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Spelling as Part of the Writing Process in Intermediate-Grade Students

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Spelling is an important skill that requires knowledge of phonology, morphology, and orthography, as well as strong visual memory. In this study, we introduce a spelling coding rubric that accounts for different knowledge types needed for spelling and can be used to describe error patterns for both encoding and decoding as part of the writing process. Eighty participants wrote a first draft and final copy of a narrative generated with extended time over 3 days. Spelling error patterns from these samples were coded using the spelling coding rubric, which was informed by prior research. Approximately 2% of words were misspelled, and the frequency of error types across error codes was similar on first drafts and final copies and required that all 15 error codes be applied to writing samples. Interrater agreement for coding errors was acceptable. The spelling coding rubric described the spelling error patterns in the writing samples while accounting for spelling knowledge in a usable way for educators. Clinical implications and future directions of this research are discussed. **Key words:** *language learning*, *literacy*, *school-age children*, *spelling*, *writing*

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SPELLING is an important linguistic skill that oftentimes is overlooked by speech–language pathologists (SLPs) as part of a comprehensive language assessment. This is especially important for the 56% of SLPs in the United States (American Speech-Language-Hearing Association [ASHA], 2013) working in schools. Both reading and writing assessment and remediation are within SLPs' scope of practice (ASHA, 2001), and spelling is a skill identified as a learning outcome in the Common Core State Standards (CCSS, 2012). Intermediate (fourth through sixth) grade students are expected not only to read but also to "Spell grade-appropriate words correctly, consulting references as needed" (CCSS, 2012, p. 28). Despite this, instruction related

to the language basis for spelling is lacking in classroom instruction (Moats, 2009).

McNeill and Kirk (2014) surveyed 405 elementary school teachers on their theoretical beliefs and instructional practices for teaching spelling. Although there was large variability in their findings, 64% of teachers reported that they analyzed spelling errors and 60% individualized spelling programs as part of spelling instruction. The authors reported a mismatch between teachers' beliefs and practices for spelling assessment and instruction, meaning that they knew about the importance of teaching spelling and some strategies for doing so but did not implement these with high frequency. Two reasons for this were a lack of linguistic knowledge of spelling and inadequate time to teach spelling. Findings from the study also indicated that professional development is needed to increase teachers' knowledge about language structure, practical implementation strategies, and connections across the curriculum for spelling. In the current study, we propose a spelling coding system that can be applied to student writing samples produced as part of the writing process during everyday classroom writing tasks. In doing so, the system can provide educators, including SLPs, a manageable way to focus spelling strategy instruction relative to individual student needs.

School-age children must be able to apply their knowledge of spelling as part of the writing process for both encoding and decoding purposes. According to the Simple View of Writing (Berninger & Amtmann, 2003), spelling to encode words occurs as part of the transcription process when a student spells a word that represents the message being conveyed. Spelling as part of the revision process occurs when a student reads their written work and must decode words to ensure that the intended meaning is conveyed clearly (Hayes & Berninger, 2014). Research indicates that transcription skills, including spelling, develop during the primary grades (K through third) and eventually become automatic (Berninger & Swanson, 1994; McCutchen, 1996) and that during the intermediate grades is when students are able to engage in advanced planning and follow up revision when writing (e.g., Dockrell & Connelly, 2015; Garcia & Fidalgo, 2008; Koutsoftas, 2018; Koutsoftas & Gray, 2013). It is during the revision process that writers employ spelling knowledge to detect and correct spelling errors. The spelling coding system proposed in this study applies not only to the transcription (encoding) phase of writing but also to the revision (decoding) phase. This will allow educators to offer spelling instruction based on both encoding and decoding processes integrated with academic writing tasks.

THEORETICAL FRAMEWORKS FOR SPELLING

Research has indicated that spelling is a multicomponent skill that requires visual and working memory, as well as phonological, orthographic, and morphological knowledge (e.g., Bahr et al., 2012; Berninger et al., 2010; Daffern et al., 2015; Jung, 2019; Kim et al., 2013; Silliman et al., 2006; Wolter & Apel, 2010). A challenge to developing a theoretically driven spelling coding system is how to account for the quantity of spelling conventions while being feasible to implement by educators for assessment and subsequent intervention purposes. Researchers have addressed this challenge by validating approaches to describing spelling errors that account for visual memory and the phonological, orthographic, and morphological knowledge needed for spelling.

To account for visual memory needed for spelling, researchers have used the term "mental graphemic representations" (MGRs; Apel, 2009; Apel et al., 2006; Wolter & Apel, 2010). Mental graphemic representations are the mental representations of spelled words or parts of words in memory and are word specific (Apel & Masterson, 2001). An MGR can be a clear and complete image of a word's spelling (e.g., *desk*) or it can be an inaccurate or less complete (e.g., "acommodate" instead

of *accommodate*) image (Wolter & Apel, 2010). Mental graphemic representations are hypothesized to occur when a student sees a written word for the first time and mentally maps the letters only by vision and not by segmenting phonemes or encoding it phonetically (Apel, 2009). Mental graphemic representations have an important role in the development of fluent reading and spelling (Ehri, 2000). Fully developed MGRs can allow for an automatic process of spelling, whereas underdeveloped MGRs can lead to spelling errors based on poor visual memory traces that require individualized instruction to remediate.

