The building blocks of writing: Learning to write letters and spell words

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Abstract This study examined the development of beginning writing skills in kindergarten and the relationship between early writing skills and early reading skills. Sixty children were assessed on beginning writing skills (including letter writing, individual sound spelling, and real and nonsense word spelling) and beginning reading skills (including letter name and letter sound knowledge, global early reading ability, phonological awareness, and word reading). Children's beginning writing abilities are described, and they exhibited a range of proficiency in their ability to write letters, spell sounds, and spell real and nonsense words. Global early reading proficiency, phonological awareness, and/or letter sound fluency predicted letter writing, sound spelling, and spelling of real and nonsense words.

Keywords Letter writing · Spelling · Writing and reading relationship · Early writing

Introduction

Literacy is essential for academic and vocational success, and early literacy development is central in current research and political agendas. During the last three decades, researchers learned a great deal about the importance of early reading acquisition and the multiplying consequences of failure to acquire beginning reading skills (e.g., National Reading Panel, 2000; Snow, Burn, & Griffin, 1998). The same attention is shifting to beginning writing skills as this aspect of literacy is also important. However, much less is known about writing, especially the earliest

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stages of writing development for children in kindergarten. The purpose of this study is to examine the development of children's letter writing and beginning spelling in the spring of kindergarten. Specifically, students' ability to write alphabet letters, to spell sounds, and to spell real and nonsense words was examined in relationship to beginning reading and phonological awareness skills.

Learning to read and write in an alphabetic system

Learning to write represents a tremendous accomplishment in children's educational development. Similar to reading, learning to write requires knowledge of the phonological and orthographic systems of English. This knowledge can be acquired through literacy experiences prior to beginning formal schooling (e.g., home literacy activities, exposure to literacy through games and television, and preschool experiences) or is acquired through formal instruction in elementary school. Typical components of effective early literacy instruction include learning the names and sounds of alphabet letters and developing phonological awareness, including rhyming, blending, and segmentation.

Reading and writing development generally occur within the same developmental timeframe and are considered to follow a developmental progression. Stage models of spelling development often parallel stages of word reading development. For example, Ehri (1997, 1998) posits that children progress through parallel, although not identical, stages for sight word reading and spelling development. Stages within her model include periods during which children first rely on logographic cues to read and spell words and then use partial alphabetic information (e.g., initial and final letters/sounds) to read and spell words. In later stages, children use more complete letter-sound relationships and consolidated knowledge of the alphabetic system of English to read and spell. For young children, learning to read and learning to spell draw from a similar knowledge base (i.e., phonological and orthographic information). As children become more adept at the skills required for reading, typically spelling proficiency becomes more sophisticated.

In additional to theoretical models of development, many studies explored the relationship between beginning reading skills and beginning spelling skills. Hecht and Close (2002) reported a composite of letter name knowledge, letter sound knowledge, and letter writing knowledge correlated moderately ($r = .47$) with invented spelling for a subgroup of kindergarten students prior to their participation in a phonological awareness intervention. Mann, Tobian, and Wilson (1987) reported correlations of kindergarten invented spelling of .48 with first grade word reading and .59 with word attack. Similarly, Stage and Wagner (1992) reported correlations for invented spelling of .48 with word reading and .56 with word attack for first grade children. Moderate correlations with early reading skills (e.g., letter names and sounds) and word reading are found with spelling during kindergarten and first grade.

One reason for the relationship between reading and spelling is the shared role of phonological awareness. With the exception of words spelled by memory, word spelling requires phonological segmentation (i.e., breaking the word into individual sounds) and matching each sound to its respective letter or letters. The relationship between phonological awareness and spelling is supported by both correlational and

intervention research. For example, Stage and Wagner (1992) reported correlations of .68 between spelling and phonological awareness in first grade. This correlation is of a higher magnitude than the correlations reported between two measures of word reading. Similarly, literacy intervention research supports a causal relationship between early reading and writing. Improvements in spelling are noted as one result of phonological awareness or early reading instruction (Hecht & Close, 2002; Lundberg, Frost, & Petersen, 1988; Tangel & Blachman, 1992) or improvements in reading are noted as the result of spelling instruction (Ehri & Wilce, 1987; Graham, Harris, & Fink Chorzempa, 2002; Uhry & Sheperd, 1993). Taken together, the relationship between learning to read and learning to spell is clear.

