i-e	kn	
15. knew			kn ew	
16. tardy	t d		ar	y
17. nineteen	n n t n	i-e ee		
18. section	s e	c		sec (cut) tion (state of)
19. signal	s i g n		a l	
20. expect	e p e c t	x		ex (out)
21. canyon	c a n y n	o (ə)		
22. district	d i s t r i c t		c	
23. fountain	f n t n	ou	ai	
24. legal	l e g		a (ə)	Leg (law) al (of the)
25. terrible	t e		rr (from terror)	ible (can do)
26. unify				uni fy (make)

Word	Phonological/Phonetic	Orthographic	Etymological	Morphological
27. bicycle				bi (two) cycle (wheel)
28. institution	i n s t t u		i (ə)	tion (state of)
29. collar	c o	ll ar		
30. agriculture	c u l	i (ə)	t(sounds like ch)	agri ure (process of)
31. visualize	v i u	s	al	vis (to see) al(relating to) ize (make)
32. baste	b a s t	a-e		
33. nucleus	n u l e	c	Us (ə)	
34. tangible	t a n b		g	ible (can do)
35. tranquil	t r a n l	qu	i (ə)	
36. continuity	c o n t i n u			ity (state or quality of)
37. luminous	l u m n		i	ous (full of)
38. laborious	l b		a (ə) or i	ous (full of)
39. linguistic	l i i s t	ng	n gu	ic (of or pertaining to)
40. opaque	o p a		que	
41. gauntlet	g n t l e t		au	
42. panorama	p a n r a m		o (ə) a (ə)	
43. finesse	f i n e		sse	
44. gregarious	g r g		e ar i	ous (full of)
45. zealous	z l		ea	ous (full of)
46. requisite	r e i	qu s(z)	ite	
47. champagne	a m p	a-e	ch gn	
48. cyst	s t		c y	
49. versatile	v s		er a (ə)	vers (to turn) ile (of)
50. liason	l a	s	i on	

APPENDIX B

Scoring Guide

The placement of errors in categories is driven by the following question, “**What does this child need to know in order to spell accurately?**” The question refers to spelling instruction that is needed in order to spell the word correctly.

1. Phonological Errors

- Phoneme or syllable is not represented by any symbol.
- Any phoneme within a morphological unit is not represented.

2. Phonetic Errors

- Phonemes are represented with graphemes or other symbols, but illegal ones for the sound. (example: *bed* spelled *ted*)
- Phonemes are added to the word. The phonetic error is assigned to an adjacent grapheme. (example: *requisite* spelled *redquisit*; error is assigned to the /k/ and is phonetic).
- Phoneme is present in the letter string, but is out of order by more than one letter. (example: *expect* spelled *epecxt*)

3. Orthographic Errors

- Phoneme is represented with a legal grapheme for the sound, but not the correct one. Correcting this error would require either learning a regular spelling pattern or developing a mental orthographic image (Masterson & Apel, 2000). (example: *legal* – *leegal*)
- Phoneme is represented correctly but is out of order by only one letter.

4. Etymological Errors

- Phoneme is represented with legal grapheme, but not the correct alternative. In addition, the correct spelling is influenced by spellings derived from Latin, Greek or French which can be taught and generalized to a substantial number of words. (soft *ch* and *gne* in *champagne*, *k* in *knife*, and *knew*).

- Participant chooses a legal grapheme for which etymological information would aid in correct spelling (example: /f/ in *finesse* spelled *phaness*; knowledge that *ph* is Greek and the word is French would aid in choice of the correct spelling for /f/).
- When a word is derived from another word which would aid in correct spelling. (example: schwa vowel in the second syllable of *continuity* would be clarified by knowledge that the word was derived from *continue*, in which the second syllable is accented and vowel sound audible)

5. Morphological Errors

- Phoneme is part of a morpheme which changes or influences the meaning of the word derived from Greek, Latin, or other language which can be learned and applied a substantial number of other words. (example: *-ous* ending in *luminous* which creates adjectival form).
- Confusion of homophones, correctly spelled (example: *baste* spelled *based*)

Note: Suffixes that are typically taught as a unit are scored as units (-ous*, *tion*). However, if the unit is not represented phonologically (example: part of the sound missing (*station* – *staton*, *staon*, or *stasn*) the whole unit is to be counted as a phonological error.

VITA

Barbara Tenney Conway

Neuhaus Education Center, 4433 Bissonnet, Houston, Texas 77401, 713.664.7676,
bconway@neuhaus.org

EDUCATION

Texas A&M University	2011
Ph.D.	
Curriculum & Instruction (C&I): Reading	
License: Dyslexia Therapy (Texas)	2010
Academic Language Therapy Association	2007
CALT Certification	
Neuhaus Education Center	2006
Dyslexia Specialist Preparation	
University of Houston	1978
M. Ed.	
C&I: Reading	
University of Texas, Austin	1972
B. S.	
Elementary/Special Education/Psychology	

PROFESSIONAL WORK EXPERIENCE

Neuhaus Education Center	Current
Director of Virtual Programs	
Texas A&M University	2008-2010
Graduate Assistant Instructor	
Ft. Bend ISD	2008-2009
Differentiated Instruction Coach;	
Special Education Teacher	
Neuhaus Education Center	2004-2006
Teaching Coach ("Shepherd")	
Ft. Bend Baptist Academy	1995-1997
Academic Therapist, LD	
Lamar CISD	1991-1992
Teacher, Reading, Grade 6	
Houston ISD	1977-1978
Reading Teacher (at risk students)	
Houston ISD	1973-1975
Special Education Teacher	