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Spelling Development in Young School Age Children

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Spelling Development in Young School Age Children

by

Kelly M. Fawcett

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Science
Department of Communication Sciences and Disorders
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ABSTRACT

Previous research investigations in the area of spelling development have adopted two approaches, the broad approach and the narrow approach. The broad approach suggests that spelling develops in sequential stages whereas the narrow approach focuses on individual linguistic patterns. However, research findings have revealed that children's spellings do not exhibit errors pertaining to specifically one stage or reflecting one linguistic element, yet a research void exists in resolving how these two approaches might intermix.

This study examined the spelling errors of typically developing children in first through fourth grades (N = 400) to determine the quantitative and qualitative differences in misspellings among grade levels. Each grade level had an equal representation of children (N = 100) and male and female participants. The spelling errors were extracted from two writing samples completed by the children, a narrative and expository sample. In an attempt to combine the broad and narrow approaches, a coding system was designed to evaluate the linguistic category (phonological, orthographic, morphological) and specific features (letter name spelling, vowel error, digraph, etc.) of the spelling errors.

The findings revealed a significant interaction between grade level and error type for phonologically-based spelling errors (1st graders made more errors than 2nd and 4th

graders) and a greater number of morphological errors was noted in 4th vs. 2nd grade. No significant effects were noted for writing genre or gender. Analysis of performance patterns for specific linguistic category errors within and across grade levels revealed that all four grade levels committed the most phonological errors in the PSE (phonological – silent /e/) and PSON (phonological – sonorant clusters) categories. The OLN (orthographic – letter name) and ODI (orthographic – digraph) errors also occurred frequently in all four grades with first graders demonstrating significantly more occurrences of the OLN than ODI error. Morphological findings revealed that first graders made significantly more MINF (morphological – inflection) than MHOM (morphological – homonym) errors and all four grades had significantly more MINF than MCON (morphological – contraction) errors. A qualitative analysis regarding the most frequently misspelled words and most frequently encountered codes was also performed. The clinical and educational implications of these findings are discussed.

Chapter 1: Literature Review

Spelling instruction is increasingly important in education today (Graham, Harris, & Chorzempa, 2002). In previous years, spelling instruction in the classroom did not emphasize connections to reading and writing (Apel & Masterson, 2001; Goswami, 1992). This oversight has led to a decreased awareness that English spelling is a patterned system. In general, spelling has been taught through rote teaching and memorization of a weekly spelling list, with little stress on the importance of teaching patterns (Apel, Masterson, & Hart, 2004a; Goswami, 1992). However, a recent shift towards improving spelling assessment and instruction highlights the importance of spelling as the study of word patterns (Bear, Invernizzi, Templeton, & Johnston, 2004).

Current research focuses on improving spelling instruction through the understanding of how spelling develops (Bear et al., 2004; Berninger et al., 1998; Masterson & Crede, 1999). Comparisons have been made across groups of children to quantify errors (Bruck & Waters, 1988). However, minimal research exists regarding the qualitative assessment of spelling, which is pertinent for providing information regarding the types of linguistic errors children make. In turn, more specificity on individual linguistic patterns would enhance individualized instruction and intervention.

This literature review discusses the research pertaining to spelling development and assessment. The discussion begins with an overview of the theories of development that describe the errors that are common throughout spelling development. The second

section discusses patterns of typical development in the emergence of linguistic knowledge that supports spelling followed by a comparison of spelling errors in children who are typically developing versus those with a reading disability and those with a language learning disability. The third section presents various spelling assessments and quantitative and qualitative scoring systems used to assess spelling skills. The increased need for qualitative as opposed to quantitative assessments is then discussed. A brief comparison of written genres is made in the fourth section to increase awareness of the effects genres have on spelling. Finally, the statement of the problem presents the study's purpose and research questions.

Theories of Spelling Development

The broad approach and the narrow approach are two frameworks for describing how spelling develops. These approaches represent different perspectives that focus either on general stages of spelling development (the broad approach) versus the linguistic development of individual spelling features (the narrow approach). However, it is important to mention that both frameworks aim to achieve the same goal, providing a description of spelling development.

The Broad Approach.

The broad approach captures developmental patterns that signal changes in performance. This approach, qualitative in nature, subscribes to the concept of stages in spelling development (Bear et al., 2004; Reece & Treiman, 2001). Stage theory places patterns of development in various time frames. While many researchers have developed their own stage theories, three of the most well known are those proposed by Gentry (1982), Henderson (1985), and Ehri (1986).

Gentry's theory consists of five stages (precommunicative, semiphonetic, phonetic, transitional, and correct spelling). In contrast, Ehri (1986) proposed three stages (semiphonetic, phonetic, and morphemic). Henderson (1985), like Gentry, also had five stages of development, but the stages differed in that Henderson believed in a life-long approach to spelling development, whereas Gentry proposed that complex spelling development could be completed during early academic instruction (Gentry, 2004; Treiman & Cassar, 1997). A complete description of the primary stage theories is provided in Table 1.1, followed by a comparison of the three theories.

Table 1.1. Broad Approach Stage Theories.

	Gentry (1982)	Henderson (1985)	Ehri (1986)
<i>Stage 1</i>	Precommunicative - Strings together random letters; no concrete knowledge of the sounds the letters represent.	Preliterate - Meaningless marks on paper with a crayon or pencil; no understanding that writing represents speech.	Semiphonetic - Uses letters with no knowledge of the sounds that match.
<i>Stage 2</i>	Semiphonetic - Attempts to spell using the letters that match the sounds in the word; vowels and consonants in words	Letter-name spelling - Understanding that each sound represents a letter and letter names are	Phonetic - Demonstrates partial awareness of sounds and letters that match.

Table 1.1 (Continued)

	Gentry (1982)	Henderson (1985)	Ehri (1986)
	are usually represented as one letter (R=ARE).	used to spell words.	
<i>Stage 3</i>	Phonetic - All sounds represented but no orthographic rules applied.	Within-word pattern - Spelling has been learned from exposure to print during reading. Knowledge of sight words assists in spelling unfamiliar words.	Morphemic - Orthographic and morphological awareness skills are applied.
<i>Stage 4</i>	Transitional - No longer relies on sound to spell words; applies orthographic and morphological information to spellings.	Syllable juncture - Spelling rules are applied, such as doubling of consonants, to mark short vowels in words.	n/a

Table 1.1 (Continued)

	Gentry (1982)	Henderson (1985)	Ehri (1986)
<i>Stage 5</i>	Correct Spelling - Concrete understanding of fundamentals of spelling and spellings are more likely to be correct.	Derivational Principles - Understanding of root word and the meaning it carries; develops throughout life.	n/a

Table 1.1 shows three different variations of stage theory. Ehri (1986) and Gentry (1982) share a similar view that Stage 1 consists of strings of letters carrying no real meaning. Henderson (1985), on the other hand, includes random doodling with a writing utensil in Stage 1. Representations for Stage 2 are similar across all three researchers, revealing early knowledge of letters and the sounds representing each letter. Stage 3 shows a greater amount of variation in that Ehri considers children in this stage to demonstrate advanced morphological skills while the Gentry and Henderson stages include only phonetic and orthographic skills. Ehri's (1986) Stage 3 is more developmentally advanced than those of Henderson and Gentry. Ehri argued that the development of orthographic and morphological skills was the final stage where children learned word regularities during morphological development, which then led to conventional spelling. Conventional spelling skills are thought to continue throughout life, and therefore, are not classified into a specific stage (Treiman & Cassar, 1997).

In contrast to Ehri, Henderson and Gentry's Stage 3 consisted of beginning spelling skills. Stages 4 and 5 were similar in that the child was learning and applying more advanced spelling rules. However, Henderson (1985) suggested that individuals would not completely master these skills because vocabulary continued to build and word roots, origins, and meanings continued to develop. Gentry (1982), in contrast, believed that spelling skills become automatic because the child no longer relies on sound to spell, but is able to apply orthographic and morphological information to spell (Treiman & Cassar, 1997).

The Narrow Approach

While stage theory may seem to be an appropriate spelling framework, recent research questions the presumption that spelling develops in specific stages (Reece & Treiman, 2001). Instead, aspects of phonologic, orthographic, and morphologic knowledge, in addition to mental graphemic representations (Apel et al., 2004a), simultaneously interact during all levels of spelling development. Relative to this idea, Reece and Treiman (2001) presented evidence that first grade children were using phonologic and orthographic knowledge to spell. Thus, Reece and Treiman (2001) argued against stage theory in that multiple aspects of linguistic knowledge interacted simultaneously within and across children to yield increasingly conventional spellings. Phonologic aspects, therefore, do not act independently of the other components.

Consistent with the notions of the narrow approach, Sulzby (1996) proposed the idea of repertoire theory in which spelling developed based on an interaction of many different linguistic aspects. In other words, all of the phonologic, orthographic, and morphologic skills a child has at any given time may interact to assist in spelling a word.

Thus, it is suggested that older children must access these linguistic components simultaneously to meet the demands of spelling complex words (Apel, Masterson, & Niessen, 2004b). Misspellings occur because the linguistic complexity of the word exceeds the child's ability to utilize one or more linguistic components.

In contrast to the broad approach, which classifies spelling development according to stages, the narrow approach analyzes individual linguistic features and attempts to determine how these features affect children's misspellings (Reece & Treiman, 2001; Silliman, Bahr, & Peters, 2006). This approach typically limits spelling analysis to one feature at a time. While the broad and narrow approaches provide two different perspectives regarding spelling development, both provide ways to classify error patterns in children and afford opportunities for valuable information to be gathered for instructional and intervention purposes.

Spelling Errors as a Window into Linguistic Knowledge

Spelling development frameworks, such as those found in the broad and narrow approaches, provide a way to examine children's emerging abilities to spell. While every child will not meet milestones at the same point in time, similarities will be found across children.

The Emergence of Linguistic Knowledge in Spellings

As described by Dodd and Carr (2003), children initially demonstrate phonological spelling errors in letter-to-sound associations. These errors will appear as random strings of letters that carry no meaning (Dodd & Carr, 2003). However, upon entering kindergarten, most children have knowledge of letter names from routine activities, such as singing the alphabet. They will then use this knowledge to assist in

spelling unfamiliar words, thus reducing the occurrence of random letter strings (Bourassa & Treiman, 2001).

Phonologically-based misspellings. As children learn to spell using increased alphabetic knowledge, error patterns occur that include letter name spellings and phonological violations. According to Bourassa and Treiman (2001), letter-name spellings substitute for vowel spellings and sequences of phonemes and occur most often in kindergarten and first grade children. The most frequent letter name misspellings occur with the liquid phonemes /r/ and // (Bourassa & Treiman, 2001). For example, early spellers may demonstrate errors, such as spelling *eat* as *et*, *elephant* as *lefít* or *far* as *fr*. In this case, the child has not developed an understanding of phoneme sequences, and therefore, spells the sequence with the single letter name. Letter name spellings reduce over time as the result of increased exposure to print and formal instruction (Bourassa & Treiman, 2001).

According to Bourassa and Treiman (2001), letter name spellings occur due to inexperience with the phonological structure of the language and less print exposure. However, English pronunciation makes it difficult, at times, to decipher the phonemes in a word, thus leading to other types of spelling errors, such as misspellings containing flaps (Treiman, Cassar, & Zukowski, 1994). A flap is a phoneme represented in the International Phonetic Alphabet (IPA) to phonetically represent the combination of /t/ and /d/ (Small, 1999). In the case of flaps, children often spell words such as *city* and *dirty* as *cidy* and *dirdy* due to the voiced nature of the flap's pronunciation (Treiman et al., 1994). This error more likely occurs when children are capable of segmenting the word phonemically, with the outcome that the /t/ sounds like /d/.

In addition to the previously described errors with letter name spellings and flaps, early spelling errors also reveal difficulties with consonant clusters in the initial, medial, and final positions of words (Treiman, 1991). This difficulty arises from children's inexperience with dividing the cluster into separate phonemes (Treiman, 1991). In other words, consonant cluster errors occur because the clusters are being analyzed as a one phoneme unit rather than as a single unit with two phonemes. For example, the word *play*, spelled phonetically as /ple/, has one unit containing two phonemes, /p/ and /l/, and a second unit containing /e/. However, the initial phoneme /p/ of the first unit followed by the phoneme /e/ of the second unit makes it challenging for young children to understand that the /l/ needs to be represented separately from the /p/. In other words, writing /p/ for the first unit does not represent the /pl/ in play, as children often portray the spelling.

Although the phonological process of cluster reduction in the initial position of words is most common, errors in nasal clusters, such as /nd/, are also prominent in beginning spellers (Treiman, 1991). This accounts for why young children will spell *and* as *ad*. These problems with nasal clusters also occur because nasal phonemes are difficult to hear when the child is decoding the word (Treiman, 1991).

Orthographic misspellings. While phonological errors are prominent in beginning spellers, orthographic errors are also evident early in development (Cassar & Treiman, 1997). The presence of orthographic violations supports the idea that spelling does not develop in specific stages but builds on multiple linguistic factors.

Orthographic errors include problems with consonant doubling and marking long vowel patterns through the use of silent –e. Beginning spellers make errors in consonant doubling when they understand a word contains a double consonant but do not

understand where the double consonant occurs. In written English, double consonants can occur in the middle of a word after a short vowel or at the end of a word. Double consonants do not occur in the beginning. For example, the word *press* has a doubled consonant in the final position. However, children might mark the doubled consonant in the wrong position, such as *ppres* for *press*. This type of error indicates an awareness of the need for a doubled consonant, but also illustrates the lack of integration of phonologic with orthographic knowledge to result in a correct spelling (Cassar & Treiman, 1997).

Orthographic errors involving the omission of silent *-e* also occur in young spellers, who lack the knowledge that when adding a silent *-e* to the end of a word, the preceding vowel is pronounced as a long vowel. For example, misspelling *trade* as *trad* indicates absence of the orthographic understanding of the silent *-e*.

Morphological misspellings. Morphological development consists of both inflectional and derived forms. Inflectional morphology involves maintaining the original root of a word but changing agreement, number, or possession with a grammatical marker, such as past tense *-ed*, present progressive *-ing*, or plural *-s*.