Of note, much of the literature on the early reading-early writing relationship examined spelling as either an indicator of reading or as a skill in some way unrelated to foundational or basic writing. In many cases, students' earliest development of writing skills, specifically writing alphabet letters, is unconsidered or uncontrolled for when spelling has been included. For example, Mann et al. (1987) assessed letter identification, but not whether children could write the letters necessary to spell words. O'Connor and Jenkins (1995) taught spelling as a component in a reading intervention, but students used magnetic letters to spell words. However, other skills may be essential in learning to spell. McBride-Chang (1998) studied invented spelling four times during kindergarten and first grade. She reported that invented spelling at the end of first grade was predicted by previous performance on invented spelling (kindergarten and fall first grade assessments). Letter-name knowledge, letter-sound knowledge, and three measures of phonological awareness did not contribute additional variances beyond initial levels of invented spelling. Orthographic processing did, however, contribute a small amount of unique variance. McBride-Chang concluded that invented spelling may be measuring ''core abilities not tapped by other phonological awareness tasks'' (1998, p. 156). A possible ability is basic writing skills. The ability to write individual letters (e.g., print upper and lower case letter of the alphabet from dictated letters) and associate isolated sounds with letters (e.g., write a letter that matches an orally presented letter-sound) are two skills that are potentially important in better understanding early writing development.

Learning to write letters

Students' ability to write alphabet letters represents one aspect of knowledge of the English orthographic system. Many studies established the predictive relationship between letter-name knowledge (e.g., identifying upper and lower case alphabet letters) and letter-sound knowledge and word reading (McBride-Chang, 1999; Treiman, Tincoff, Rodriguez, Mouzaki, & Francis, 1998). However, few studies included the parallel writing skill—whether or not children can write the alphabet letters. Letter writing can be assessed in different ways including copying letters from a model, writing all letters in alphabetic order, or writing letters from dictation. Research conducted with children in first grade and older children provides evidence of the importance of handwriting, including legibility and fluency (Graham, Harris, & Fink, 2000). However, few studies included kindergarten

children. First grade studies often assess letter writing when it is expected that most children are able to write letters and when individual differences in legibility and fluency may be more remarkable. The current study includes letter writing from dictation. Students were asked to name alphabet letters and asked to write upper and lower case alphabet letters as they were dictated in random order. Analyses of students' letter writing ability make it possible to describe the scope of kindergarten children's letter writing skills and if students' letter writing ability is important in understanding their spelling abilities. Given the developmental nature of writing and the relationship of parallel reading abilities, it is hypothesized that (a) knowledge of letter names would predict letter writing ability, and (b) letter writing would be a significant predictor of more advanced writing skills, including spelling.

Learning to spell sounds

Another early writing skill is students' ability to associate letter-sounds with alphabet letters by writing letters that match a sound, an ability that captures a skill intermediate of letter writing and word spelling. A literature search identified no study formally assessing sound spelling as part of investigation into kindergarten children's writing development or spelling ability. Based on Ehri's stage model (1997, 1998), the ability to map letters to sounds is important if children are to progress from a logographic stage to an alphabetic stage. In the current study, students were asked to identify letter sounds and to spell individual sounds from dictation. Analyses of students' sound spelling abilities make it possible to describe the scope of children's proficiency in sound spelling and to examine their performance in relationship to children's other reading and writing abilities. It is hypothesized that (a) letter sound knowledge combined with letter writing would predict sound spelling, and (b) that sound spelling would be a significant predictor of real and nonsense word spelling.