To account for phonological, orthographic, and morphological knowledge needed for spelling, researchers have applied Triple Word Form Theory (TWFT) approaches to assess children's writing (e.g., Bahr et al., 2012; Daffern et al., 2015; Silliman et al., 2006). Phonological spelling errors consist of adding, substituting, omitting, or distorting graphemes meant to represent phonological patterns in words. A phonological spelling error has occurred when the misspelled word differs in phonological information from the target word ("bads" for *bags*). Orthographic spelling errors consist of letters that correctly represent phonemic information with incorrect spelling patterns; thus, the misspelled word sounds like the target word but does not use correct spelling patterns ("kool" or "col" for *cool*). This example provides two illustrations of orthographic spelling errors. The first error is the incorrect consonant and the second error is the incorrect vowel; either way, the misspelling represents the three phonemes in the target word. Morphological spelling errors occur when a grammatical or derivational morpheme is incorrectly spelled ("happly" for *happily*; "walkt" for *walked*) or a correctly spelled word that is acceptable phonologically but does not convey the intended meaning ("bear" for *bare*).

Triple Word Form Theory has been validated as an approach to spelling assessment across several studies (Bahr et al., 2012; Daffern, 2017; Daffern et al., 2015; Daffern & Ramful, 2019; Silliman et al., 2006). Daffern and colleagues developed the Components of Spelling Test, an Australian standardized spelling assessment that provides educators with efficient and reliable data on student spelling errors (Daffern et al., 2015) using TWFT. Although the assessment proved to be a valid and reliable measure of spelling (Daffern, 2017; Daffern & Ramful, 2019), it does not account for spelling errors produced by students during writing tasks; rather, it assesses spelling ability based on a predetermined set of words.

Silliman et al. (2006) developed the Phonological, Orthographic, and Morphological Assessment of Spelling (POMAS), based on TWFT, as a qualitative approach to coding spelling error patterns in children's writing samples. Phonological, Orthographic, and Morphological Assessment of Spelling accounts for the complexity of spelling error patterns across phonological, orthographic, and morphological knowledge and is subdivided to further describe the type of spelling error, resulting in 46 different categories. Phonological errors are subdivided to account for errors children produce in speech represented in spelling (e.g., consonant deletion, cluster reduction, vocalic /r/ errors). Orthographic errors account for spelling pattern rule errors such as consonant errors, digraphs, and grapheme doubling. Morphologic errors account for errors related to derivational or grammatical morphemes, contractions, and compound words. Bahr et al. (2012) demonstrated the validity of the POMAS system by applying it to writing samples of 888 schoolchildren in first through ninth grades. Their findings indicated that, in the primary grades, the percentage of misspelled words ranged from 14% to 23% and then decreased to approximately 3% misspelled words in fifth through ninth grades. The majority of the spelling errors in older students were orthographic and morphological. The POMAS coding system is comprehensive and aligns with current knowledge of the spelling conventions of standard English while accounting for speech and language

development in children. However, with 46 codes, it is time consuming for educators to implement with accuracy and reliability, and it would be difficult to develop subsequent interventions to target spelling errors in the context of the writing process due to the depth of knowledge and training time required for implementation. Because it accounts for TWFT and has been validated in prior research, the POMAS (Silliman et al., 2006) was used as a source for developing the spelling coding rubric described in the current study that employs only 15 unique codes.

THE CURRENT STUDY

One limitation to these approaches for assessing spelling in children is that each accounts for spelling skills only via written transcription (encoding) during writing. However, according to the Simple View of Writing (Berninger & Amtmann, 2003), an important part of the writing process is decoding and correcting spelling errors while revising (Hayes & Berninger, 2014). When a student reads his or her own written product, they are relying on reading (receptive written language) that requires phonological, orthographic, morphological, and semantic knowledge to ensure that correct spelling has been used. As an example, the student writing about a bear in the woods may transcribe the word *bare* but upon revision uses their receptive semantic knowledge to detect that error. In this example, in order to detect the misspelling, the student would rely on semantic meaning of words along with morphological knowledge for spelling to correct the error. Therefore, in the current study, we propose inclusion of a morphological–semantic knowledge subcategory needed for spelling especially when considering spelling in the context of editing and revising processes.

The purpose of a semantic subcategory as a branch of morphological knowledge is to address the role of spelling as part of revision processes (Berninger & Amtmann, 2003; Hayes & Berninger, 2014). A semantic spelling pattern error occurs when the misspelled word is a legal word in English but represents a different meaning than the one intended by the writer. Although these errors can be described as a result of unstable MGRs due to rapid expansion of vocabulary in intermediate-grade children, the primary difference is that these are legal and correctly spelled words that may not be as easily detected as more overt spelling errors (e.g., those that can be detected quite accurately via spell-check in a word processing program). Thus, these types of errors would require different instruction from morphological approaches to be detected and corrected and so should be assessed as such. Moreover, accounting for the semantic level of language aligns with levels of language frameworks used by educators and SLPs working in school settings who are charged with supporting language at phonological, morphological, semantic, syntactic, and discourse levels (e.g., Abbott et al., 2010; Ritchey et al., 2016).