Nunes, Bryant, & Bindman (1997), studied children in grades 2, 3, and 4 (N=363) to determine how they developed inflectional morphology skills. This study included a spelling task that incorporated regular past verbs, irregular past verbs, and nonverbs. Based on children's performance, the authors proposed that young children utilized inflectional markers, but failed to understand their meaning. In other words, the children represented the inflectional marker by spelling the word phonetically, resulting in the word *called* being spelled as *calld*.

Nunes et al. (1997) then proposed that, as children began to understand and utilize inflectional markers, such as *-ed*, they overgeneralized and applied *-ed* to words ending in /d/, including irregular past tense verbs, such as *found*, or nonverbs, such as *cold*. Finally, children are observed to understand the meaning that the inflectional marker represents and spell the words correctly. The development of inflected morphology, as presented by Nunes et al. (1997), coincides with stage theory of development in that children spell the word phonetically without understanding its meaning prior to utilizing the morphological form.

Stage theory suggests that knowledge of inflections is later developing. According to Bourassa, Treiman, and Kessler (in press), children actually utilize inflectional markers early in spelling development. In fact, Bourassa et al. (in press) suggests that children utilize inflectional markers to help solve problems occurring as a result of phonological limitations. For example, if a child understands that *wait* ends in /t/, this information will assist him/her in correctly spelling *waiting* (an inflected form) since the flapped /t/ makes the word more difficult to spell phonetically.

To demonstrate how young children utilize morphological knowledge, Bourassa et al. (in press) compared children who were dyslexic and typically developing to determine if both groups utilized inflectional morphology in the same ways. The typically developing children (N=25) ranged from grades 1 to 3 while the chronological ages of the children with dyslexia (N=25) ranged in age from 9;2 to 14;7 years. This group also scored below a grade 4 level on a standardized spelling measure. Results indicated that both groups performed similarly. Both more accurately spelled complex words that included an inflectional marker, such as *rained*, than simple words, such as *brand* in

which they omitted at least one letter of the final nasal cluster. However, neither group utilized their knowledge of the word's root. For example, both groups misspelled the root word *lace* as *lase*, but spelled the inflected form correctly as *laced*. Thus, as children continue to develop morphological understanding, they could use their knowledge of inflections, such as the spelling of *laced* to correct the spelling of the simpler word *lace*.

In contrast to inflectional morphology, derivational morphology alters the meaning of a word, which can include changing it from a verb to a noun among other changes (Carlisle, 2003). The general consensus is that derived morphological representations require a longer period of time for their conventional spellings to be mastered (Carlisle, 1987, 1988; Green et al., 2003; Nagy, Berninger, Abbott, Vaughn, & Vermeulen, 2003), however, it has been found that derivational morphology does develop concurrently with inflected morphology. In other words, children do not wait until inflected forms are mastered before utilizing derived forms (Carlisle, 2003). For example, consider the suffix *-able*. Children as young as the preschool years have been observed to use this suffix, as in the word *flyable*. Although the added suffix is an overgeneralization, this is the first step in understanding and utilizing derived meanings (Carlisle, 2003). A clearer and more consistent use of derived forms in writing appears to occur sometime between first and fourth grades (Carlisle, 1996).

To reflect on how derivational morphology develops in spelling, a study by Green et al. (2003) should be considered. The purpose of this study, which included 3rd and 4th graders (N= 247), was to observe the use of inflectional markers in their writing. Results revealed that inflected morphology was more accurately used than derived forms. Based on these results, Green et al. (2003) suggested several explanations for derivational

development. One of the most frequent observed derived forms was the addition of *-ly*. The early development of these derived forms most likely occurs because children use these forms early in speech development. Transparent derived forms, such as *dance-dancer*, also emerge initially because the base word is present in the derived word (Green et al., 2003). Errors would thus be more evident with opaque forms, such as *magic-magician*.

Spelling errors at the phonologic, orthographic, and morphologic levels, such as the ones just described, are a natural part of spelling development. As children progress academically, it would be expected that errors would shift from primarily phonological to primarily orthographic and morphological errors, especially morphological errors related to derivational meanings (Bear et al., 2004; Ehri, 1986; Gentry, 1982; Henderson, 1985). However, it cannot be expected that all children will develop in the same way, demonstrating identical errors at the same points in their spelling development. Therefore, variations in experience with academic language through reading and writing, as well as the quality of spelling instruction, may create variations in children's error types.

Spelling Variations in Differing Groups of Children

Typically developing children vs. children with language learning disabilities.

While spelling errors of typically developing children will vary, it is also important to consider how spellings of typically developing children differ from those of children with language learning disabilities (LLD). One speculation is that error patterns between these two groups of children will differ with respect to the utilization of phonologic, orthographic, and morphologic knowledge.

Phonology, orthography, and morphology appear to develop in different phases with derivational morphology considered to be the most complex and, therefore, a later developing skill (Nunes et al., 1997). Since the broad approach (Bear et al., 2004) regards spelling as developing in phases, it would be appropriate and typical to see spelling errors occurring in advancing phases. However, children with language learning disabilities or other spelling delays may not demonstrate these patterns. Because these children struggle with the various kinds of linguistic knowledge necessary for typical spelling development, it is likely that they may display many of the same errors evident in younger spellers (Treiman & Bourassa, 2000a).

Most of the studies on spelling in children with atypical development have focused on struggling readers, especially children with reading disability (RD) or dyslexia (Hauerwas & Walker, 2003). Some of these studies yielded results to support the hypothesis that struggling readers performed similarly to young spellers. For example, Hauerwas and Walker (2003), studied 11-13 year old children (N= 26) with spelling and reading problems (indicated by a standard score of less than 85 on the *Wide Range Achievement Test 3* (WRAT-3; (Jastak & Wilkinson, 1984). They were compared to normally developing children of the same age (N= 31; as indicated by a standard score of 90 or above on the WRAT-3), and normally achieving second and third graders (N= 31), also selected based on a standard score of 90 or above on the WRAT-3. This study was designed to determine whether phonological deficits contributed to deficits in inflected morphology (e.g., spelling inflected verbs, such as *skip* for *skipped*) or whether limitations in orthographic and morphologic awareness were the primary contributing factors. All participants were given a phonological awareness task, which required the

deletion of syllables or phonemes, a morphological awareness task in which a target cloze format was completed by adding the appropriate inflected morphemes, and an orthographic awareness task where non-words presented in pairs were identified. In addition, three spelling tasks were completed. These tasks included spelling inflected verbs in a sentence context, spelling inflected verbs in a list format, and spelling base words from the inflected forms (e.g., *jump* for *jumped*).

Results indicated that the preadolescents with reading and spelling difficulties (described as specific language impairments) showed particular difficulty with inflected morphology, which is mastered earlier than derivational morphology. For example, in comparison to the younger participants, the preadolescents with reading problems misspelled inflected verbs in sentences by frequently omitting the past tense –ed form, as in *jumped* and *waved*, which were spelled as *jump* and *wave*. Although the participants demonstrated errors across the spelling tasks, it was in the inflected morphology where the most errors were evident (Hauerwas & Walker, 2003).

Hauerwas and Walker (2003) analyzed spelling errors quantitatively, but they did not analyze errors individually. In contrast, Silliman et al. (2006) included a qualitative system for the analysis of spelling errors. The Phonological, Orthographic, and Morphological Analysis of Spelling (POMAS) was developed to evaluate whether spelling errors differed when comparing three different groups of children, ages 6 to 11 years: a group with language learning disabilities (LLD) (N = 8), a chronological age matched (CA) group (N = 8), and a spelling age matched (SA) group (N = 8). The purpose of the study was to assess quantitative and qualitative performance differences. Quantitative scoring systems included constrained and unconstrained systems and

orthographic legality. The qualitative scoring system (POMAS) incorporated specific error codes based on linguistic category and feature type.

Based on the application of different scoring systems, results of the quantitative analyses indicated a significant difference for three of the four categories assessed with the CA group found to have significantly different performance from the LLD and SA groups. Similar performance was found for the SA and the LLD children, which was described as a result of delayed development of interactions between phonologic and orthographic knowledge for the LLD group (Silliman et al., 2006).

Of interest for the current study were the qualitative differences in spelling performance. The qualitative analysis focused on linguistic category (phonologic, orthographic, and morphologic) and feature differences among the three groups of children that the quantitative analysis failed to distinguish. For instance, the LLD group struggled with “r” colored vowels, making errors like *cos* for *curls*. Similar to the Hauerwas & Walker (2003) and Bourassa et al. (in press) results, this group also demonstrated difficulties with the past tense -ed. For example, errors included spelling *move* for *moved* or *crawl* for *crawled* (Silliman et al., 2006). Moreover, children with a LLD exhibited more errors across the three categories while typically developing children resolved these errors at an appropriate phase in the developmental spectrum.

In regard to variations of spelling errors across groups of children, researchers have compared spelling errors at many levels including typically developing, dyslexic and non-native speaking (Apel & Masterson, 2001; Leybaert & Lechat, 2001; Masterson & Crede, 1999; Silliman et al., 2006). Variation in spelling acquisition is evident across the groups due to home and instructional experiences and ability (Leybaert & Lechat,

2001). These differences were established quantitatively in the Hauerwas and Walker (2003) study in which groups of children differed based on the total number of errors. The Silliman et al. (2006) study, on the other hand, revealed differences between groups of children based on the quality of the errors. Based on the findings previously discussed, it is of importance to implement both quantitative and qualitative assessments into the assessments of spelling that currently exist in elementary classrooms to assist in identifying those children who may be exhibiting greater literacy problems.

Assessments of Spelling

Spelling assessments can occur in various ways to evaluate a child's knowledge of spelling skills. Gentry (2004) points out that, while much of spelling instruction in the classroom is completed in the form of a weekly spelling test, the resulting information does not adequately assess the knowledge that students possess. As a result, remedial instruction cannot be determined. As discussed by Apel et al. (2004a; 2004b), the standard weekly spelling test assesses material in one context and signifies only if the child spelled the word correctly or incorrectly. However, spelling assessments can occur in the form of inventories, writing samples, pretest-posttest studies, or standardized assessments. These strategies are described in the following section.

Spelling inventories. Bear et al. (2004) make the case that spelling inventories, or words specifically chosen by the teacher to represent various spelling patterns and features relating to different phases of spelling development, are an effective qualitative technique for spelling analysis. Bear and colleagues suggest that this type of approach lends itself to analyzing specific types of errors that children produce in their spellings versus a quantitative approach, which assesses only the total number of errors.

Numerous types of spelling inventories exist or can be created by the teacher or speech-language pathologist and can be grade or level specific regarding the child's current spelling abilities considering phonologic, orthographic, and morphologic skills. Words included in the list should represent different spelling patterns at increasing levels of difficulty. The inventories are collected from each child in the form of a spelling test and charted according to the stage/phase or repertoire theory of spelling development (emergent, alphabetic, within-word pattern, syllables/affixes, and derivational relations), as well as spelling features (Apel et al., 2004b; Bear et al., 2004; Henderson, 1985). Apel et al. (2004a) and Silliman et al. (2006) suggest that, when the broad and narrow approaches are integrated, the resulting information can highlight the phase of children's spelling development and the linguistic components mastered or still in the process of emergence. However, for this type of assessment to be effective, it is important that the inventory words are not taught as examples during the intervention process (Bear et al., 2004).

Pretest-study-posttest. In Gentry's (2004) opinion, weekly spelling tests can be of significant importance for assessing spelling skills. Gentry (2004) argues that weekly spelling tests present a more rapid approach to understanding a child's difficulties. While many researchers believe that spelling is best assessed in a writing context (Berninger et al., 1992; Masterson & Crede, 1999), Gentry states that it is too cumbersome for the teacher to sift through the writing samples of entire classes to evaluate errors. In the pretest-study-posttest approach to spelling assessment, a form of response to intervention, the teacher obtains knowledge of each student's errors through a spelling test. The teacher then addresses the errors by teaching the spelling patterns that lead to accurate

spellings. The spelling test is repeated at the end of each unit to determine if the child demonstrates skill mastery (Gentry, 2004).

The pretest-study-posttest differs from the spelling inventory in that the pretest-study-posttest assessment directly utilizes the weekly spelling test and the child's misspellings are obtained; therefore, the spelling inventory may be a more extensive record of spelling errors. In the inventory approach in which the broad and narrow perspectives are combined, the errors are not only analyzed and reviewed in future spelling lessons, but also the errors can be classified according to linguistic category and their respective features.

Norm-referenced assessments. Researchers often use standardized or norm-referenced assessments when selecting participants in spelling studies (Apel et al., 2004b). This type of assessment allows for a comparison of an individual child's spelling performance to a group's performance. Thus, the level of spelling proficiency can be determined from the standard scores and percentile rank derived from the child's test performance (Apel et al., 2004b).

While it seems advantageous to compare a child's spelling performance to other children of the same age, the norm-referenced assessment actually has minimal relevance for spelling intervention. These assessments do not recognize individual error patterns in need of remediation, and their structure does not allow for assessment of all linguistic aspects of spelling (Apel et al., 2004a). Masterson & Crede (1999) make the case that writing in context is a more effective way to assess spelling errors than weekly spelling tests because the misspelled words can be compared to other words used in the sentence and, therefore, help in determining if other words affected the misspelling. The following

section describes how various written genres are used to assess spelling and considers how different genres require different knowledge bases and, therefore, may increase spelling errors as a consequence.

The Effects of Composing on Spellings

Spelling words in context is another approach to assessing spelling abilities (Gentry, 2004; Masterson & Crede, 1999). Berninger et al. (1992) suggested that assessing spelling through written compositions, whether narrative or expository, was most effective because it revealed not only spelling abilities, but also the fluency of children's writing (how many words were produced), as well as how children structured sentences. Another advantage of compositions is that children use words that are already in their vocabulary, and, therefore, are familiar to them (Paul, 2001).

Narrative writing is generally considered easier for children to generate because the focus is placed on relationships between people and events. On the other hand, expository compositions are considered more challenging because they focus on factual information and ideas (Paul, 2001) and the topic may require knowledge that is less familiar to the writer (Scott & Windsor, 2000). Also, the structure of the expository genre differs considerably from narrative organization in that expository structures do not necessarily follow a temporal order of events. As Singer and Bashir (2004) note, world knowledge and the type of written genre affect the quality of a child's writing. Therefore, misspelling may occur less frequently in narrative writing samples because children are accessing available knowledge about social relationships between characters and events. In comparison, expository samples require children to utilize less contextualized

information since they must focus on relationships among ideas. It may be the case, that depending on the type of expository genre, misspellings will increase.