The current study

To date, the majority of studies investigating beginning writing in kindergarten children have examined spelling as a predictor of later reading achievement or the effects of intervention that include spelling as either the intervention or the outcome. The role of letter writing has been largely investigated in first grade or older children. This study provides a downward extension of the extant research to focus on younger writers: children in kindergarten. Additionally, the study includes isolated letter writing and sound spelling as additional aspects of early writing ability. The following research questions guide the study:

(1) What are children in the spring of kindergarten able to write and spell?
(2) What are the correlations among reading abilities and writing abilities in the spring of kindergarten?
(3) Which beginning reading, phonological awareness, and writing skills predict letter writing, sounds spelling, and word spelling for children in kindergarten?

Methods

Participants

The participants were 60 kindergarten children from four classes in one school in the Northeast US. The participants included 23 girls (38%) and 37 boys (62%) with a mean age of 5 years, 9 months (*SD* 3.62 months). The school and surrounding community was ethnically diverse. Twenty-three students (40%) were Caucasian and the remaining 37 students were from minority racial backgrounds that included African–American (15%), Asian–American (22%), Hispanic (18%), and biracial (5%) ethnicities. Information about the specific primary languages and English proficiency of participating students was not available from school personnel, but ∼3% of students enrolled in the school were of Limited English Proficiency. Teachers indicated that all students who participated in this study had sufficient English skills to benefit from instruction in English and to understand the research tasks. Fifty of the participants (83%) were right handed.

Students were enrolled in full-day kindergarten classrooms. Teachers reported that a balanced approach to beginning literacy instruction was used in all classrooms. There was no standard commercial reading or literacy curriculum, but teachers reported using a variety of reading texts and instructional activities to teach beginning reading and writing. The curriculum included direct instruction in the alphabetic principle (letter names and sounds), big books, literacy centers, journal writing, use of invented spelling, and other reading and writing activities that are typical in kindergarten classrooms. According to the teachers, all letters and letter-sounds had been taught by the end of the school year.

Measures

The measures used in this study included four writing measures, four reading measures, and two phonological awareness measures. The writing measures were developed specifically for this study, and the reading measures included both curriculum-based measures of early reading and norm-referenced measures of phonological awareness and early reading ability.

Letter Writing

Letter Writing assessed students' ability to write upper and lower case alphabet letters from dictation. An example of the directions for this task is as follows: ''*I want you to write some letters for me. I will say a letter and I want you to write the upper and lower case, or the capital and the little letter that I say. Write both the upper and lower case letters in this box. Do your best. If you come to one that you don't know, take your best guess or we can skip it. Do you understand? OK, let's try one. Write P. Write an upper and lower case P.*'' Then, the examiner presented subsequent letters orally in random order. Randomly ordered letters were presented in a standard order to all students.

Alternate forms of the Letter Writing measure were developed by randomly ordering alphabet letters. Six alternate forms were created as part of a pilot investigation, and one form was randomly selected to be administered to students. Additionally, a response sheet was developed using a standard size paper consisting of 3×9 boxes of ~ 1 in. tall and 2.5 in. wide. The examiner pointed to boxes, as needed, so that students would write letters in the appropriate location on the response sheet. Pilot testing of the measure indicated that students were unfamiliar and imprecise at using a headline, mid-line, and baseline for letter formation and spacing. The response sheet was modified to provide a space for students to write the letters without lines. Reliability estimates (alternate-form and internal consistency) for Letter Writing range from .92 to 94 (Ritchey, 2006).

Responses were scored based on a legibility criterion that focused on whether or not the letter could be identified in isolation. Because letter reversals are common in young children's writing, a reversed letter was scored as correct with one exception. If a reversed letter resulted in another letter (e.g., *b/d* or *p/q*), the reversed letter was scored as incorrect. Inversions were not scored as correct. The total number of letters written correctly (upper and lower case) was calculated and used in analyses. The maximum score was 52. Inter-scorer agreement was .99 for Letter Writing.