Research has indicated that intermediate-grade students produce relatively low proportions of spelling errors (e.g., Bahr et al. 2012; Koutsoftas, 2018); however, a fine-grained analysis of these errors can provide insights into the linguistic underpinnings of spelling errors. By analyzing spelling error patterns of students in schools, educators gain an understanding of the student's knowledge of spelling and of language. The current study is a first step for translating current research into practice by evaluating the feasibility of a theoretically driven spelling coding rubric in a sample of typically developing intermediate-grade students. The primary purpose of the study is to describe the spelling coding system and demonstrate how it can be applied to writing samples derived from a composing task. The secondary purpose is to examine the feasibility for coders to reach adequate reliability using the spelling coding rubric as indicated through interrater agreement.

METHOD

The data set used for the current study has been reported in a prior study (Koutsoftas, 2018) that examined writing process products in intermediate-grade students across multiple writing outcomes. Those writing outcomes included productivity, complexity, mechanics (including punctuation, capitalization, and paragraph demarcation), and accuracy. Included as part of the latter was a measure of spelling accuracy. In the current study, one measure of spelling accuracy was further examined using a fine-grained descriptive analysis of spelling error patterns. The data set for the current study was developed by combining two data sets that used the same exact research protocol with the difference being grades sampled. The primary data set included more fourth- than sixth-grade students, so additional sixth-grade students from a secondary sample were included and matched to the fourth-grade participants by gender and mother's years of education.

Participants

Intermediate-grade students ($n = 80$) from northern New Jersey and Phoenix, Arizona metropolitan areas, representing 22 classrooms in 17 schools across five districts, participated in this study. See Supplemental Digital Content Appendix A, available at: http://links.lww.com/TLD/A71, for a table showing the distribution of participants across districts, schools, and classrooms. All participants met the following inclusionary criteria for typical development based on parent survey and teacher survey data: (a) no concerns about hearing; (b) no history of or current academic concerns; (c) no report of language, cognitive, or neurological impairments; (d) no history of special education services; and (e) spoke English as their primary language. Participants were evenly split between fourth ($n = 40$) and sixth ($n = 40$) grades. There were 22 females in the fourth-grade group and 21 females in the sixth-grade group. The mean age in years for the sixth-grade group was 11.60 ($SD = 0.50$) and for the fourth-grade group was 9.55 ($SD = 0.50$). There was no significant difference between groups in mothers' years of education, $F(1, 77) = 2.51$, $MSE = 6.77$, $p = .12$, an indicator of socioeconomic status. Across the entire sample, mothers had an average of 14.51 ($SD = 1.66$) years of education.

This sample represented a broad range of students one would find in general education classrooms who are not receiving special education or academic support services. As part of the research protocol, we asked teachers to complete a survey about their students as a way to ensure that they met the study's criteria for typically developing. In addition, we asked teachers to rank each student's overall academic performance and spelling skills relative to other students in the same class, where 4 = highest quarter, 3 = third quarter, 2 = second quarter, and 1 = lowest quarter. Across the sample, the mean rating for overall academic performance was 3.24 ($SD = 0.81$) and for spelling was 3.29 ($SD = 0.78$).

Spelling coding rubric

We developed a spelling coding rubric to include four primary types of knowledge needed for spelling. The codes were established as part of a pilot study on a smaller portion of these data (Wilson & Koutsoftas, 2015). The goal of that study was to define the minimal number of codes needed to best represent spelling knowledge categories of phonological, orthographic, morphological, and MGRs (i.e., visual memory). Table 1 provides the spelling knowledge category, error type with definition, and example for the 15 codes used in the current study. Error types within knowledge categories were developed on the basis of prior research (Apel et al., 2006; Bahr et al., 2012; Silliman et al., 2006) and further refined in the current study based on spelling error patterns observed in the writing samples. One of the refinements we added to this study was the inclusion of a semantic subcategory to morphological knowledge (morphological–semantic). Our goal was to not only remain

Table 1. Spelling coding rubric by category with definition, example, mean proportion of total spelling errors, and frequency of spelling errors on first drafts and final copies across the entire sample ($N = 80$)