When comparing spelling errors from two different genres, it seems appropriate to consider the differences in the types and number of errors evident in each genre. Scott and Windsor (2000) compared expository and narrative writing samples in 60 children; 20 children with a LLD (mean age = 11;5 years), 20 chronologically age (CA) matched children (mean age = 11;6 years), and 20 language age (LA) matched children (mean age = 8;11 years). The study focused on comparing the productivity, fluency, lexical diversity, and grammatical complexity of the three groups in narrative and expository writing samples. Results revealed that both the children with LLD and the CA children had more difficulties with expository writing. However, the children with LLD demonstrated a greater number of grammatical errors, including punctuation and spelling errors, in the expository writing sample. The expository compositions were also shorter in length and less fluent (Scott & Windsor, 2000).

Spelling assessments, such as those just described, are used clinically and educationally. However, regardless of format, the results are meaningless if the analysis is not consistent with a particular scoring system.

Scoring Systems

When analyzing spelling errors, the type of scoring system must be predetermined. Various types of scoring systems exist and the type of system chosen will determine how misspellings are classified. Traditionally, scoring systems have focused on phonological errors, visual accuracy, and orthographic legality (Bruck & Waters, 1988). In contrast, the POMAS (Silliman et al., 2006) permits the qualitative analysis of

linguistic spelling errors through a scoring system composed of linguistic categories and features. These systems are discussed in detail next.

Constrained vs. unconstrained approaches. Phonological errors can be analyzed using a constrained or unconstrained system (Bruck & Waters, 1988). In a constrained scoring system, a misspelled word is considered phonetically accurate if each phoneme occurred in the same place as in the target word, and, therefore, the word could be pronounced as the target word. Examples of phonetically accurate misspelled words under this system are *reche* for *reach* and *kepe* for *keep* (Bruck & Waters, 1988).

Although the previous examples are misspelled, the –e at the end of each word marks the long vowel, and the word would be pronounced like the target (Bruck & Waters, 1988).

The unconstrained system, on the other hand, accepts a misspelling as phonetically accurate if each phoneme in the word is represented by a grapheme according to English pronunciation, such as *rech* for *reach* or *necesite* for *necessity* (Bruck & Waters, 1988). Although the words are spelled incorrectly, there is a match between phonemes and graphemes making the words phonetically plausible. In both cases, the long vowels are marked with the letter name *-e*.

Visual accuracy approach. Because spelling can occur through direct memory retrieval of the orthographic form of a word (Bruck & Waters, 1988), visual accuracy measures can also be used to analyze the orthography of spelling in a quantitative sense. Apel et al. (2004a) refer to this same approach as the bigram approach. With this measure, the amount of overlap between individual letters in the misspelling and the letters in the target word are assessed (Apel et al., 2004a; Bruck & Waters, 1988). Bigrams focus on individual letters and their correct order in the misspelled word as

compared to the target word. The percentage of bigrams produces a visual accuracy score. An example from Bruck and Waters (1988) illustrates the bigram measure. The word *nature* has five bigrams: (na+at+tu+ur+re) and six letters. If a child spelled the word as *nachure*, the child's spelling would match the target word with 3 bigrams and 5 letters for a total score of 8 of 11 (five bigrams and six letters), therefore, the percent of bigrams would be .73 for visual accuracy.

The visual accuracy score is problematic for analyzing types of spelling errors for two reasons. First, the score is a representation of orthographic similarities (i.e., letter order) of the correct and incorrect word rather than a representation of the letters the child used to spell the word. For example, a child may represent all of the phonemes in a word but reverse the order of letters. Although the spelling is phonologically represented, the letter reversals within the word will yield a visual accuracy percentage representing minimal accuracy of the correct spelling. Furthermore, a misspelling of the word in this system would not tell where the error occurred or the type of error.

Orthographic legality approach. The orthographic legality approach to misspellings analyzes whether or not the sequence of graphemes used to spell a word is legal in English spelling (Treiman & Bourassa, 2000b). For example, *mfbvg* is not orthographically legal because the sequence of consonants does not exist in English. However, *frip* for *trip* does not violate English orthography, although it is misspelled, it is a legal sequence of letters.

Orthographic legality was designed to assess structural and positional orthographic knowledge. For example, when administering a group of words, such as a spelling inventory, the spelling of each word is analyzed to determine if the words

contain orthographically legal sequences of graphemes. The child receives credit even if the word is misspelled as long as the sequence of graphemes is legal. Therefore, the spelling error *frip* for *trip*, although misspelled, would receive full credit using the orthographic legality approach because the order of phonemes is legal in English. To determine the percentage of orthographically legal spellings, the total number of words containing legal sequences is divided by the total number of words administered in the session (Silliman et al., 2006).

While these three scoring approaches reveal how many spelling errors children make, the need for understanding the types of errors is equally important. A lack of focus on the quality of children's errors does not yield insight into understanding children's patterns and the linguistic sources of their errors. The POMAS scoring system (Silliman et al., 2006) details a more qualitative approach to scoring.

The Phonological, Orthographic, and Morphological Assessment of Spelling (POMAS). The POMAS (Silliman et al., 2006) allows for a qualitative assessment of errors by linguistic category. In contrast to the other scoring systems previously described, the POMAS examines error patterns rather than concentrating solely on the total number of errors. First, misspellings are categorized according to the linguistic categories of phonology, orthography, and morphology, which is an advantage of using this qualitative system. In addition, spelling errors can be further classified by feature according to types of errors, such as tenses (inflectional morphology), deletions, clusters, and digraphs (Silliman et al., 2006). Each misspelled word can be classified into a broad category (phonology, orthography, morphology) and then further examined for specific features in a linguistic category.

As revealed previously, the process of teaching spelling seems challenging and the connection between spelling and other aspects of literacy development are often overlooked. Different types of spelling assessments exist. These include pretest-study-posttests and spelling inventories, yet the process of rote memorization of weekly spelling words seems to persist (Apel et al., 2004a). Weekly spelling tests, much like most of the spelling analyses, quantitatively examine the errors children commit. The importance of shifting towards qualitative analyses assist in revealing exact error types, yet these types of analyses remain rare. The POMAS was the first qualitative analysis of its kind, particularly with regard to children with a LLD.

Statement of the Problem

The research reviewed suggests that spelling develops in phases. Although the phases of development vary among researchers, the basis of spelling development consists of phonologic, orthographic, and morphologic knowledge and strategies for implementing this knowledge. To analyze the development of spelling patterns, various scoring approaches have been utilized. These approaches tend to focus quantitatively either on the number of errors, visual accuracy scores, or orthographic and phonological information. The total number of errors is then compared across groups. What this information fails to reveal is that, although two different groups of participants may have the same number of errors in any given category, the quality of the errors may differ. Similarly, two groups who demonstrate different numbers of errors in any given category may demonstrate the same errors. In general, these quantitative scoring systems are weak in their ability to show patterns and types of errors within and across the phases of spelling development.

A need exists to develop a qualitative approach to analyzing spelling errors for determining whether or when a shift in error type (phonologic, orthographic, or morphologic) and features occurs in spelling performance among children in different grade levels. In addition to providing a more detailed approach to classifying spelling errors, qualitative analyses of spelling may be a more effective approach to understanding the evolution of linguistic features in misspellings as children progress academically. This study attempts to provide the information overlooked by other spelling studies and to fill the gaps needed for improved spelling intervention through the qualitative analysis of spelling errors in children in the lower elementary grades.

The current study is a secondary outcome of a project initiated by Berninger and colleagues (Berninger, Cartwright, Yates, Swanson, & Abbott, 1994; Berninger, Whitaker, Feng, Swanson, & Abbott, 1996; Berninger et al., 1992). These three studies included children in grades 1 to 9 (Berninger et al., 1994; Berninger et al., 1996; Berninger et al., 1992). The first two studies (Berninger et al., 1994; Berninger et al., 1992) focused on how developmental skills, such as fine motor skills, working memory, orthography, phonology, and word finding, affected writing and reading acquisition in grades 1 to 3 and 4 to 6. Results indicated that developmental skills did influence writing acquisition in the younger grades when writing is introduced (Berninger et al., 1992). Lower level skills (automatic production of alphabet letters, rapid coding of orthographic information, speed of sequential finger movement, visual-motor integration, and orthographic-phonological mappings) were found to affect the quality of writing. However, these skills must be developed before the quality of the writing can improve.

The second study (Berninger et al., 1994) assessed the relationship of cognitive skills to reading and writing. Cognitive skills assessed included: a) rhyme, b) semantic association, c) phrase, narrative and expository text, and d) listening recall. Results revealed that cognitive skills and reading and writing were related but not specific to one another.

In the third study, Berninger et al. (1996) assessed cognitive skills (planning, translating, and reviewing) of students in grades 7 to 9 during a writing task. The ability to be an effective writer consisted of these cognitive skills combined with the ability to produce fluent thoughts. Results indicated that strengths in one area of composition were not predictors of strengths in other areas. Stated another way, demonstrating strengths in planning did not indicate strengths in the ability to revise.

While the purpose of the three studies varied, they all had composition tasks in common. Across grade levels, students completed a narrative and expository writing sample with the same prompts. All were allotted five minutes to write. Then, misspelled words from both tasks were collected for the future analysis of spelling. The misspelled words for grades 1 to 4 are the focus of the current study.

Because the current study centers on spelling development in the lower elementary grades, samples from grades 5 to 9 were excluded (Berninger et al., 1994; Berninger et al., 1992). However, since all of the data relative to the current study were collected in the same manner, inconsistencies should not exist and analysis of the data across grade levels can be conducted.

This study examined the qualitative error differences in grades 1 to 4 to determine whether grade level and type of writing sample had an influence on the type of misspellings. The four questions addressed whether:

1. The number and type of spelling errors (phonological, orthographic, morphological) differed as a function of grade level.
2. The genre, expository or narrative, and gender affected the total number and/or specific error type of misspellings.
3. Patterns of performance regarding specific errors differed across and within grades for the phonological, orthographic, and morphological categories.
4. Additional information was revealed through a qualitative analysis of features within the phonological, orthographic, and morphological categories.

Chapter 2: Method

Children's spellings are based on their knowledge and experience with the phonological, orthographic, and morphological components of language (Carlisle, 2003; Cassar & Treiman, 1997; Dodd & Carr, 2003; Hauerwas & Walker, 2003), which is influenced by reading and writing as they advance in grade levels. Therefore, the number and type of misspellings present in a writing sample may differ across grade levels. This study examined the different types of misspellings in children's writing across grade levels 1 to 4. The data used in this study were extracted from the writing samples of children gathered in the three different studies by Berninger et al. (Berninger et al., 1994; Berninger et al., 1996; Berninger et al., 1992). The purpose of this study was to examine closely the spelling errors of young children to determine what, if any, error patterns consistently existed in their spelling development. The data collected by Berninger et al. (1994; 1992) was coded using the POMAS coding system (Silliman et al., 2006) and the errors were classified into broad (phonological, orthographic, morphological) and narrow (linguistic feature) categories.

Participants

1st to 3rd grade. A total of 300 children in grades 1, 2, and 3 were selected from eight different elementary schools in three school systems in the Seattle, Washington area. Of the three school systems, one was suburban, one was suburban/rural, and one was urban. The 300 children who participated in the studies were selected from 570

volunteers. An equal number of girls and boys were selected to participate. Mothers' educational level ranged from high school to college and beyond. The grade 1 children's age ranged in years and months from 6;6-8;2, grade 2 ranged from 7;5-9;1, and grade 3 ranged from 7;6-9;11 (Berninger et al., 1992). Mean ages and standard deviations were not provided.

4th grade. While the Berninger et al. (1994) study included grades 4 to 6, this study focused only on the fourth grade data. A total of 100 4th grade children were chosen from five urban and suburban schools. An equal representation of boys and girls were included. In this sample, mothers' education level ranged from less than high school to college and beyond. Age ranges for the children were not provided (Berninger et al., 1994). The following table provides the percentages of ethnic representation for the children included for this project.

Table 2.1. Ethnic Representation of Participants in Grades 1 to 4 (Berninger et al., 1994; Berninger et al., 1992)

	1 st -3 rd grade	4 th -6 th grade
Asian American	6%	14%
African American	6%	10%
Hispanic	3%	4%
Caucasian	84%	70%
Native American	<1%	1%
Other	N/A	1%

Materials

The study consisted of separate narrative and expository writing samples obtained from the 400 children. All were given paper and a writing utensil (Berninger et al., 1992, 1994, 1996) and the examiner used a watch or timer to limit them to 5 minutes of writing per sample. The narrative writing sample was identical for all grade levels, and began with the prompt “One day _____ had the best or worst day at school.” The expository writing sample prompt was also identical for all grade levels, and began with the sentence “I like _____ because _____.”

Procedures

The children in grades 1 to 3 were tested during individual sessions in a quiet space provided by each school. The assessment took place during the school year, sometime between February and May, 1990. At the beginning of the experiment, each child was assigned a number. Children with an even number completed the narrative essay first, while children assigned odd numbers completed the expository essay first. The examiner gave the child the prompt and five minutes to write. At the end of five minutes, each child was asked to read their writing sample to the examiner. The examiner then transcribed the child’s retell of the compositions on a separate sheet of paper and compared the transcribed composition with the original composition (Berninger et al., 1992). Misspelled words occurring within the sample were extracted from the composition and listed on a separate sheet of paper with the correctly spelled word listed next to it.

The grade 4 children were also tested in individual sessions in the sixth or seventh month of the school year. Similar to the task for grades 1 to 3, the grade 4 participants

were required to write a narrative and an expository essay with prompts identical to the compositions for grades 1 to 3. Table 2.2 provides the mean number of words and clauses per writing sample for each grade level.

Table 2.2. Grade Performance by Writing Sample

	Mean Words Narrative	Mean Clauses Narrative	Mean Words Expository	Mean Clauses Expository
1 st – 3 rd	35.20	5.62	33.16	5.72
4 th	57.47	7.94	55.61	8.37

After reviewing the compositions produced by each child, the examiner listed the child's misspelled words on a separate sheet of paper with the correct word listed next to it, based on the examiner's best judgment of the misspelled word (Berninger et al., 1994).