Sound Spelling

Sound Spelling assessed students' ability to write letters from a dictated sound. The examiner presented a phoneme and asked students to write the letter that makes that sound. The directions were standardized and similar to that of Letter Writing and were the following: ''*Now I am going to say a sound and I want you to write the letter that makes that sound. You can write the upper or lower case letter. Do your best. If you come to one that you don't know, take your best guess or we can skip it. Do you understand? OK, let's try one. Write the letter that makes the /m/ sound.*'' Subsequent phonemes were presented in random order; the order of presented sounds was standardized for all students. The dictated sounds included consonant sounds and short vowel sounds.

Similar to Letter Writing, six alternate forms of the Sound Spelling measure were developed by randomly ordering letter sound associations for consonants and short vowel sounds. One form was randomly selected to be administered in the current study. Students responded on an identical response sheet as the one used for Letter Writing. Responses were scored as correct if they represented one of the appropriate spellings of that phoneme and were legible. Letter reversals were counted as correct unless they resulted in another valid letter. In the case of phonemes that could be represented by more than one letter (e.g., */s/ or /j/*), credit was awarded for either correct response. The raw score was used in analysis and the maximum score was 25. Inter-scorer agreement for Sound Spelling was .98. Reliability estimates (alternate-form and internal consistency) for Sound Spelling range from .90 to .92 (Ritchey, 2006).

Real Word Spelling

Real Word Spelling assessed students' ability to spell five real words following consonant-vowel-consonant (*c-v-c*) patterns. A pool of 50 c-v-c words was developed and words were randomly selected by short vowel so that each probe had one word with each short vowel. Five words were selected for each alternate form, and one alternate form was randomly selected to be administered. The directions were the following: ''*I want you to spell some words for me. I am going to say a word and I want you to write it. If you come to one that you don't know, take your best guess or we can skip it. Make sure you write down any sounds you can. OK, spell 'sun'*.'' The four additional words were then administered.

Students responded on a response sheet consisting of two columns and five rows of boxes. Spaces to spell words were ∼1.5 × 3.5 in. Students were encouraged to spell part of the word if they were unable to spell the entire word. If a student only wrote one or two letters, the examiner prompted them by saying ''*Are there any other sounds in sun?*''

Responses were scored using a correct letter sequence scoring (CLS) (Tindal & Marston, 1990; White & Haring, 1980). In CLS scoring, the total number of points possible in a given word is the number of letters in the word plus one. Thus, the maximum score for each spelling probe was 20. Students' earned one point if the first letter was correct, a second point if the last letter was correct, and up to two points for correct letter sequences within the word. For example, in the word '*sun*' spelled '*sn*,' the score would be two (first and last letter correct) but a spelling of '*sun*' earned four points. Similarly, a spelling of '*s*' earned one point. Inter-scorer agreement for Real Word Spelling was .94. Reliability estimates (alternate-form and internal consistency) for Real Word Spelling range from .84 to .90 (Ritchey, 2006).

Nonsense Word Spelling

Nonsense Word Spelling assessed students' ability to spell five nonsense words following *c-v-c* patterns. A pool of 50 c-v-c nonsense words was developed and words were randomly selected by short vowel so that each alternate form had one word with each short vowel. One alternate form was randomly selected to be administered. Directions were similar to those for Real Word Spelling but the task initially was introduced with ''*Now I want you to spell some words that are not real words. They are make-believe words.*'' The remaining directions from Real Word Spelling were repeated, the response sheet and scoring were identical for Nonsense Word Spelling. In most cases, students wrote real words in one column of the response sheet and nonsense words in the second column. Inter-scorer agreement for Nonsense Word Spelling was .92. Reliability estimates (alternate-form and internal consistency) for Nonsense Word Spelling range from .86 to .89 (Ritchey, 2006).

Letter Name Fluency

Letter Name Fluency (LNF; DIBELS, 2001; Ritchey & Speece, 2006) measured the number of correctly identified upper and lower case alphabet letters per minute.