Category	Error Type With Definition	Example		Frequency of Spelling Errors[a]		Mean Proportion of Errors to Misspelled Words (*SD*)[b]	
		Target Word	Error	First Draft	Final Copy	First Draft	Final Copy
Phonological	Omission of vowels or consonants	beautiful	beauiful	61	57	0.12 (0.16)	0.13 (0.20)
	Additions of vowels or consonants	do	dowe	34	37	0.06 (0.12)	0.06 (0.11)
	Substitution for consonants only—fronting, backing, nasal error, stopping, voicing	strange	shrange	18	22	0.03 (0.09)	0.04 (0.11)
	Substitution of vowels resulting in a nonword	certain	cortain	59	44	0.08 (0.14)	0.08 (0.14)
Orthographic	Pattern frequency	apparently	aparrently	17	19	0.04 (0.13)	0.03 (0.08)
	Rule error	morphed	morfed	95	103	0.21 (0.24)	0.23 (0.24)
MGR	Exception to rule	field	feild	9	12	0.01 (0.04)	0.03 (0.07)
	Irregular nouns or verbs	lent	lended	11	6	0.02 (0.05)	0.02 (0.07)
Morphological	Derivational	scarily	scarely	11	11	0.03 (0.08)	0.03 (0.08)
	Inflectional	wings	wing	27	33	0.06 (0.12)	0.06 (0.12)
	Contraction	I'm	Im	5	4	0.02 (0.07)	0.01 (0.02)
Morphological–semantic	Homophone	new	knew	11	7	0.02 (0.07)	0.02 (0.07)
	Compound word	overnight	over night	27	23	0.07 (0.18)	0.05 (0.15)
	Word boundary	tooth fairy	toothfairy	11	23	0.04 (0.15)	0.06 (0.12)
	Consonant or vowel changes resulting in a real word	angel	angle	57	58	0.14 (0.23)	0.12 (0.22)

Note. MGR = mental graphemic representation.
[a]Frequency of spelling errors across all participants.
[b]Mean proportion of spelling error type to the total number of misspelled words.

aligned with TWFT but also account for MGRs and include semantic knowledge as a subcategory of morphological errors for subsequent alignment with editing and revision writing processes and to support educator instruction.

Procedures

The research protocol was administered on-site at schools in four sessions within 10 days. Students participated in small groups or whole classroom sessions supervised by the first author of this article. On the first day, participants completed the Group Reading Assessment and Diagnostic Evaluation (GRADE; Williams, 2001), which is a group-administered norm-referenced standardized assessment of reading. The test includes three sections that contribute to a composite total test standard score: vocabulary, sentence comprehension, and paragraph comprehension. The total test standard score has a mean of 100 and an *SD* of 15 and was used for descriptive purposes. There was no significant difference between grades on the total test standard score, $F(1, 79) = 0.16$, $MSE = 21.01$, $p = .69$, and the mean standard score across the total sample was 110.04 ($SD = 11.35$).

On the second through fourth days, students completed a 3-day writing process protocol that has been validated in prior research (Koutsoftas & Gray, 2013). The protocol required students to write a narrative in response to the prompt, "One day you are on your way to school and your backpack turns into a pair of wings! Tell the story of what happens, be creative, provide good detail, and be sure your story has a beginning, middle, and end." A story generation prompt was used because it controlled for background knowledge. On the first day, students planned their story by producing an outline following a model provided by the researcher. On the second day, they produced a first draft of their story based on the outline. On the third day, they produced a final copy of the story based on the outline and first draft. Students had 45 min each day (60 min for final copies) and were provided all writing materials including pens, paper with the prompt written at the top, and their prior work from each day of the study. The researcher was available for questions and encouraged students to do the best they could to produce a story of which they were proud. The instructions provided for the third day were to write a final copy based on the outline and rough draft and to make changes that improve the story but stick to the original idea. The open-ended nature of these instructions leads students to engage in editing of superficial features of writing, including penmanship, in addition to minimal revisions to the story structure.

Transcription and coding

A total of 160 writing samples (first drafts = 80; final copies = 80) were orthographically transcribed into Microsoft Word by trained research assistants who were undergraduate or graduate students in communication sciences and disorders or education. They typed verbatim what students wrote on first drafts and final copies and then read aloud the transcript to ensure that it matched participant's writing samples. The auto-correct features were turned off to allow for retention of spelling errors. Spelling errors were logged by the assistants into a form to include the misspelled word and the target word such that only unique spelling errors were entered. If a participant misspelled a word the same way more than one time, it was included only once in the log form.

The third author of this article, a graduate student in communication sciences and disorders at the time, was the primary coder for spelling errors. First, spelling errors were entered into a spreadsheet by participant, draft (first or final copy), and included the target word along with the misspelled word. The third author coded each spelling error using one of 15 different spelling error codes included in Table 1. Each misspelled word received only one code that represented the primary misspelling of the word. That is to say, even if a word had more than one spelling error, only the primary error code was noted, which was the first misspelling in the word.

The first author reviewed all coding and disagreements were resolved by consensus. Finally, the first author aggregated the data so that the frequency of spelling error types across the 15 codes for first draft and final copies could be analyzed across the sample. Supplemental Digital Content Appendix B, available at: http://links.lww.com/TLD/A71, includes the training protocol used to train coders.