In summary, although 400 children differed in age, each grade level was given the same narrative and expository writing prompts. The misspelled words from each child's samples were extracted, and these misspellings were analyzed in this study as a secondary analysis. The number of errors and type of each error was determined using a qualitative analysis system.

POMAS. The *POMAS* scoring system (Silliman et al., 2006) classifies errors into the three broad areas of development: phonology, orthography, and morphology. The *POMAS* also divides the three broad categories into smaller subsets of linguistic features that describe qualitative differences within each error category. For example, an error would be coded as phonological, if the child spelled *resses* as *deses*, because the child omitted the second letter in the consonant cluster, and the complete sound structure of the

word was not represented. This type of error therefore would be classified under the code Phonological-Cluster Reduction (PCR).

Orthographic errors were analyzed according to misspellings that represented a digraph and the marking of syllable juncture. Again using *dresses* as the sample word, if the child spelled the word as *dreses*, this error would be coded as an orthographic error due to the omission of the double “s” (Orthographic - Digraph).

Morphological errors were analyzed according to inflections, including the presence or absence of past, present, or present progressive tense, and derivations with and without phonological changes, as well as prefixes/suffixes. For example, if a child spelled the word *dresses* as *dress*, the error would be coded as an inflectional morphological error since the plural marker *-es* (Morphological - Inflection) was omitted.

The error codes from the original POMAS were included in the coding system for this study. However, modifications were made and many new codes were established due to the variety of words obtained from each participant contrasted with the original POMAS, in which each child spelled the same set of words. Tables 2.3 to 2.8 include a small sample of the linguistic features and the error category to which each feature was assigned. A full listing of the error codes can be found in Appendix A.

Table 2.3. POMAS Coding System – Phonological Errors (Silliman et al., 2006)

<i>Feature</i>	<i>Word</i>	<i>Example</i>
Short vowel	cast	Caste
Long vowel	cake	Cak
Diphthong	found	Fond
Sonorant clusters	and	Ad

Table 2.3 (Continued)

<i>Feature</i>	<i>Word</i>	<i>Example</i>
Cluster reduction	struck	Stuck
Vocalic /r/	curls	Cos

Table 2.4. POMAS Coding System – Orthographic Errors (Silliman et al., 2006)

<i>Feature</i>	<i>Word</i>	<i>Example</i>
Digraph	ship	Sip
Long vowel pattern	keep	Kipe
Unusual vowel pattern	found	fowned
Syllable juncture (consonant doubling)	stirring	Stiring
Syllable juncture (“y” to “i”)	cries	Cryes

Table 2.5. POMAS Coding System – Morphological Errors (Silliman et al., 2006)

<i>Feature</i>	<i>Word</i>	<i>Example</i>
Inflection-present tense	cries	Cry
Derivational shift with phonologic change	magician	magishen
Inflection-plural (-s pronounced /z/)	curls	Curl
Inflection-plural (-es)	dresses	Dress
Derivational – suffix	later	Late
Agentive “er” suffix	prisoner	Prison
Derivation (no phonologic change)	government	govrment
Derivation (phonologic change)	magician	megishen

Table 2.6. POMAS Coding System – Mixed Phonological-Orthographic Errors

(Silliman et al., 2006)

<i>Feature</i>	<i>Word</i>	<i>Example</i>
Letter reversals	thier	their
Vowels missing	double	dbl

Table 2.7. POMAS Coding System – Mixed Morphological-Orthographic Errors

(Silliman et al., 2006)

<i>Feature</i>	<i>Word</i>	<i>Example</i>
Misspelled root word resulting in phonologically accurate spelling	Magician	magishan

Table 2.8. POMAS Coding System – Mixed Morphological-Phonological Errors

(Silliman et al., 2006)

<i>Feature</i>	<i>Word</i>	<i>Example</i>
Visually similar error	car	are

Data Reduction. The misspelled words were entered in the *Systematic Analysis of Language Transcripts Software* (SALT) (Miller & Chapman, 1991) for the purpose of coding the spelling errors. Each sample was identified by grade level, gender, and type of writing sample (narrative vs. expository). Then, the errors were coded by category

(phonological, orthographic, and morphological) and feature using the POMAS scoring system.

A specialized computer program was created to assist with quantifying the results of the qualitative analysis. The program analyzed each line of coded information from the SALT files and tallied the number of times each error code was used. The total occurrences of each error per writing sample, child, grade level, and across all grade levels were identified. Finally, the data obtained from the computer program was transferred into an Excel file for statistical analysis. The error features belonging to the major categories (phonological, orthographic, morphological, and mixed) were grouped together and sums were obtained to determine the total number of errors for each major category in the individual samples. For statistical analyses, these totals were normalized by the total number of errors produced by a particular child. In addition, words in error were grouped together to assist in identifying commonly misspelled words.

Qualitative Analyses. A qualitative analyses was completed to determine types of errors and error patterns that occurred in the data. The first analysis completed compared the frequency of each error according to individual feature. The errors were compared within and across grade levels and according to the type of writing sample. An analysis of words frequently in error was also completed. Although all of the children were required to write based on the same prompts, the words produced were unique to each child; therefore, the analysis of words frequently in error determined if children consistently used, and made, spelling errors on the same words.

In conjunction with the analysis of words frequently in error, a second analysis was performed to determine variations in the spellings of the same word. To complete

this analysis, each misspelled word was grouped according to the intended word even if each misspelling varied. This type of analysis allowed determination of patterns in misspellings to see if there were words consistently misspelled by children and whether different children misspelled words exactly the same way.

Agreement. A second trained examiner reanalyzed and coded the spelling data from 5% of the participants to determine interrater consistency. The participants included in the recoding were randomly selected from the grade 1 to 4 data with an equal number of boys and girls per grade level selected. The second examiner recoded both the narrative and expository writing samples of each participant to assist in determining error patterns unique to the individual. Six participants were selected from each grade level with an average of 7.583 words per participant. The second examiner was directly trained to use the POMAS coding system through the use of spelling samples not related to the study. Errors observed during the training were reviewed and further examples of the same error type were provided. The agreement findings will be reviewed in the following chapter.

Statistical Analysis. A four-way MANOVA was used to compare and analyze the quantitative data. The independent variables were writing sample (narrative vs. expository), error type (phonological, orthographic, morphological, or combinations of these errors), gender (male/female) and grade level (1-4). The dependent variable was the frequency of occurrence in each error category. Post hoc tests were run when appropriate. Effect sizes were calculated.

Two-way ANOVAs were also completed to compare and analyze differences in the types of errors the children made in the writing samples. The independent variable

was grade level (1-4) and the dependent variable was the specific error types. T-tests were completed for each comparison of major category (phonology, orthography, morphology) and grade level. Effect sizes were calculated as appropriate.

Chapter 3: Results

This study was designed to describe the error patterns of children in grades 1-4 to determine whether the child's level of education, type of writing sample, and sex had an influence on the type of errors seen in their spelling performance. The data was collected from two separate writing samples administered to the children during a previous study (Berninger et al., 1994; Berninger et al., 1996; Berninger et al., 1992). The spelling errors were transcribed for each child and coded for grade level and type of writing sample (narrative and expository). The data were analyzed using an embellished version of the POMAS (Silliman et al., 2006). Qualitative analyses included determining the most frequently misspelled words and the most common error codes from the sample data. This study examined the qualitative error differences in grades 1 to 4 to determine whether the children's grade level and type of writing sample had an influence on the type of misspellings. The three questions addressed whether:

1. The number and type of spelling errors (phonological, orthographic, morphological) differed as a function of grade level.
2. The genre, expository or narrative, and gender affected the number and type of misspellings.
3. Patterns of performance regarding specific errors differed across and within grades for the phonological, orthographic, and morphological categories.

4. Additional information was revealed through a qualitative analysis of features within phonological, orthographic, and morphological categories.

Inter-Examiner Agreement

Agreement was conducted regarding feature error categorization. Of the total 800 writing samples (N = 2 per child x 400 children), 6 percent (N = 48) of the samples were randomly selected for the agreement analysis. A second examiner was trained to recode the narrative and expository data for each selected participant using the POMAS scoring system. Training consisted of reviewing the rules within each of the POMAS categories (phonology, orthography, and morphology) and then having the second rater analyze some of the current spelling samples along with the primary examiner. Once the second rater was comfortable with the scoring system, she was asked to rate randomly selected samples from the database.

Due to the complexity of the coding for individual error features, the features were collapsed into specific error categories (phonology, orthography, and morphology) rather than specific error feature for agreement analysis. The agreement was calculated using the following formula (Salvia & Ysseldyke, 2001):

$$Agreement = \left(\frac{\text{number of agreements}}{\text{total number of agreements}} * 2 \right) * 100$$

The results of the analysis determined an overall 75% agreement for specific error category (phonology, orthography, and morphology). A 75% agreement between examiners is a reasonable outcome due to the complexity of the study. The coding system was complex in that several errors overlapped into two different major categories. Therefore, the category coding was left to the examiner's discretion. In several instances in the coding system, the error feature was the same although the error feature varied.

Therefore, the examiner's interpretation of the child's representation of the misspelled word had an effect on the code selected. For example, the coding system included three different codes for vowel errors. One code was represented as a phonological error regarding short vowels, while the other error was an orthographic vowel error. Given the word *funny* spelled as *fany*, which was included in the random sample, the first examiner coded this error as OVE (orthographic error in which the substituted vowel error still represented a short vowel) while the second examiner coded the error as PSV (phonological error involving the short vowel). Thus, although both examiners agreed on the specific error feature, agreement was not revealed for this error because the exact error code or category match did not occur. Instances such as this example occurred throughout the study. Although two examiners may agree on the error type, but not necessarily the main category, the resulting agreement appears to be lower than the actual coding represented.

An additional barrier effecting a strong agreement between examiners occurred because the original writing samples for the subjects were not available for reference. Therefore, the context of the misspellings could not be determined and other correct spellings in the samples were not available for review. This information would be useful because the examiner could observe if any of the misspelled words were spelled correctly at any other point in the sample and if a previously spelled word may have impacted the misspelling.

Overview of Subject Performance

The data then was analyzed to determine the total number of spelling errors for each of the four grade levels (1st-4th) included in this study. Each grade level included

approximately 100 equally represented male and female participants who contributed both a narrative and expository writing sample. For this analysis, the total number of spelling errors was analyzed regardless of the type of writing sample or sex of the child. To normalize the data across participants, each child's data was normalized as follows: the number of errors produced in each major category (phonology, orthography, morphology) was divided by the total number of errors produced by the child. Table 3.1 represents the means and standard deviations for the analysis.

Table 3.1. Total Number of Errors for Each Grade Level (N= 3,264)

Grade Level	Mean	Standard Deviation
1	7.88	5.903
2	5.77	5.456
3	4.73	4.663
4	4.99	4.921
Total	5.84	5.390

The data were also analyzed to determine the influence writing sample (expository or narrative) had on the total number of errors for each grade level. Table 3.2 represents the means and standard deviations for the analysis of the total number of errors based on writing type.

Table 3.2. Total Number of Errors in the Two Writing Samples According to Grade Level.

	Type	Mean	Std. Dev.
1	Expository	7.83	6.055
	Narrative	7.93	5.776
2	Expository	5.27	4.897
	Narrative	6.26	5.946
3	Narrative	4.98	4.868
	Expository	4.49	4.458
4	Expository	4.96	4.684
	Narrative	5.02	5.172

An additional analysis was completed to determine the total number of errors according to grade level based on gender. Table 3.3 presents the means and standard deviations for this analysis.

Table 3.3. Total Number of Errors According to Grade Level Based on Sex.

Grade	Gender	Mean	Std. Dev.
1	Boys	8.16	6.244
	Girls	7.60	5.558
2	Boys	5.72	5.420
	Girls	5.82	5.519
3	Boys	4.46	4.711
	Girls	5.01	4.620

Table 3.3 (Continued)

4	Boys	4.68	4.304
	Girls	5.30	5.474

The data previously described was analyzed in closer detail to answer the research questions of importance for this study. These analyses are discussed in the following sections.

Statistical Analyses of Data for the Research Questions

Question 1: Grade Level Effects on Number and Types of Errors

A four-way MANOVA was conducted to analyze whether 1st through 4th grade typically developing children differed in the number and type of spelling errors they produced as a function of writing sample and gender. Specifically, a 4 (grade level) x 4 (error type) x 2 (gender) x 2 (sample type) analysis was completed. The results of the MANOVA indicated only one significant interaction, the interaction between grade and error type, $F(9, 2352)=4.838, p<.001, \eta_p^2=.018$. This finding would suggest that the differences between error types were dependent on grade. However, the effect size suggested that this interaction explained very little of the variance in this analysis. Post hoc testing for across grade differences was completed using t-tests, with a Bonferroni correction ($p=.002$). Of the 18 pairwise comparison of interest, only 3 were shown to be statistically significant (see Appendix B for t-test results). As illustrated in Figure 3.1, and supported by the t-test results, 1st graders made more phonological errors than did the 2nd and 4th graders. All groups made similar numbers of orthographic errors, while 4th graders made more morphological errors than 2nd graders.