Upper and lower case letters ($n = 52$) were presented in random order on a standard size paper. This measure was modified from the DIBELS measure to include only one upper case and one lower case letter per form (multiple alternate forms of LNF were developed as part of a separate investigation, and one probe was randomly selected to be administered to students in the current investigation). Alternate-forms reliability ($r = .86$–$.93$; Good, Simmons, and Kame'enui cited in DIBELS, 2001; Speece, Mills, Ritchey, & Hillman, 2003) and concurrent and predictive criterion-related validity with word reading ($r = .50$–$.70$; Daly, Wright, Kelly, & Meadows, 1997; Good et al., cited in DIBELS, 2001; O'Connor & Jenkins, 1999; Ritchey & Speece, 2006; Speece et al., 2003) are adequate to strong.

Letter Sound Fluency

Letter Sound Fluency (LSF; Elliott, Lee, & Tollefson, 2001; Ritchey & Speece, 2006) measured the number of correctly identified letter sounds per minute. Lower case letters ($n = 26$) were randomly presented on a standard size page. To ensure students understood the task demands, three practice items with corrective feedback were included. Students were required to give the sound of consonants (including either the hard or soft sound of ''*c*'' and ''*g*'') and the short sound of vowels. Alternate-forms reliability (r = .82–.93; Elliott et al., 2001; Ritchey & Speece, 2006; Speece & Case, 2001) and predictive criterion-related validity with word reading (r = .58–.75; Elliott et al., 2001; Speece & Case, 2001) for a similar measure are judged as adequate.

Phoneme Segmentation Fluency

Phoneme Segmentation Fluency (PSF; DIBELS, 2001) measured a student's ability to segment phonemes in orally presented words that contain 2–5 phonemes. For example, the examiner orally presents the child with the word ''*sat*,'' and the ideal response would be ''*/s/ /a/ /t/*.'' Scoring also allows for partial credit so a student who responds with each phoneme in ''*sat*'' would earn a score of three, but a response of */s/ /at/* would earn a score of two. After a student segmented the first word, subsequent words are administered for 1 min. The directions were modified slightly from Good et al. (DIBELS, 2001) to include additional practice items with picture cues and more explicit corrective feedback. Alternate-forms reliability (r = .60–.88; Kaminski & Good, 1996; Good et al., cited in DIBELS, 2001;Ritchey & Speece, 2006) and predictive and concurrent criterion-related validity with word reading, reading-related measures, and spelling ($r = .54$–$.68$; Kaminski & Good, 1996; Good et al., cited in DIBELS, 2001; Ritchey & Speece, 2006) are adequate.

Phonological awareness

To assess students' phonological awareness, the phonological awareness subtests of the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, & Rashotte, 1999) were administered. The Sound Matching subtest measures students' ability to identify beginning or final sounds in orally presented words. The Blending

subtest measured a student's ability to blend orally presented words (to create compound words), syllables, onset-rimes, and phonemes. For example, students were orally presented with */c/ /at/* and are required to respond */cat/*. The Elision subtest measured a student's ability to delete a sound or sounds from an orally presented word. For example, students were presented with ''*baseball*'' and asked to say ''*baseball without base*.'' The correct response was ''*ball*.'' Items increased in difficulty and required Elision at the syllable and phoneme level in initial, final, and medial positions of words. Scores from the three subtests yield a Phonological Awareness Composite Score (mean 100; *SD* 15).

The CTOPP is an individually administered, standardized, norm-referenced assessment consisting of 13 subtests of phonological processing. The CTOPP is appropriate for students from age 5–25 years old, and Salvia and Ysseldyke (2004) reported strong evidence of validity and adequate reliability of phonological awareness subtests. Controlling for age, test-retest reliability is .83 for Sound Matching and .88 for both Blending and Elision. Concurrent validity coefficients with the Lindamood Auditory Conceptualization Test are .58 for Blending and .75 for Elision (no data are reported for Sound Matching). Using the Woodcock Reading Mastery subtests (Woodcock, 1998) as the criterion, concurrent criterion-related validity coefficients with Word Identification and Word Attack, respectively, are .49 and .58 for Sound Matching, .61 and .62 for Blending and .73 and .74 for Elision, controlling for age.