RESULTS

The following measures were obtained from orthographic transcription procedures: the total number of words and the proportion of unique spelling errors to total number of words. One-way analyses of variance indicated that there were no significant differences between grades in the length of story measured by the total number of words or in the proportion of spelling errors to total words on first drafts and final copies. Table 2 provides means and standard deviations for these measures by grade and for the total sample. Paired-samples *t* tests across the total sample revealed that there was a statistically significant increase in length of story from first drafts to final copies, $t(79) = 3.38$, $p = .001$, with a small effect size, Cohen's $d = 0.15$. There was, however, no change in the proportion of spelling errors from first drafts to final copies, $t(79) = 0.48$, $p = .64$. Given the parity between grades across productivity and spelling error rate, subsequent spelling analyses were conducted across the entire sample.

Table 1 includes the frequency of occurrence for each type of spelling error alongside the mean proportion of spelling error type to total number of spelling errors across the 15 different codes on first drafts and final copies. Paired-samples *t* tests comparing the mean proportion of spelling errors across 15 codes from first drafts to final copies were all nonsignificant (*p* value range = .21–.92), suggesting similar proportions of error types on first drafts and final copies. Across the 15 categories, the proportion of spelling errors on first drafts ranged from 0.01 to 0.21, and on final copies ranged from 0.01 to 0.23. The largest proportion was for orthographic—rule error on both first drafts and final copies; however, the smallest proportion was for MGR—exception to rule on first drafts, and morphological—contraction on final copies.

To understand how the spelling coding system accounted for the knowledge categories (see Table 1, first column), we summed proportions of spelling errors within each category for both first drafts and final copies (sums do not total 100% due to rounding). For first drafts, there were 30.01% phonological, 25.25% orthographic, 2.95% MGR, and 37.35% morphological spelling errors. For final copies, there were 31.27% phonological, 26.00% orthographic, 4.13% MGR, and 34.85% morphological spelling errors. Across both first drafts and final copies, morphological spelling errors were the largest proportion

Table 2. Means and standard deviations for writing measures by grade and across the entire sample

	Fourth Grade ($n = 40$)	Sixth Grade ($n = 40$)	Total ($N = 80$)
First drafts			
Total number of words	283.10 (98.93)	304.30 (124.29)	293.70 (112.13)
Proportion of spelling errors	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)
Final copies			
Total number of words	306.15 (127.26)	321.53 (141.11)	313.84 (133.73)
Proportion of spelling errors	0.02 (0.02)	0.02 (0.01)	0.02 (0.02)

of error types observed, followed by phonological, orthographic, and MGR. To account for the subcategory of morphological–semantic spelling errors, we calculated the proportion of these types of errors separately from morphological errors. Of the total spelling errors, morphological–semantic spelling errors accounted for 27.73% of spelling errors on first drafts and 25.22% on final copies.

Reliability

To address the reliability of the spelling coding system, we conducted interrater agreement analysis on spelling errors in 50 first drafts and 50 final copies (63% of writing samples). A second coder, a graduate student in speech–language pathology, was trained in the spelling coding system by the first author and completed the training protocol for the spelling coding system. The training protocol included description of the purpose of the spelling coding system with examples and practice opportunities and took approximately 2 hr to complete (see Supplemental Digital Content Appendix B, available at: http://links.lww.com/TLD/A71). There were 297 spelling errors in first drafts and 319 spelling errors in final copies that were coded by the second coder. The second coder recorded 150 total minutes spent coding 616 total error words, proportionally reflected as 4.12 min per word coding time.

The following formula was used to calculate interrater agreement percentages: (total number of agreements/[total number of disagreements + total number of agreements]). Table 3 includes interrater agreement across all 15 spelling error codes for first drafts and final copies. Agreement greater than 80% was considered acceptable, given industry standards and that this study is an initial step in validating the coding scheme. Points of agreement were all above 80% except for 2 error codes, Orthographic—Rule Error and Morphological—Derivation, each with a pattern of increase in agreement from first drafts to final copies, though none above 80%.

Table 3. Interrater agreement by spelling codes across categories for first drafts and final copies

	First Drafts	Final Copies
Phonological		
Omission of vowels or consonants	85.52%	91.54%
Additions of vowels or consonants	90.24%	92.16%
Substitution for consonants only	95.62%	94.36%
Substitution of vowels resulting in a nonword	80.47%	84.64%
Orthographic		
Pattern frequency	93.27%	94.04%
Rule error	73.74%	76.80%
MGR		
Exception to rule	95.56%	94.98%
Irregular nouns or verbs	92.26%	93.42%
Morphological		
Derivational	67.34%	70.22%
Inflectional	90.91%	90.28%
Contraction	95.56%	97.81%
Morphological–semantic		
Homophone	98.65%	98.75%
Compound word	92.59%	95.30%
Word boundary	91.58%	90.28%
Consonant or vowel change resulting in a real word	84.18%	81.50%

Note. MGR = mental graphemic representation.

DISCUSSION

The purpose of this study was to describe a spelling coding system that accounts for spelling error patterns across five main categories: phonological, orthographic, MGRs, morphological, and morphological–semantic. Inclusion of MGR and morphological–semantic categories to accommodate TWFT across 15 codes allowed for a manageable way, especially for educators, to assess the breadth and depth of intermediate-grade students' spelling knowledge. This study demonstrates the initial feasibility of this spelling coding rubric for describing spelling error patterns of intermediate students in the following ways.