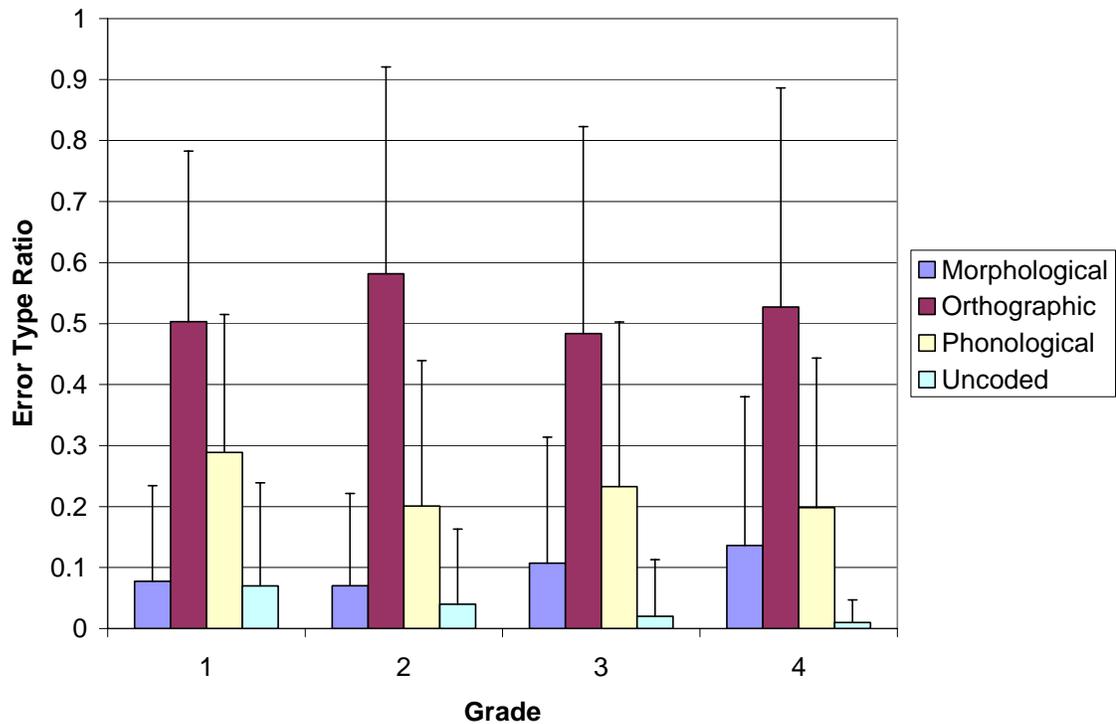


Figure 3.1. Comparison of Category Error Ratios by Grade Level.

Question 2: Did The Writing Sample or Gender Affect Number And Type of Spelling Error?

This question can be answered by continued explanation of the previously described four-way MANOVA. The results indicated that none of the interactions involving writing type nor the main effect was significant, $F(1,784) = .119, p = .730, \eta_p^2 < .001$. This finding suggested that the differences between the types of errors were not dependent on the type of writing sample and that the number of errors within each writing sample type were not significantly different.

In addition to the analysis completed to determine if writing sample had an effect on the number and type of spelling errors, an analysis to determine the effect of gender

on the number and types of errors was also completed. In this case, the four-way MANOVA revealed that none of the interactions involving gender were significant, $F(1,784)=.247, p=.619, \eta_p^2<.001$. In addition, the main effect of gender was not significant. In other words, boys and girls made similar types of errors.

Question 3: Error Patterns within Grade Level

Statistical analyses were completed for each of the major error categories, phonology, orthography, and morphology, to determine differences across grade levels for particular error types and between error types within grade levels. The error types were selected for each category based on the total number of occurrences within the sample and those that occurred relative to stage theory. In other words, the phonological and orthographic errors were chosen because the total number of error occurrences for these error types decreased across the grade levels and the morphological error types increased from first to fourth grade. Two-way ANOVAs were completed to determine relationships within and across grade levels while post hoc testing was completed to identify specific differences between error types. These results will be discussed by error category.

Phonological errors.

To determine if there were grade differences in the use of particular phonological error patterns, a two-way MANOVA was run with grade and error type as the independent variables and error frequency as the dependent variable. The results revealed a two-way interaction between grade level and error type, $F(9,2388) = 6.45, p < .001, \eta_p^2 = .024$. This finding would suggest that the occurrence of error type was dependent upon grade level. To further analyze this interaction, differences in errors will be considered

both across grades for a particular error pattern and within grades for differences in error pattern use.

Across grade patterns. Post hoc testing with the Bonferroni procedure (a procedure which controls for family-wise error) revealed that 8/24 pairwise comparisons of interest were significant. (Appendix C lists the data associated with these post hoc comparisons). As illustrated in Figure 3.2, first graders made the most errors for all phonological error types with second through fourth grades following in a decreasing pattern. However, only PFPV (final position voicing) and PSON (sonorant clusters between first and second grades displayed a significant difference.

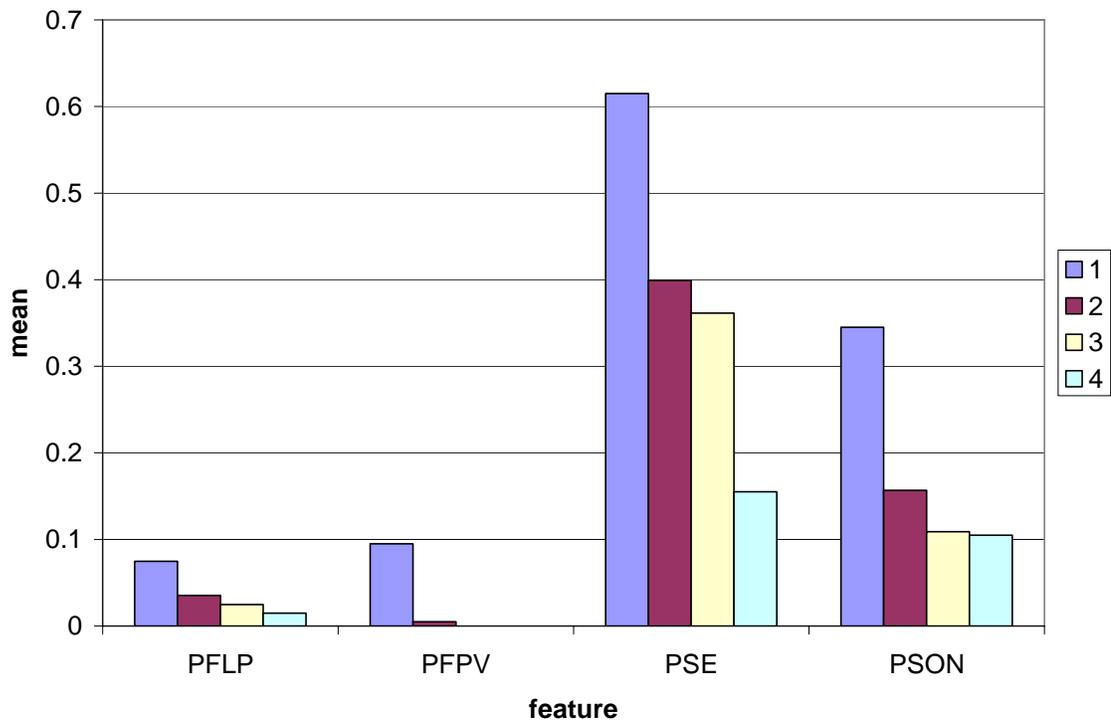


Figure 3.2. Decreasing Phonological Error Feature Use by Grade Level. Phonological Codes Represented: Flap (FLP), Final position voicing (FPV), Silent e (PSE) and Sonorant Clusters (PSON).

Within grade patterns. Post hoc testing using t-tests with a Bonferroni correction ($p = .002$) revealed that 17/24 pairwise comparisons of interest were significant. As illustrated in Figure 3.4, children in all 4 grades demonstrated a similar pattern in that the PSE (silent e) and PSON errors were produced the most frequently. Frequency of pattern use was the largest for the first graders, with PSE being used significantly more often than PSON ($p=.0003$). This was also true for the second and third graders ($p<.001$ and $p=.0001$ respectively). A significant difference for the occurrence of the PSE and PSON error types was not found for the fourth graders ($p=.1871$).

Orthographic errors

To determine if there were grade differences in the use of particular orthographic error patterns, a two-way MANOVA was run with grade and error type as the independent variables and error frequency as the dependent variable. The results revealed a two-way interaction between grade level and error type, $F(12,3184) = 6.5, p < .001, \eta_p^2 = .024$. This finding would suggest that the occurrence of error type was dependent upon grade level. To further analyze this interaction, differences in errors will be considered both across grades for a particular error pattern and within grades for differences in error pattern use.

Across grade patterns. Post hoc testing with the Bonferroni procedure (a procedure which controls for family-wise error) revealed that 5/30 pairwise comparisons of interest were significant. (Appendix C lists the data associated with these post hoc comparisons). As illustrated in Figure 3.3 first graders made the most errors for all orthographic error types. Orthographic errors decreased in quantity across second through

fourth grades. A significant difference was found for the OLN (letter name) error type when comparing first to second grade, first to third grade, and first to fourth grade. Similarly, a significant difference was also found for the OVr (vocalic r) error type when comparing first to third and first to fourth grades.

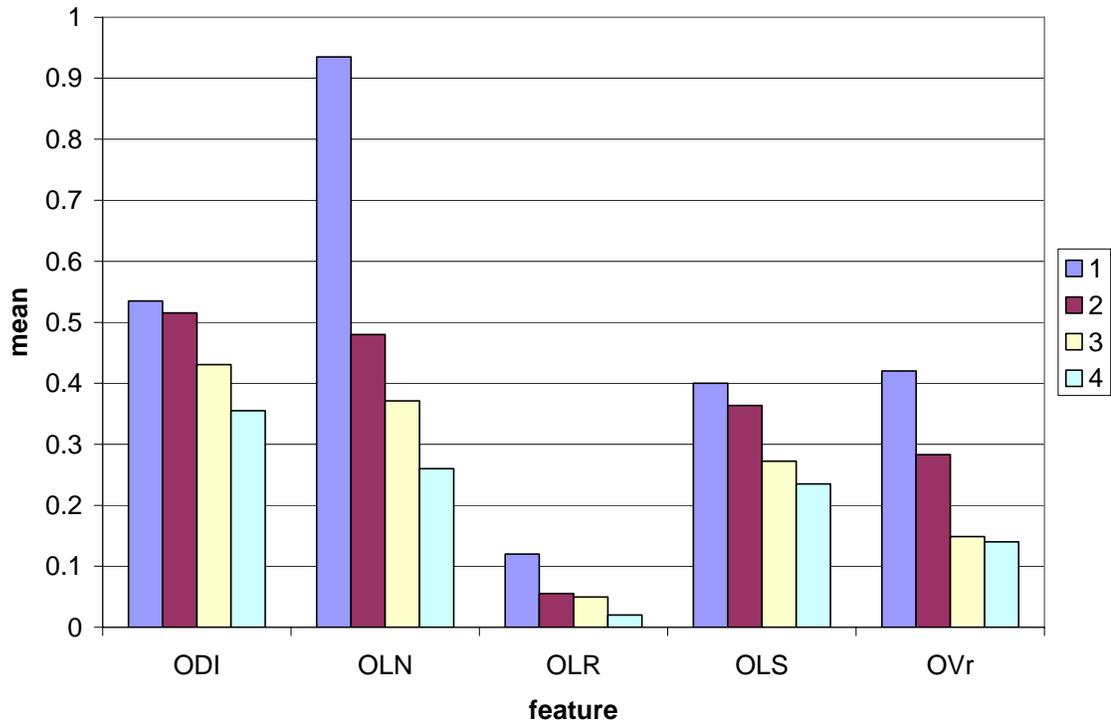


Figure 3.3. Decreasing Orthographic Feature Use by Grade Level. Orthographic codes represented: Digraph (ODI), Letter name (OLN), Letter reversal (OLR), Letter sound (OLS), and Vocalic r (OVr).

Within grade patterns. Post hoc testing using t-tests with a Bonferroni correction ($p = .001$) revealed that 21/40 pairwise comparisons of interest were significant. As illustrated in Figure 3.6, all 4 grade levels committed the most orthographic errors in the OLN and ODI (digraph) categories. However, the first graders had the most errors in the

OLN category followed by the ODI category while the other 3 grades displayed the opposite pattern. Frequency of pattern use was the largest for the first graders, with OLN being used significantly more often than ODI ($p=.0001$). The OLS (letter sound) and OVr error types were also common for all 4 grade levels occurring in a decreasing manner across grade levels. However, no significant differences were revealed. Significant differences were found for all four grade levels between ODI, OLN, OLS, OVr when compared to OLR (letter reversal).

Morphological Errors

To determine if there were grade differences in the use of particular morphological error patterns, a two-way MANOVA was run with grade and error type as the independent variables and error frequency as the dependent variable. The results revealed a two-way interaction between grade level and error type, $F(2,1592) = 5.491, p < .001, \eta_p^2 = .020$. This finding would imply that the occurrence of error type was dependent upon grade level. To further analyze this interaction, differences in errors will be considered both across grades for a particular error pattern and within grades for differences in error pattern use.

Across grade patterns. Post hoc testing with the Bonferroni procedure (a procedure which controls for family-wise error) revealed that 4/18 pairwise comparisons of interest were significant. (Appendix C lists the data associated with these post hoc comparisons). As illustrated in Figure 3.4, an overall pattern for all morphological error types was not determined. Morphological errors for the MCON (contractions) and MHOM (homonyms) error types were greatest in fourth grade. However, the MINF (inflections) error type was greatest for first graders with fourth graders having the

second most frequent occurrences. A significant difference was found for the MHOM error type when comparing first to third grade, first to fourth grade, and second to fourth grades. The MINF error type also revealed a significant difference when comparing first to third grade.