Early reading

The Test of Early Reading Ability—Third Edition (TERA; Reid, Hresko, & Hammill, 2001) was administered as a global assessment of early reading abilities. The TERA is a standardized, norm-referenced assessment that measures students' print awareness, alphabetic skills, and ability to derive meaning from print. There are three subtests: Alphabetics, Conventions, and Meaning. The Alphabetics subtest includes 29 items that assess children's knowledge of alphabet letters and letter-sound correspondences. The Conventions subtests consists of 21 items and measures children's knowledge of and familiarity with conventions of print including book handling, print conventions, and knowledge of punctuation, capitalization, and spelling. The Meaning subtest consists of 30 items that measures children's ability to read and understand written text. Words, sentences and paragraphs are presented. The three subtests are combined to form a Reading Quotient (mean 100, *SD* 15).

The third edition of the TERA was normed with 875 students across US. Reliability estimates for internal consistency (Coefficient α = .95 for 6-year old children) and test-retest reliability (r = .99 for 4–6-year old children) are strong. Criterion-related validity coefficients for the TERA are .48–.64 when the criterion measure was the Woodcock Reading Mastery Test (Woodcock, 1998).

Procedure

All data were collected during the second half of kindergarten. Data collection began in late February and continued until May. The CTOPP, TERA, LNF, LSF,

and PSF were administered during February and March. Writing measures were administered during April and May. All measures were administered to students individually in a quiet location within the school by the author.

For the writing measures, inter-scorer agreement was established for all measures. The author scored all writing measures, and a random sample of 25% of the letter dictation, sound spelling, and real and nonsense word spelling assessments were scored by one of two graduate students. Inter-rater agreement was established for all writing measures and exceeded 90% for all measures; specific reliability estimates are described above. Any discrepancies were discussed, resolved, and final agreement was 100% for all measures.

Results

Descriptive statistics are presented in Table 1. There were no significant differences in writing or reading performance for gender or handedness on any measure (t-tests were conducted for each measure, all $p > .05$), so data were analyzed as a group. The results section is organized around the following sections: (a) descriptive analysis of children's writing skills; (b) relationships among reading and spelling skills, and (c) predictors of writing abilities.

Descriptive analysis of children's performance

Letter Writing

Figure 1 displays the percentage of students who could accurately write each letter of the alphabet (upper and lower case). In this group of students, all children could write *A, O, o, X,* and *x,* and there were 13 letters that 90% of more of the students

Table 1 Descriptive statistics

	Mean	SD	Range
Letter Writing	45.32	8.49	13–52
Sound Spelling	16.30	5.88	0–24
Real Word Spelling	9.26	5.34	0–20
Nonsense Word Spelling	7.72	4.44	0–16
TERA Reading Quotient (SS)	97.50	9.38	72–117
CTOPP Composite (SS)	96.42	11.95	70–119
LNF	39.15	15.67	5–84
LSF	10.73	8.66	0–45
PSF	13.78	10.48	0–51