Findings from this study support the use of TWFT that accounts for phonological, orthographic, and morphological knowledge with the addition of knowledge categories of MGRs and morphological–semantic. We compared our results with those of Bahr et al. (2012), a primary source for developing the current spelling coding rubric, who reported that fourth-grade students had 17% phonological, 51% orthographic, and 14% morphological spelling errors whereas sixth-grade students had 15% phonological, 37% orthographic, and 21% morphological. In the current study, using final copies only, the percentage of total spelling errors was 31% phonological, 26% orthographic, and 10% morphological, with 4% MGRs and 25% morphological–semantic. Our results differ from those of Bahr et al. (2012) because of the inclusion of the latter two knowledge types providing codes that would have been coded as one of the primary TWFT categories. Mental graphemic representations would likely be coded as orthographic errors whereas morphological–semantic errors would be included with morphological errors. By creating a subcategory of morphological–semantic, the proportion of error types is distributed across five types of knowledge needed for spelling, instead of the four we began the study with, and aligns with a levels of language framework (Abbott et al., 2010; Ritchey et al., 2016). We propose that because morphological–semantic errors accounted for 25% of spelling errors on final copies, it be considered a fifth knowledge category for ease of implementation by educators. In this way, if educators are going to describe students' spelling errors using this coding rubric, they could classify spelling errors by primary knowledge type and perhaps group children based on similar spelling knowledge targets. For example, students who primarily produce phonological spelling errors would require different instruction than students who primarily produce morphological–semantic spelling errors.

Students in this sample were given time to revise their writing from first drafts to final copies, representative of current writing instructional practices (Gilbert & Graham, 2010; Koutsoftas & Gray, 2013) and aligned with academic learning standards (e.g., CCSS, 2012). As part of the revision process, we expected to see a decrease in spelling errors. However, this was not the case in the current study where there were approximately 2% misspelled words on both first drafts and final copies. Koutsoftas and Gray (2013) found that sixth-grade students who completed the 3-day writing process protocol used in the current study engaged in revision as an editing task that focused on improvements in grammatical accuracy and mechanics of punctuation, capitalization, and paragraph demarcation rather than changes to story content. In that study and in the current study, few changes were observed in spelling that was approximately 98% accurate on both first drafts and final copies. Koutsoftas and Gray (2013) concluded that, when provided with open-ended instructions for revising, intermediate-grade students engaged mostly in editing of superficial features of writing rather than deeper revisions in content.

In this study, there were relatively small proportions of spelling errors in relation to the total number of words (2%) and in line with a prior study's findings (Bahr et al. 2012); yet, students in the current study

did not decrease spelling errors in their final copies, given extended time to revise. This was a sample with high socioeconomic status as indicated by mothers' years of education, which was an average of 2 years of college, and that might explain the high rates of spelling accuracy, even in their first drafts. The writing task itself, however, may have limited the opportunities for students to produce a higher proportion of spelling errors because they were able to use words with which they were most familiar. When given time and open-ended instruction to revise their writing, students in this study did not improve spelling as indicated by no significant changes in the total proportion of spelling errors or across the 15 spelling error categories from first draft to final copy. It could be that students in this study did not attend to spelling as part of the revision process, but it is more likely that because of low rate of spelling errors and the use of familiar words, students were unable to detect and correct the spelling errors as part of revising or editing processes. Combined, this suggests that spelling error patterns in intermediate students will not spontaneously resolve and individualized remediation is necessary to correct and connect spelling for encoding and decoding as part of the writing process. Without instruction that draws direct attention to the knowledge deficits driving spelling errors, students will not be able to detect and correct these spelling errors.

The spelling coding system was implemented with ease by coders who spent 4.12 min per word, on average, when coding, and required 2 hr of training to achieve acceptable levels of interrater agreement (>80%). There were two spelling error codes that did not meet criterion for agreement, orthographic—rule error, which was one of the most frequent types of spelling errors, and morphological—derivation, which was one of the least frequent types of spelling errors. Of note, coders were advanced graduate students in speech and language who had completed multiple courses in language assessment and remediation, so the lack of agreement regarding the classification of these spelling errors is an issue to be addressed as a future direction of this research.

Clinical implications

The overarching goal of this research is to provide educators a simple and reliable way to understand and assess spelling error patterns that also can inform individualized instruction for intermediate students as part of their everyday classroom writing tasks. The spelling coding rubric is grounded in research (Apel et al., 2006; Bahr et al., 2012; Daffern et al., 2015; Ouellette & Fraser, 2009; Silliman et al., 2006). In the current study, 15 codes captured the pattern of spelling errors reflected in prior research using a detailed coding system (POMAS; Silliman et al., 2006). Although the POMAS approach provides breadth and depth for analyzing spelling, with 46 codes it would be difficult for educators to implement with ease and reliability, interpret the findings, and embed findings into writing instruction. The spelling coding rubric described in this study still accounts for the breadth and depth of knowledge needed for spelling with two additional knowledge types, MGRs and morphological–semantic error patterns. The inclusion of these knowledge types ensures that spelling is accounted for in a way that aligns with levels of language frameworks.