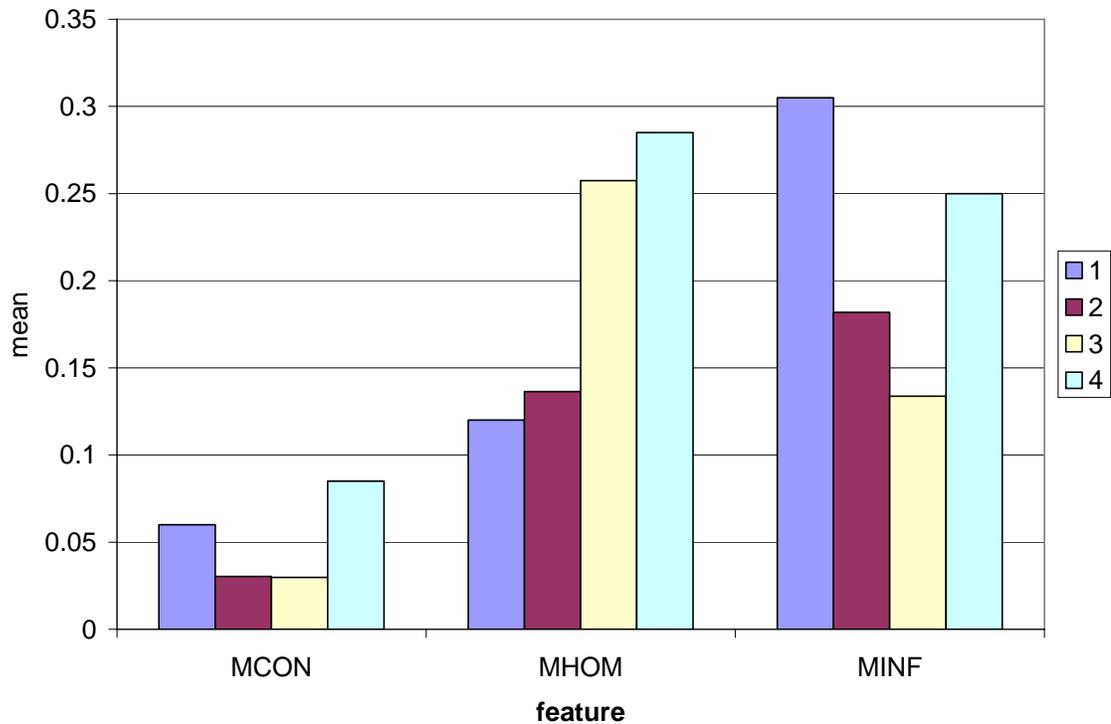


Figure 3.4. Morphological Error Feature Use by Grade Level. Morphological codes represented included: Contractions (MCON), Homonyms (MHOM), and Inflections (MINF).

Within grade patterns. Post hoc testing using t-tests with a Bonferroni correction ($p = .004$) revealed that 8/12 pairwise comparisons of interest were significant. As illustrated in Figure 3.4, children in all 4 grades demonstrated the most errors in the MHOM and MINF error categories. A pattern for error use was not determined for this

category. The first and second graders made more MINF errors than MHOM and the third and fourth graders made more MHOM than MINF errors. However, only the first graders were found to have significantly more MINF errors than MHOM ($p=.0002$). Significant differences were also determined for all four grade levels for the MCON and MINF error types, with second, third, and fourth graders demonstrating a significant difference in MCON and MHOM errors.

In summary, two-way MANOVAs for phonology, orthography, and morphology determined that the occurrence of error type was dependent upon grade level for all three error categories. Between and within grade patterns were determined. The first graders made the most errors in all phonological and orthographic error categories. All children committed the most errors in the PSON (phonological – sonorant clusters) and PSE (phonological – silent /e/) types for phonological errors and OLN (orthographic – letter name) and ODI (orthographic – digraph) types for orthographic errors. The first graders had significantly more instances of the PSE error type than the PSON error type and the OLN error type than the ODI error type. A common pattern was not determined for morphological errors. The MHOM (morphological – homonyms) and MINF (morphological – inflection) errors were greatest among all grade levels. The first graders made significantly more MINF than MHOM errors which is consistent with the finding of the Carlisle (1996) study discussed in Chapter 1. Significant differences were also determined for all grade levels for the MCON (morphological – contraction) and MINF error types. Second through fourth grades demonstrated significant differences between MCON and MHOM errors perhaps resulting from the second graders having less formal exposure to these language elements.

Questions 4: Qualitative Analysis of Error Patterns Within Grade Level

A qualitative analysis was completed after the misspelled words were coded and statistically analyzed. This analysis was completed to determine common patterns among error types of misspelled words. All of the misspellings of the same word were grouped together. Next, the same misspellings were then sorted to determine if patterns emerged within a specific grade level or if children across all grade levels exhibited the same patterns of misspellings. Based on this informal analysis, common misspellings were revealed among different children. Table 3.4 provides a representation of the most commonly misspelled words (misspelled more than 25 times) throughout the writing samples. The table also provides the number of occurrences for the specific misspelling and which grade levels the misspellings occurred.

Table 3.4. Most Commonly Misspelled Words in The Spelling Samples.

Word	Number of times misspelled	Most common Misspelling (occurring among different children)		Grade levels of children using the common misspelling
		Word	Number of occurrences/total children committing error	
because	113	becaus	7/7	1 st , 2 nd , 3 rd
recess	74	reses	13/12	1 st , 2 nd , 3 rd , 4 th
favorite	61	favrit	7/7	1 st , 2 nd , 3 rd
friend	55	frend	13/13	1 st , 2 nd , 3 rd , 4 th
when	51	wen	14/13	1 st , 2 nd , 3 rd

Table 3.4 (Continued)

Word	Number of times misspelled	Most common Misspelling (occurring among different children)		Grade levels of children using the common misspelling
		Word	Number of occurrences/total children committing error	
nice	46	nise	8/7	1 st , 2 nd , 4 th
teacher	45	techer	10/9	1 st , 2 nd , 3 rd , 4 th
school	43	scool	3/3	1 st , 2 nd , 4 th
too	39	to	39/36	1 st , 2 nd , 3 rd , 4 th
they	35	thay	12/10	1 st , 2 nd , 3 rd , 4 th
there	35	ther	8/8	1 st , 2 nd , 3 rd
played	34	plad	6/6	1 st , 3 rd
they're	33	there	10/10	1 st , 2 nd , 3 rd , 4 th
friends	33	freinds	7/4	3 rd , 4 th
pretty	27	prety	4/4	1 st , 2 nd , 3 rd
like	27	lik	9/9	1 st , 2 nd , 3 rd
didn't	27	did'nt	4/3	2 nd , 4 th
with	26	wihe	2/2	2 nd

As indicated in the previous table, many children misspelled the same words, and common misspellings were evident among many of them. It should be noted that when

analyzing this information, the common error patterns indicated occurred among different children. For example, if the same child used the same misspelling throughout the writing sample, that misspelling was considered as one instance of that error.

As is evident in Table 3.4, the analysis revealed that the word *because* was most frequently misspelled; however, only seven children, in 1st, 2nd, and 3rd grades, misspelled it the same way. Fourth graders did not have any instances of this spelling. Similar findings were evident in the words *favorite* and *recess*, in which a small number of children agreed on a common misspelling when compared to the number of times the words were misspelled. The word *favorite* was commonly misspelled by 1st, 2nd, and 3rd graders and *recess* was commonly misspelled by all four grades. Thus, from these numbers, it is evident that there were a large number of error discrepancies between spellings and grade levels. Children were not relying on the same phonological and orthographic strategies or knowledge and thus many different spellings occurred for the same word.

In contrast to the previously described misspelling patterns, the analysis of *they* (common among 1st-4th graders), *they're* (common among 1st-4th graders), *friend* (common among 1st-4th graders), *when* (common among 1st-3rd graders), and *like* (common among 1st-3rd graders) revealed more common agreement among misspellings when comparing the number of children who spelled the word the same way and the total number of times the word was used. Of utmost interest was the word *too*. This word was misspelled 39 times throughout all 800 writing samples. In all 39 instances, 39 different children from all four grade levels agreed on the misspelling as *to*, which is a homonym.

A qualitative analysis was also completed to determine the most commonly used error codes. Table 3.5 presents this information (refer to Appendix A for a complete listing of all of the error codes).

Table 3.5. Most Commonly Used Error Codes for All Grade Levels.

<i>Code</i>	<i>Number of uses</i>	<i>Code</i>	<i>Number of uses</i>
OVE	620	OLS	254
OLN	409	OUVP	234
ODI	367	POR	229
PSE	306	OVr	198
Key: OVE = orthographic vowel error, OLN = orthographic letter name, ODI = orthographic digraph, PSE = phonological silent /e/, OLS = orthographic letter sound, OUVP = orthographic unusual vowel pattern, POR = phonological-orthographic reversal, OVr = orthographic vocalic /r/			

As illustrated in Table 3.5, the most frequent error type throughout the data analysis was the OVE feature. The OLN and ODI error types were also used numerous times followed by the PSE error type. The OLS, OUVP, and POR error types were used relatively evenly throughout the samples. As indicated from the information in Table 3.5, the most commonly used error codes occurred in the orthographic and phonological error categories, with the orthographic error codes the most frequent. These error codes were found the most often because they represented a broader category. For example, the OVE (vowel) error type could be any kind of vowel error (short or long). Rather than having an individual orthographic category for each, all vowel errors were classified into that category. This increased the number of possible occurrences for the error type because specific error categories such as one category for short vowels and a second category for

long vowels did not exist in which the orthographic vowel errors could be assigned separately. Thus, it may have been appropriate to have had individual error categories for each type of orthographic error.

To conclude, a qualitative analysis revealed common spelling errors and patterns between error codes. The most commonly misspelled word was *because*, which frequently occurred in 1st, 2nd, and 3rd graders. The commonly misspelled words showed varying patterns among grade levels. Some of the misspellings were committed by only one grade level while others were committed by all four grade levels. The most common error codes were also determined. Analyses indicated that the OVE error type occurred with high frequency, and that error types most often represented the phonological and orthographic categories.

Chapter 4: Discussion

The primary objective of the current study was to determine whether differences in the quality of errors produced by children in grades 1-4 were influenced by their grade level. In other words, the major issue addressed whether different patterns were evident when comparing the types of the errors rather than strictly comparing the quantity of errors. Secondary objectives were to determine if the written genre (expository or narrative) influenced the number and types of errors and if gender influenced the number of errors.

Results of the study indicated that the type of errors varied as a result of grade level. Analyses were completed for the error types in each major category (phonology, orthography, and morphology). Findings revealed that the most frequent feature errors were clustered in the following categories: a) for phonology, final position voicing (PFPV), silent /e/ (PSE), and sonorant clusters (PSON); b) for orthography, letter name (OLN) and vocalic /r/ (OVr); and c) for morphology, homonyms (MHOM) and inflectional markers (MINF). The three categories were significantly different from one other when comparing across grade levels. Grade level also influenced the number of errors that children produced. Finally, the findings indicated that neither genre type nor gender significantly contributed to the number of spelling errors.

First, these results will be discussed with a focus on patterns found within error types and across grade levels. Strengths and limitations of the POMAS system of

classification will also be considered. Then, findings will be related to their educational and clinical implications for improved spelling intervention.

Question 1: Grade Level Effects on Number and Types of Errors

The purpose of this first question was to determine if the number of errors in each spelling category (phonology, orthography, and morphology) differed as a result of grade level. Results of the four-way MANOVA revealed an interaction between the number of error types and grade level, although the effect size ($\eta_p^2=.018$) suggested that this interaction had minimal practical significance. Further analysis using t-tests revealed a significant difference in the occurrence of phonological errors between grades 1 and 2 and grades 1 and 4. Children in grade 1 made more errors. Moreover, a significant difference occurred in the frequency of occurrence of morphological errors between second and fourth grades. In this comparison, grade 4 children made more errors.

As suggested by stage theory discussed in Chapter 1, phonological knowledge develops early as children are exposed to the alphabet and gain letter knowledge. Therefore, these results are consistent with other studies (Reece & Treiman, 2001) that have found the number of phonological errors to decrease as children advance in grade level. A major difference between previous studies (e.g., Reece and Treiman (2001) and this study is the number of spelling samples that were analyzed (N = 400), lending further support to previous findings that children become less dependent on the phonological route as their memory for spellings (sight words) increases (Ehri & Snowling, 2004).

Stage theory (e.g., Bear et al., 2004) places the development of morphological skills in the later phases of spelling development. For example, inflectional morphology develops in the upper elementary and middle school grade levels before derivational

morphology, which may not emerge until middle school and continues into adulthood. As described by Bear et al., (2004), with the spelling mastery of inflected morphology, children can already spell simple words and thus move to include markers that denote past tense, plurality, or aspect (e.g., the progressive marker) (Bear et al., 2004).

Other studies challenge the Bear et al. (2004) description of inflectional morphology development. Even young children utilize characteristics of inflections. In the written narrative studies of Carlisle (1996) and Green et al. (2003) with children in grades 2 to 4, conventional use of inflectional markers for the past tense, plurals, and the progressive increased significantly between grades 2 and 4. The more frequent written inflections appeared to be relatively well mastered in less demanding narrative writing by grade 4 (Green et al., 2003), with a transitional period in more correct use spanning grades 2 to 3 (Carlisle, 1996). On the other hand, derived morphological representations require a longer period of time for their conventional spellings to be mastered (Carlisle, 1987, 1988; Green et al., 2003; Nagy et al., 2003).

Results from this study did not completely agree with these previous findings in that inflectional errors increased between grades 2 to 4. Based on the findings of Carlisle (1996) and Green et al. (2003), these errors should be infrequent in grade 4. In regard to derivational morphology, a greater number of error occurrences would have been expected; however, derivational errors rarely occurred and, as a consequence, were not a factor in these findings. Because the original writing samples did not accompany the misspelled words, it was impossible to determine if the children correctly spelled derived forms or failed to use them at all.

Orthographic errors were also anticipated to decrease as a function of increasing grade level; however, significant differences for the number of error occurrences in this category were not evident. In fact, when plotting the error type ratio by major category, children in grade 4 exhibited more orthographic errors than did children in grades 1 and 3. The increase in orthographic errors for the fourth graders was possibly a result of using more complex and less common words. In this case, the fourth graders were able to represent the phonological skeleton of the word, but instructional factors, such as lack of attention to spelling refinements, may have contributed to increased errors. Examples included the spelling of compound words with a space, such as *everybody* as *every body*, or choosing the incorrect letter to represent a sound as in *sament* for *cement*. For the inflectional morphological and orthographic categories, these patterns may add support to repertoire theory (Sulzby, 1996) or the idea that multiple aspects of linguistic knowledge interact simultaneously.

A second consideration accounting for the orthographic and morphological errors may be that the academic abilities of each child were unknown. Based on participant information, children with possible dyslexia and/or a LLD were not excluded from the sample, although all participants had to meet inclusion criteria. For example, the fourth graders had more orthographic letter reversal errors than did children in the lower grades. As discussed previously, children of this age would be expected to demonstrate fewer errors in all categories including inflectional morphology (Green et al., 2003). Therefore, it is possible that the grade 4 sample was populated with children still experiencing significant decoding or other phonological processing difficulties characteristic of children with dyslexia (Bourassa et al., in press) or a LLD (Catts, Hogan, & Fey, 2003).

Question 2: Genre and Gender Effects on the Number and Type of Spelling Errors

The second question asked if the type of written genre (narrative and expository) or gender affected the number of errors produced in each grade level. The results of the MANOVA did not reveal significant differences either for the two written genres or gender.