Note: *TERA* Test of Early Reading Ability, *CTOPP* Comprehensive Test of Phonological Processing, *LNF* Letter Name Fluency, *LSF* Letter Sound Fluency, *PSF* Phoneme Segmentation Fluency, *SS* Standard Score. The standard score mean is 100, *SD* 15 for TERA Reading Quotient and CTOPP Composite
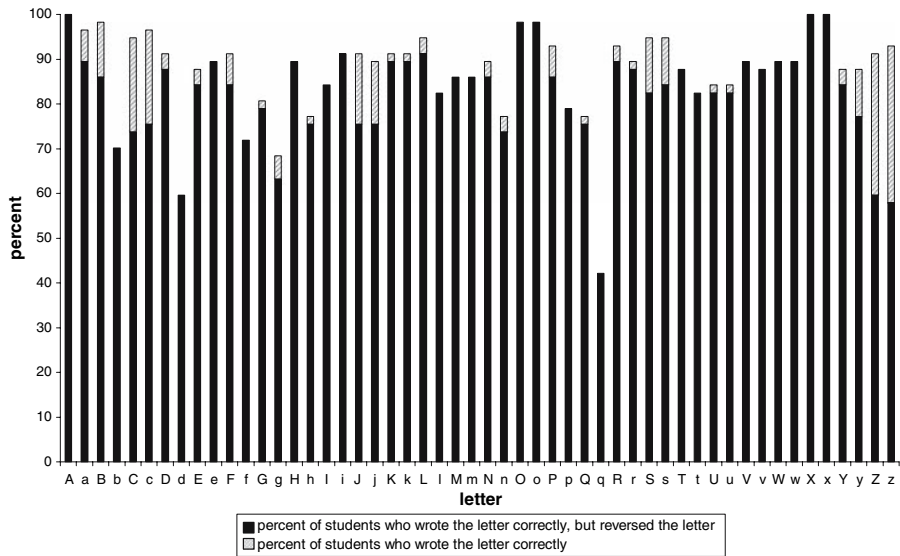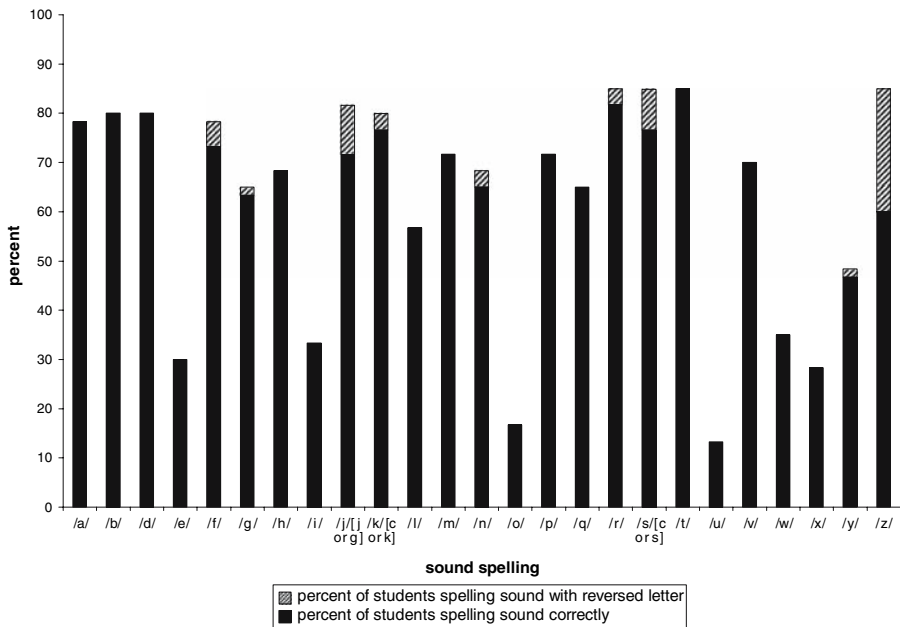
Fig. 1 Percent of students who were able to write individual letters

could write. The most difficult letters for children to write were *K* and *q*. Letters that require shifts in directions such as *Cc*, *Ss*, and *Zz* were often more difficult, and reversals were more common with these letters. Students wrote a minimum of 13 letters, and 11 students were able to write all the alphabet letters.

Sound Spelling

Figure 2 displays the percentage of students who were able to spell each sound with a correct letter. Spelling sounds was a more difficult task than letter writing, and there were no sounds that all students were able to spell accurately. Vowel sounds, with the exception of /a/, were more difficult than consonant sounds, with less than 20% of the children able to spell vowels. Analysis of students' responses indicated that students typically substituted vowels, most commonly using another vowel in its place. Two students were unable to spell any sounds, and no students were able to spell all sounds (max score = 24).