We use the term "levels of language" to align with the knowledge that SLPs and teachers in school settings have about language across five domains (e.g., Abbott et al., 2010; Ritchey et al., 2016). Our aim was to develop a spelling coding system that will allow educators to understand the linguistic underpinnings of the spelling error patterns observed that can account for both encoding and decoding words as part of the writing process (Berninger & Amtmann, 2003; Hayes & Berninger, 2014). To illustrate, if a student demonstrates larger proportions of morphological–semantic errors using this rubric, it might indicate that the student needs support in both transcription (i.e., during drafting of text) and revision phases of

writing with the focus on the linguistic domains of morphology at the word (semantic) level, and subsequent interventions should reflect this. The intervention might utilize a strategy that focuses the student's spelling knowledge at the morphologic–semantic level to detect associated error types, such as decomposition of morphologically complex words that share similar morphological patterns. Likewise, students who demonstrate a majority of phonological spelling errors would be taught strategies to target phonologically based spelling error patterns as part of transcription and revision processes. The proportion of morphological–semantic errors was found to be substantial (25% on final copies), further emphasizing the importance of separately capturing this error type. In doing so, we can train educators to understand spelling as a language-based skill so that spelling assessment and instruction can be individualized for students and embedded in daily academic writing tasks.

Limitations and future directions

This study examined spelling skills and application of the rubric in only one genre, fictional narrative. Although learning standards (CCSS, 2012) include narrative writing in intermediate grades, other genres such as informative, opinion, and persuasive should be included in future studies to validate this spelling coding rubric across a variety of academic writing genres. A limitation to the current study is that we did not conduct a side-by-side analysis of first drafts and final copies to specifically describe the nature of individual spelling changes. This is something that can be addressed in future research and would confirm whether students are indeed able to detect and correct spelling errors by knowledge type consistently across drafts. Another limitation was that only the first spelling error within a word was used to apply a code; as we further develop the training protocol, we plan to account for multiple misspellings within a word. Future directions of this research include refinement of the spelling coding rubric and psychometric evaluation. Subsequent studies will aim to demonstrate validity across populations (e.g., students with language-based learning disabilities) and with measures of writing quality and standardized scores of oral language and reading. As part of these studies, we plan to evaluate the reliability and usability of the training protocol and spelling coding rubric by educators in school settings.

CONCLUSION

This study demonstrated feasibility of a spelling coding rubric for describing spelling error patterns in intermediate-grade students' writing samples across first drafts and final copies. The spelling coding rubric included 15 types of spelling errors across five types of knowledge needed for spelling. The addition of MGRs and morphological–semantic categories further simplifies the underlying linguistic representations of spelling error patterns within the functional context of everyday academic writing, allowing educators to align interventions with academic standards.

REFERENCES

Abbott, R. D., Berninger, V. W., & Fayol, M. (2010). Longitudinal relationships of levels of language in writing and between writing and reading in grades 1 to 7. *Journal of Educational Psychology*, *102*(2), 281–298.

American Speech-Language-Hearing Association. (2013). *2013 Membership survey. CCC-SLP survey summary report: Number and type of responses*. www.asha.org

American Speech-Language-Hearing Association. (2001). *Roles and responsibilities of speech-language pathologists with respect to reading and writing in children and adolescents [Technical Report]*. www.asha.org/policy

Apel, K. (2009). The acquisition of mental orthographic representations for reading and spelling development. *Communication Disorders Quarterly*, *31*(1), 42–52. https://doi.org/10.1177/1525740108325553

Apel, K., & Masterson, J. J. (2001). Theory-guided spelling assessment and intervention. *Language, Speech, and Hearing Services in Schools*, *32*(3), 182–195. https://doi.org/10.1044/0161-1461(2001/017)

Apel, K., Wolter, J. A., & Masterson, J. J. (2006). Effects of phonotactic and orthotactic probabilities during fast mapping on 5-year-olds' learning to spell. *Developmental Neuropsychology*, *29*(1), 21–42. https://doi.org/10.1207/s15326942dn2901_3

Bahr, R. H., Silliman, E. R., Berninger, V. W., & Dow, M. (2012). Linguistic pattern analysis of misspellings of typically developing writers in grades 1–9. *Journal of Speech, Language, and Hearing Research*, *55*(6), 1587–1599. https://doi.org/10.1044/1092-4388(2012/10-0335)

Berninger, V. W., Abbott, R. D., Nagy, W., & Carlisle, J. (2010). Growth in phonological, orthographic, and morphological awareness in grades 1 to 6. *Journal of Psycholinguistic Research*, *39*(2), 141–163. https://doi.org/10.1007/s10936-009-9130-6

Berninger, V. W., & Amtmann, D. (2003). Preventing written expression disabilities through early and continuing assessment and intervention for handwriting and/or spelling problems: Research into practice. In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* (pp. 345–363). Guilford Press.