In regard to genre, children in each grade level did not display significantly more errors in one type of writing over the other, an unexpected finding. Based on the results of the Scott and Windsor (2000) study, expected outcomes would have favored considerably more errors in the expository writing samples than in the narrative samples.

It should be pointed out that data from the current study were based only on listings of spelling errors by child. The actual writing samples were not available; thus, other variables, such as the productivity (length) of the narrative versus expository samples, could not formally be factored into the results. Based on the mean number of words and clauses produced by grade level (see Table 2.2), productivity did seem to be a variable as the compositions were generally short. Given this important qualification, the similar patterns of error occurrence for narrative and expository writing may be attributed to several factors. First, as Carlisle (1996) points out, the fact that children in these grades were likely still “orchestrating” the writing process (p. 70) for both genres may have contributed to the absence of differences. Even as late as the middle school years, marked individual differences exist in compositional fluency, or the rate of producing text, which is an important aspect of text generation (Berninger et al., 1996). In theory, the more fluent or more productive is the composition, the more opportunities that may exist to

misspell, at least for typically developing children who have progressed in their integration of the phonological, orthographic, and morphological aspects of writing.

A second factor that may account for the unexpected outcome is the fact that children may have avoided words that they were less certain about how to spell. Apel et al. (2004b) discuss the strengths and limitations of prompted writing samples. On the one hand, writing samples are the most representative measure of children's ability to spell in that spelling must be coordinated with writing demands (e.g., genre, content, etc.). On the other hand, children tend to select words that are highly familiar rather than less familiar words. Another limitation of prompted writing samples is the lack of consensus on what comprises a representative example of writing ability, an issue that is not easily separated from the ability to spell.

Finally, the absence of differences in errors between the two genres may be attributed to a combination of the prompts and the time allocated to produce a product. The narrative frame was "One day (fill in a person) had the (best) (worst) day in school," while the expository frame consisted of "I like (someone, someplace, or something) because" (Berninger et al., 1992, p. 264). A total of 5 minutes was given for each. It is possible that a lack of interest in one or both topics and the short time frame for completion yielded spelling outcomes that were similar across the two genres.

Question 3: Error Patterns within Grade Level

The third question concerned the analysis of the spelling errors in relation to whether specific error patterns occurred as a result of grade level. Two-way MANOVAs comparing grade and error type were completed for each major error category, including errors in each category that decreased as grade level increased.

The MANOVA for phonological error types revealed a significant interaction between error type and grade level for flaps (PFLP), silent /e/ (PSE), final position voicing (PFPV), and sonorant clusters (PSON). As described by Treiman, Cassar, and Zukowski (1994) and Bourassa et al. (in press), phonological errors in the flap, as in *liddle* for *little*, would be expected to be higher in young children who are attempting to spell phonetically. Due to this phonetic attempt at spelling flaps, young children showed a bias for using /d/ for /t/ for the flap due to the voiced sound heard when orally decoding the word or simply pronouncing flapped words in everyday conversation.

The current study's finding for the PFLP error type was thus consistent with the findings from Treiman et al. (1994) and Bourassa et al. (in press). Flap errors gradually improved across grade levels. Findings were similar for the silent /e/ (PSE) error type. It seems likely that the same reason applies to the silent /e/ (PSE) rule as applied to the flap (PFLP) rule. Because this sound is not pronounced when decoding the word, younger children will be less likely to include it in a spelling.

Orthographic errors, in particular letter name (OLN) and vocalic /r/ (OVR), also differed across grade level. The number of these orthographic errors significantly decreased from grade 1 to grade 4, consistent with the finding of Reece and Treiman (2001), who found more orthographic spellings as children developed early spelling skills. This finding may suggest that the children improved in orthographic skills from first to fourth grade possibly due to increased experience with reading and writing.

The orthographic error findings also correlated with the grade level expectations. According to Bourassa and Treiman (2001), letter name spellings should reduce over time as a result of increased experience with reading and writing and through formal

instruction. This error occurs because children have not yet developed an understanding of phoneme unit and, therefore, spell the unit with the single letter name. For example, young children would spell the word *elephant* as *leftit* or *far* as *fr* (Bourassa & Treiman, 2001).

The results of the analysis for morphological errors also revealed a significant interaction between error type and grade level. However, unlike the phonological and orthographic errors, this category did not reveal a decreasing pattern for the number of occurrences across grade levels. For the homonym (MHOM) error type, the number of error occurrences increased from first to fourth grades. However, for the inflectional morphology (MINF) error type, the grade 1 children actually made more errors than did the grade 4 children, a finding consistent with Bourassa et al. (in press) and Green et al. (2003). This may suggest that the fourth graders had more experience with this specific feature, whereas the grade 1 children had less experience. Thus, the first graders were attempting to include inflectional markers but misspelling them either due to the lack of direct teaching combined with their reliance on phonetic (invented) spellings (Hauerwas & Walker, 2003).

Although significant differences in specific inflectional morphological errors were reported, these errors increased with increased grade level. An increase in the morphological error MINF (inflected forms) contradicts the anticipated outcomes as described by Green et al. (2003) and Bourassa et al. (in press). In both of these studies, inflected morphological forms were found to gradually decrease as the children progressed academically. While it was expected that the oldest children in this sample

(4th graders) would be more likely to utilize inflectional markers in their writing, it was not anticipated that this age group would generate the most errors.

In regard to homonym errors, Simon & Simon (1973) suggested that children were likely to understand that two words were phonemically similar yet fail to infer the specific linguistic context in which to apply the appropriate form. It is possible that, although children in grade 4 implicitly understood phonemic similarity or the concept of homonyms, their errors may relate to minimal awareness of the semantic contexts that oblige the selection of one spelling form over another (Plessas, 1963).

Comparisons of specific error types and grade level revealed significant interactions for phonology, orthography, and morphology. These results for phonology and orthography were consistent with previous research findings. Children in the younger grades would be expected to make more errors in these categories. Research findings also revealed that morphological errors should decrease as children increase in grade level. However, the findings of the current study contradicted prior research. Older children (4th graders) made significantly more morphological errors than did younger children.

Question 4: Qualitative analysis of Features within Phonological, Orthographic, and Morphological categories.

The qualitative analysis revealed common patterns of spelling errors across groups of children and the most commonly used error codes. When considering the most commonly misspelled words, one might also consider whether these words are high frequency words in English. Since the words used in the writing samples were selected based on the child's vocabulary, a realistic conclusion is that children used familiar words acquired through conversational interactions, especially in the case of the younger

children who may not have read at all or were in the early stages of learning to read. Because children may not yet have a consolidated visual or orthographic representation of all of the words they accessed in their writing samples, it is expected that many errors resulted from pronunciation (how a word “sounds”), resulting in a misspelling.

With the previous information in mind, the five words most often in error were: a) *because* spelled as *becaus*, b) *recess* spelled as *reses*, c) *favorite* spelled as *favrit*, d) *friend* spelled as *frend*, and e) *when* spelled as *wen*. Interestingly, all four grade levels exhibited a common error pattern with *recess* and *friend*. The first, second, and third graders commonly misspelled the words *because*, *favorite*, and *when*.

Treiman and Bourassa (2001) discuss how young spellers often use letter name misspellings to represent liquid phonemes because children have not yet developed an appreciation of the phoneme unit. This was evident in the spelling of *favrit* for *favorite*. In this case, it seems as if children depended on letter-to-sound knowledge to spell the word, not yet understanding that the phoneme sequence *-or* represented a unit. It is also possible that the children spelled the word according to their pronunciation schema, disregarding the orthographic features of the word. It also may be appropriate to assume, based on the incorrect spellings *favrit* and *becaus*, that children as old as grade 3 may delete final position silent /e/. However, the grade 4 children did not exhibit either of these error features. Based on these findings, two conclusions are feasible. First, by grade 4, at least in this sample, children have a firm understanding of the silent /e/ pattern. Alternately, these two words, commonly misspelled by children in grades 1 to 3, were high frequency words, and the fourth graders had more adequate spelling experiences with high frequency words.

All four grade levels demonstrated the same misspellings for the words *recess* and *friend*. When compared to the previously discussed errors, it appears that, although these words are commonly occurring English meanings, especially among school age children, they are more difficult words to master due to their less regular spellings. In this situation, pronunciation would not lead to the correct spellings.

Finally, it is interesting to observe the pattern that existed between the most commonly misspelled words and the most commonly applied error codes. The most commonly misspelled words across children contained errors for the most commonly used error codes. For example, the misspellings *becaus* and *favrit* both contain errors coded as OLN (orthographic – letter name) and PSE (phonological – silent /e/). The misspelling *reses* contains an error coded as ODI (orthographic – digraph) and *frend* contains the error code OUVF (orthographic – unusual vowel pattern). These error codes are among the eight most commonly occurring codes for all 800 of the writing samples.

These results have important implications for improved spelling intervention. Because these words occurred most frequently in the children's writing, and these error codes occurred most frequently for all of the misspelled words, an important goal is to place increased emphasis on the teaching of patterns. Since the same errors were seen across all grade levels, it is insufficient to assume that these children simply have not been taught or have not fully grasped the concept. Considering the five most commonly misspelled words in this study alone, teaching one spelling pattern, such as when to place a silent /e/ at the end of a word, could generalize to correct at least two different commonly misspelled words.

Study Strengths and Limitations

Strengths

The strengths of the study are two-fold. Expanding the previously designed POMAS scoring system (Silliman et al., 2006) resulted in a new way of analyzing the misspellings of children. The misspellings were coded to determine the quality of the errors using specific error features evident in writing. The information provided from this study with this expanded scoring system adds to the limited research on qualitative differences in spelling development. Previous research has focused on differences in the total number of errors evident in spelling analyses (Bruck & Waters, 1988; Hauerwas & Walker, 2003), however, this approach does not necessarily contribute to explaining patterns of errors and why these errors occur. The quantitative results revealed differences between groups based purely on the number of error occurrences, but these data were insufficient to determine similarities in misspellings patterns.

Strengths were also evident in the design of the study. The participants comprised a large and generally representative sample of typically developing children selected from early elementary grade levels. As a result, qualitative advances in patterns of spelling development could be discerned. In contrast, other studies, while providing snapshots of spelling development, have focused on the comparison of typically developing children or adolescents with those experiencing either significant reading difficulties or language learning problems (e.g, Bruck and Waters, (1988); Carlisle, (1987), Hauerwas and Walker (2003)). Although there was variability in the predicted outcomes for the categorization of spelling errors, general patterns of development were discovered, providing valuable educational information for improved instruction, as well

as a potential direction for investigating spelling as a diagnostic marker of subtle language impairment after grade 2 (Catts, Hogan, & Adlof, 2005).

Limitations

At least four factors may have impacted the results. The first variable affecting outcomes is that the spelling words were collected from writing samples from previous studies. Interpretations of the actual words children were attempting to spell depended therefore, on the previous examiner's discretion. Although inter-rater agreement was determined for the studies, discrepancies existed in the spelling data for grades 1-3. In fact, there were several instances in which several different words were written next to a misspelling because the examiner could not distinguish the word based on the meaning or several words were appropriate for the meaning. The same situation arose for the 4th grade children. Inter-rater agreement revealed discrepancies between examiners in that the agreement for the narrative writing task was 75 percent and the expository task was 60 percent.

A second limitation was associated with the absence of the actual writing sample. The influence of other words on the misspelled word could not be analyzed. For example, a word, such as *bear* may influence a misspelling of the word *their* as *thear* due to the vowel pattern. In this case, the child may have used knowledge of the spelling of *bear* to assist in spelling the word *their*, even though the vowel spelling resulted in a spelling error.

A third factor that may have influenced the outcomes concerned the sample composition. Although children were described as typically developing, it is feasible that children with more subtle dyslexia and/or LLD were included. For example, it would be

expected that the children with dyslexia would produce more spelling errors (Bourassa et al., in press); therefore, the possibility cannot be ruled out that one grade level may have had more children who were at the lower end of the “normal” spectrum than another grade. This consideration may explain why the fourth graders had a greater increase in orthographic errors than did the lower grade levels. If the fourth grade sample did have a greater number of “struggling” students, the result may have been an inflated number of errors (Simon & Simon, 1973) in the orthographic category.

A final factor possibly affecting the results is the fact that the misspelled words were collected from prompted writing samples rather than from a dictated spelling list. In this case, children could avoid using words that they found challenging to spell. Word selection could increase or decrease the number and type of errors collected from sample

Clinical and Educational Implications

Clinical Implications

The POMAS results may offer new opportunities for determining if a child is demonstrating difficulties characteristic of a LLD, particularly in grade 2 and beyond. This version of the POMAS was designed based on 60 error codes. However, when completing the statistical analysis for all 400 participants, only 12 of the 60 codes were found to occur beyond chance levels. These errors were common among the children. Category patterns for phonology and orthography revealed that, as the grade levels increased from grade 1 to grade 4, the error occurrences in these categories decreased. The other error codes included in the POMAS occurred intermittently, with no significant pattern emerging. This evidence suggests the types of errors typically expected in children’s spellings from grades 1-4. Thus, children who display significant numbers of

errors both in the common error categories and across the span of the other 48 errors, may be exhibiting difficulties beyond what is considered typical.

The findings of the Silliman et al. (2006) study, which qualitatively compared spellings of children with a LLD with chronologically (CA) and spelling age (SA) matched groups, provided insight into errors that were typical of these groups. The LLD group demonstrated similar numbers of feature errors across all three major linguistic categories. In addition, when comparing the spelling errors of the three groups, the LLD group was found to have errors least similar to the correct spelling. The LLD group also exhibited significant difficulties representing inflected and derived morphological meanings. These findings in conjunction with the results from the current study provide strong evidence for typical and untypical error patterns. With careful consideration of spelling performance using a qualitative scoring system, such as the POMAS, speech-language pathologists can determine patterns of development.

Educational Implication

Qualitative findings for the spellings of these young elementary-age children are also beneficial for educators. The quality of spelling instruction in too many American schools appears questionable. Because spelling impacts on reading and writing abilities (Apel & Masterson, 2001; Berninger et al., 2006; Goswami, 1992), the findings from this study may be a starting point for supplying teachers with the intervention strategies to adequately assess and teach spelling skills.

Based on the findings of the most commonly misspelled words in this study, it would be appropriate to encourage teachers to target word lists containing common linguistic patterns. It has been implied that teachers often target story vocabulary that

does not relate linguistically (Apel et al., 2004a). Therefore, it would be beneficial to target vocabulary words classified as primarily in the phonological category, such as short versus long vowels. Targeting sight words with these similar patterns (many of which were evident in this study) would also lead to improved spelling abilities and the increased probability of application to more fluent reading.

Increasing awareness of spelling instruction may also assist teachers in improving reading skills in their classroom. Knowing where a child experiences a breakdown in spelling skills may also assist in explaining reading difficulties, and thus assist teachers in more accurate assignment of children to reading groups. For example, reading skills, much like spelling, require the integration of phonologic, orthographic, and morphological knowledge. Children who demonstrate phonologic and orthographic errors in their spellings will likely struggle with phonemic segmentation and identifying sight words automatically, which, in turn, affects the ease and accuracy of oral reading fluency. Understanding this information will assist in adequately identifying children according to those needing continued phonological awareness and decoding instruction versus those who are at more advanced levels.

An increased understanding of error types “typical” of children at specific grade levels helps to increase the educational value of spelling instruction. Increased teacher understanding about what can be “expected” will decrease the number of children “falling through the cracks” in spelling development, and allow teachers to teach spelling patterns. As suggested by Templeton (2004), teachers should avoid teaching rules for misspelling and focus, instead, on the spelling knowledge that the child demonstrates but confuses. For example, based on the spelling errors evident in the writing samples for this

study, if the child has several words in which the long vowel in a word is misused, the teacher can examine the sample for instances in which it was used correctly. If there are instances of correct long vowel spellings, the teacher should focus on teaching accuracy for the long vowel rather than focusing strictly on a spelling skill that was never used correctly by the child. This strategy should not only lead to improvements in spelling skills, but also in writing and reading development because the child will be able to identify relationships between words with similar patterns. In other words, if taught a pattern regarding long vowels, the child could apply this pattern to other words that may have originally occurred in error.

To conclude, this study revealed valuable information regarding the spelling development of typically developing elementary school children. Because the children were compared according to error types, patterns of spelling skills were revealed for each grade level. Thus, typical patterns of spelling development were hypothesized. Regardless of the inability to refer to the actual narratives from which the spelling errors were extracted, results from coding the listings of misspelled words revealed the progression of spelling development, which has potential import for both speech-language pathologists and teachers. These patterns achieved the goal of identifying the boundaries of typical patterns for a specific grade level. Awareness of these boundaries of typical variation should then lead to more individualized and effective intervention strategies in the classroom.

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Appendices

Appendix A – Coding System

Category	Code	Description	Example
P	PCD	Consonant deletion	beame became
P	PCR	Cluster reduction	stuck struck
P	PDIP	True diphthongs vs. Long vowels	arond around
P	PDV	Devoicing	pusels puzzles
P	PECL	2&3 element clusters	seet street
P	PEP	Epenthesis	tolid told
P	PFCD	Final consonant deletion	kee keep
P	PFLP	Flaps	pride pretty
P	PFPV	Final position voicing	becus because
P	PFR	Fronting	graphits graphics
P	PLV	Long vowel error	roop rope
P	PNE	Nasal error	junp jump
P	PSC	/s/ clusters	bes best
P	PSE	Silent /e/	Pale pal
P	PSHW	Schwa	cristle crystal
P	PSON	Sonorant clusters (nasals, l, r, j)	ad and
P	PSR	Syllable reduction	maroni macaroni
P	PSRS	Schwa reduced syllable	anmols animals
P	PST	Stopping	teel feel

Appendix A (Continued)

Table A.1 (Continued)

P	PSV	Short vowels	kite kit
P	PVO	Voicing	blay play
P	PVOCR	Vocalic /r/	cos curls
O	OAA	Apostrophe added	get's gets
O	OCD	Consonant doubling	terriffic terrific
O	OCE	Consonant error	sogt soft
O	OCL	Capital letter	california California
O	ODI	Digraphs	sip ship
O	OHY	Hyphen	fortytwo forty-two
O	OHSV	c/k – hard and soft velars	Mace make
O	OLD	Letter doubling (syllable juncture)	triped tripped
O	OLN	Letter name (l,s,r)	cr car
O	OLR	Letter reversal (b/d, d/b)	balls dolls
O	OLS	Letter sound (c/k, k/c, etc.)	sereal cereal
O	OLVP	Long vowel pattern	keep kipe
O	OLWF	Long vowel word families (“-old”, “- igh”)	nite night
O	ONA	No apostrophe	somebodys somebody's
O	OOW	One word	some times sometimes
O	OPA	Phoneme addition	sradr grade

Appendix A (Continued)

Table A.1 (Continued)

O	OPE	Plural error	fris fries
O	OSJ	Syllable juncture – y to i	cryed cried
O	OSL	Silent letter - /h/ (where, what, when)	wen when
O	OSY	Syllabic /l/	terdals turtles
O	OUVP	Unusual vowel pattern	cof cough
O	OVE	Vowel error	stuped stupid
O	OVr	Vocalic /r/ - (r/er, etc.)	sistr sister
O	OWB	Word boundary (2 sep. words)	eachother each other
M	MDER	Derivation (root word)	deposition deposition
M	MDVM	Derivational morphology	brang brought
M	MHOM	Homonyms	there their
M	MINF	Inflectional morphology	bike bikes
M	MPRE	Prefixes	Organize reorganize
M	MSH	Shifts – phonological change	magishen magician
M	MSUF	Suffixes	normal normally
PO	POR	Reversals	tis its
PO	POVDS	Vowel dependent spellings (short vowels – tch, dge, ck/ch, ge)	Baitch batch
PO	POVM	Vowels missing/deleted	dble double
MO	MCON	Contraction	wasnt wasn't

Appendix A (Continued)

Table A.1 (Continued)

MO	MOSP	Mispelled root word resulting in phonologically-accurate spelling	edgeucation education
MO	MOV	Overgeneralization	losted lost
MP	MPVS	Visually similar error (i.e. are for car)	are car
	CQ	Child started the word but failed to finish	b buy

Appendix B – t-tests for Grade Level Effects on Number and Types of Errors

Table B.1 Phonology Comparisons Across Grade Levels

Comparison	t	Degrees of freedom (df)	p
1 st compared to 2 nd	3.766	396	.000
1 st compared to 3 rd	2.252	400	.025
1 st compared to 4 th	3.840	398	.000
2 nd compared to 3 rd	-1.245	398	.214
2 nd compared to 4 th	.121	396	.904
3 rd compared to 4 th	1.346	400	.179

Table B.2 Orthographic Comparisons Across Grade Levels

Comparison	t	Degrees of freedom (df)	p
1 st compared to 2 nd	-2.515	396	.012
1 st compared to 3 rd	.631	400	.528
1 st compared to 4 th	-.744	398	.457
2 nd compared to 3 rd	2.886	398	.004
2 nd compared to 4 th	1.554	396	.121
3 rd compared to 4 th	-1.249	400	.212

Appendix B (Continued)

Table B.3 Morphological Comparisons Across Grade Levels

Comparison	t	Degrees of freedom (df)	p
1 st compared to 2 nd	.460	396	.646
1 st compared to 3 rd	-1.647	400	.100
1 st compared to 4 th	-2.871	398	.004
2 nd compared to 3 rd	-2.056	398	.040
2 nd compared to 4 th	-3.240	396	.001
3 rd compared to 4 th	-1.277	400	.202

Appendix C – Post Hoc Comparisons for Error Patterns across Grade Level

Table C.1 Bonferroni Post Hoc Testing Results for Phonological Error Type Comparisons per Grade Level

Comparison of Grade Levels	Mean Difference Between Grades	Std. Error	p value
1 compared to 2	.13	.023	.000
3	.16	.023	.000
4	.21	.023	.000
2 compared to 1	-.13	.023	.000
3	.03	.023	1.000
4	.08	.023	.004
3 compared to 1	-.16	.023	.000
2	-.03	.023	1.000
4	.06	.023	.110
4 compared to 1	-.21	.023	.000
2	-.08	.023	.004
3	-.06	.023	.110

Appendix C (Continued)

Table C.2 Bonferroni Post Hoc Testing Results for Orthographic Error Type

Comparisons per Grade Level

Comparison of grade levels	Mean Difference between grades	Std. Error	p Value
1 compared to 2	.14	.039	.002
3	.23	.039	.000
4	.28	.039	.000
2 compared to 1	-.14	.039	.002
3	.08	.039	.180
4	.14	.039	.003
3 compared to 1	-.23	.039	.000
2	-.08	.039	.180
4	.05	.039	1.000
4 compared to 1	-.28	.039	.000
2	-.14	.039	.003
3	-.05	.039	1.000

Appendix D – Comparisons of Specific Error Types Across Grade Level

Table D.1 Comparison of Error Type PFLP Between Grade Levels.

Error Type - PFLP	t	Degrees of Freedom (df)	p
1 st compared to 2 nd	1.654	396	.099
1 st compared to 3 rd	2.212	400	.028
1 st compared to 4 th	2.758	398	.006
2 nd compared to 3 rd	.620	398	.536
2 nd compared to 4 th	1.297	396	.195
3 rd compared to 4 th	.699	400	.485

Table D.2 Comparison of Error Type PFPV Between Grade Levels.

Error Type - PFPV	t	Degrees of Freedom (df)	p
1 st compared to 2 nd	3.630	396	.000
1 st compared to 3 rd	3.955	400	.000
1 st compared to 4 th	3.935	398	.000
2 nd compared to 3 rd	1.010	398	.313
2 nd compared to 4 th	1.005	396	.315
3 rd compared to 4 th	-	-	-

Appendix D (Continued)

Table D.3 Comparison of Error Type PSE Between Grade Levels.

Error Type - PSE	t	Degrees of Freedom (df)	p
1 st compared to 2 nd	2.872	396	.004
1 st compared to 3 rd	3.072	400	.002
1 st compared to 4 th	7.048	398	.000
2 nd compared to 3 rd	.499	398	.618
2 nd compared to 4 th	4.391	396	.000
3 rd compared to 4 th	3.148	400	.002

Table D.4 Comparison of Error Type PSON Between Grade Levels.

Error Type - PSON	t	Degrees of Freedom (df)	p
1 st compared to 2 nd	3.368	396	.001
1 st compared to 3 rd	4.418	400	.000
1 st compared to 4 th	4.565	398	.000
2 nd compared to 3 rd	1.191	398	.235
2 nd compared to 4 th	1.333	396	.183
3 rd compared to 4 th	.110	400	.912

Appendix D (Continued)

Table D.5 Comparison of Error Type ODI Between Grade Levels.

Error Type - ODI	t	Degrees of Freedom (df)	p
1 st compared to 2 nd	.225	396	.822
1 st compared to 3 rd	1.393	400	.164
1 st compared to 4 th	2.435	398	.015
2 nd compared to 3 rd	1.035	398	.301
2 nd compared to 4 th	1.982	396	.048
3 rd compared to 4 th	1.146	400	.252

Table D.6 Comparison of Error Type OLN Between Grade Levels.

Error Type - OLN	t	Degrees of Freedom (df)	p
1 st compared to 2 nd	4.380	396	.000
1 st compared to 3 rd	5.519	400	.000
1 st compared to 4 th	6.884	398	.000
2 nd compared to 3 rd	1.373	398	.171
2 nd compared to 4 th	2.997	396	.003
3 rd compared to 4 th	1.556	400	.121

Appendix D (Continued)

Table D.7 Comparison of Error Type OLR Between Grade Levels.

Error Type - OLR	t	Degrees of Freedom (df)	p
1 st compared to 2 nd	1.818	396	.070
1 st compared to 3 rd	1.986	400	.048
1 st compared to 4 th	3.114	398	.002
2 nd compared to 3 rd	.237	398	.813
2 nd compared to 4 th	1.748	396	.081
3 rd compared to 4 th	1.417	400	.157

Table D.8 Comparison of Error Type OLS Between Grade Levels.

Error Type - OLS	T	Degrees of Freedom (df)	p
1 st compared to 2 nd	.544	396	.586
1 st compared to 3 rd	2.012	400	.045
1 st compared to 4 th	2.571	398	.011
2 nd compared to 3 rd	1.575	398	.116
2 nd compared to 4 th	2.191	396	.029
3 rd compared to 4 th	.677	400	.499

Appendix D (Continued)

Table D.9 Comparison of Error Type OVr Between Grade Levels.

Error Type - OVr	T	Degrees of Freedom (df)	p
1 st compared to 2 nd	2.083	396	.038
1 st compared to 3 rd	4.733	400	.000
1 st compared to 4 th	4.811	398	.000
2 nd compared to 3 rd	2.711	398	.007
2 nd compared to 4 th	2.832	396	.005
3 rd compared to 4 th	.217	400	.828

Table D.10 Comparison of Error Type MCON Between Grade Levels.

Error Type - MCON	t	Degrees of Freedom (df)	p
1 st compared to 2 nd	1.349	396	.178
1 st compared to 3 rd	1.390	400	.165
1 st compared to 4 th	-.745	398	.457
2 nd compared to 3 rd	.035	398	.972
2 nd compared to 4 th	-1.776	396	.077
3 rd compared to 4 th	-1.813	400	.071

Appendix D (Continued)

Table D.11 Comparison of Error Type MHOM Between Grade Levels.

Error Type – MHOM	t	Degrees of Freedom (df)	p
1 st compared to 2 nd	-.467	396	.641
1 st compared to 3 rd	-3.300	400	.001
1 st compared to 4 th	-3.730	398	.000
2 nd compared to 3 rd	-2.848	398	.005
2 nd compared to 4 th	-3.297	396	.001
3 rd compared to 4 th	-.549	400	.583

Table D.12 Comparison of Error Type MINF Between Grade Levels.

Error Type - MINF	t	Degrees of Freedom (df)	p
1 st compared to 2 nd	2.292	396	.022
1 st compared to 3 rd	3.439	400	.001
1 st compared to 4 th	.941	398	.347
2 nd compared to 3 rd	1.126	398	.261
2 nd compared to 4 th	-1.297	396	.196
3 rd compared to 4 th	-2.394	400	.017