Berninger, V. W., & Swanson, H. L. (1994). Modifying Hayes and Flower's model of skilled writing to explain beginning and developing writing. In J. S. Carlson (Series Ed.) & E. C. Butterfield (Vol. Ed.), *Advances in cognition and education practice, Vol. 2: Children's writing: Towards a process theory of the development of skilled writing* (Vol. *2*, pp. 57–81). JAI Press.

Common Core State Standards Initiative (CCSS). (2012). *Common core state standards for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects*. www.corestandards.org

Daffern, T. (2017). Linguistic skills involved in learning to spell: An Australian study. *Language and Education*, *31*(4), 307–329. https://doi.org/10.1080/09500782.2017.1296855

Daffern, T., Mackenzie, N. M., & Hemmings, B. (2015). The development of a spelling assessment tool informed by Triple Word Form Theory. *Australian Journal of Language & Literacy*, *38*(2), 72–82.

Daffern, T., & Ramful, A. (2019). Measurement of spelling ability: Construction and validation of a phonological, orthographic and morphological pseudo-word instrument for students in Grades 3-6. *Reading and Writing*, *33*(3), 571–603. https://doi.org/10.1007/s11145-019-09976-1

Dockrell, J. E., & Connelly, V. (2015). The role of oral language in underpinning the text generation difficulties in children with specific language impairment. *Journal of Research in Reading*, *38*(1), 18–34.

Ehri, L. C. (2000). Learning to read and learning to spell: Two sides of a coin. *Topics in Language Disorders*, *20*(3), 19–36.

Garcia, J. N., & Fidalgo, R. (2008). Orchestration of writing processes and writing products: A comparison of sixth-grade students with and without learning disabilities. *Learning Disabilities: A Contemporary Journal*, *6*(2), 77–98.

Gilbert, J., & Graham, S. (2010). Teaching writing to elementary students in grades 4–6: A national survey. *The Elementary School Journal*, *110*(4), 494–518. https://doi.org/10.1086/651193

Hayes, J. R., & Berninger, V. (2014). Cognitive process in writing: A framework. In B. Arfé, J. E. Dockrell, & V. W. Berninger (Eds.), *Writing development in children with hearing loss, dyslexia, or oral language problems: Implications for assessment and instruction* (pp. 3–15). Oxford University Press.

Jung, K. H. (2019). Developmental characteristics of spelling ability of kindergarten to 3rd grade children. *Communication Sciences & Disorders*, *24*(1), 19–30. https://doi.org/10.12963/csd.19592

Kim, Y.-S., Apel, K., & Al Otaiba, S. (2013). The relation of linguistic awareness and vocabulary to word reading and spelling for first-grade students participating in response to intervention. *Language, Speech, and Hearing Services in Schools*, *44*(4), 337–347. https://doi.org/10.1044/0161-1461(2013/12-0013)

Koutsoftas, A. D. (2018). Writing-process products of fourth- and sixth-grade children: A descriptive study. *The Elementary School Journal*, *118*(4), 632–653. https://doi.org/10.1086/697510

Koutsoftas, A. D., & Gray, S. (2013). A structural equation model of the writing process in typically-developing sixth grade children. *Reading and Writing*, *26*(6), 941–966. https://doi.org/10.1007/s11145-012-9399-y

McCutchen, D. (1996). A capacity theory of writing: Working memory in composition. *Educational Psychology Review*, *8*(3), 299–325.

McNeill, B., & Kirk, C. (2014). Theoretical beliefs and instructional practices used for teaching spelling in elementary classrooms. *Reading and Writing*, *27*(3), 535–554.

Moats, L. (2009). Knowledge foundations for teaching reading and spelling. *Reading and Writing*, *22*(4), 379–399. https://doi.org/10.1007/s11145-009-9162-1

Ouellette, G., & Fraser, J. (2009). What exactly is a yait anyway: The role of semantics in orthographic learning. *Journal of Experimental Child Psychology*, *104*(2), 239–251.

Ritchey, K. D., McMaster, K. L., Al Otaiba, S., Puranik, C. S., Kim, Y. S. G., Parker, D. C., & Ortiz, M. (2016). Indicators of fluency writing in beginning writers. In K. D. Cummings & Y. Petscher (Eds.), *The fluency construct* (pp. 21–66). Brookes Publishing Co.

Silliman, E. R., Bahr, R. H., & Peters, M. L. (2006). Spelling patterns in preadolescents with atypical language skills: Phonological, morphological, and orthographic factors. *Developmental*

Neuropsychology, *29*(1), 93–123. https://doi.org/10.1207/s15326942dn2901_6

Williams, K. T. (2001). *Technical manual: Group reading assessment and diagnostic evaluation*. American Guidance Service.

Wilson, O., & Koutsoftas, A. (2015, April). *Five types of knowledge for spelling: A developmental study*. Presented at the 2015 NJSHA Convention, Long Branch, NJ.

Wolter, J. A., & Apel, K. (2010). Initial acquisition of mental graphemic representations in children with language impairment. *Journal of Speech, Language, and Hearing Research*, *53*(1), 179–195. https://doi.org/10.1044/1092-4388(2009/07-0130)