Students also were allowed to write one letter for sounds that could be spelled in more than one way. For the /j/ sound (as in Jack or giraffe), 31.7% of students spelled the sound with the letter *g*, 35% of students spelled the sound with the letter *j* and 3.3% spelled the sound with both letters. For the /s/ sound (as in sun or cent), 68.3% of students spelled the sound with the letter *s*, 13.3% spelled the sound with the letter *c*, and 3.3% of students spelled the sound with both letters. For the /k/ sound (as in king or cat), 35% of students spelled the sound with the letter *c*, 38.3% spelled the sounds with the letter *k*, and 3.3% spelled the sound with both letters. Similar to performance on Letter Writing, students had difficulty forming letters that required shifts in direction (e.g., 60% of students could spell /z/ using *z*, 25% could spell /z/ with *z* but reversed the letter).

Fig. 2 Percent of students who were able to spell individual sounds

Spelling

Figures 3 and 4 displays the frequency of students who earned 0, 1, 2, 3 or 4 points for each correct letter sequence for word on the two spelling measures (Real Word Spelling and Nonsense Word Spelling), respectively. Because of the nature of CLS scoring, students earned zero points if there were no correct letters, one point if there was a correct initial or final letter, two points if there was a correct initial and final letter (or in a few cases, vowel and one other letter), three points if there were three letters spelled correctly but additional letters also were inserted, and four points if the word was spelled correctly. One student was able to spell all real and nonsense words correctly, and two students were unable to earn any points (spell any sounds within the words) correctly. Across both types of words, there were similar numbers of students who were able to spell the entire word correctly, with the majority of students spelling partial words correctly.

Relationship of reading and writing abilities

Table 2 displays correlations among reading and writing measures. There were moderate to strong correlations for reading and writing measures, with the exception of weak associations between letter writing and the two measures of phonological awareness. For both letter knowledge measures (LNF and Letter Writing) and letter sound measures (LSF and Sound Spelling), there were strong correlations ($r = .72$
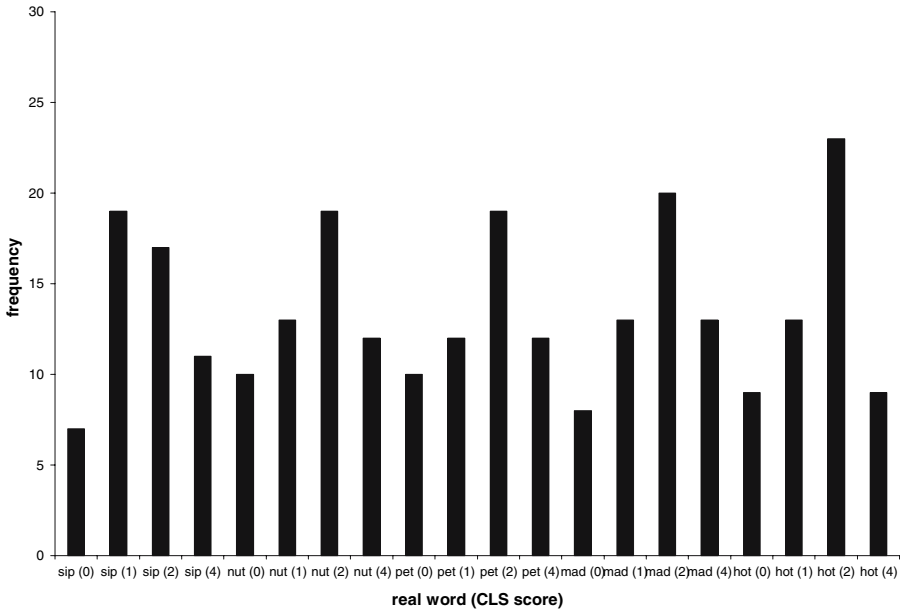
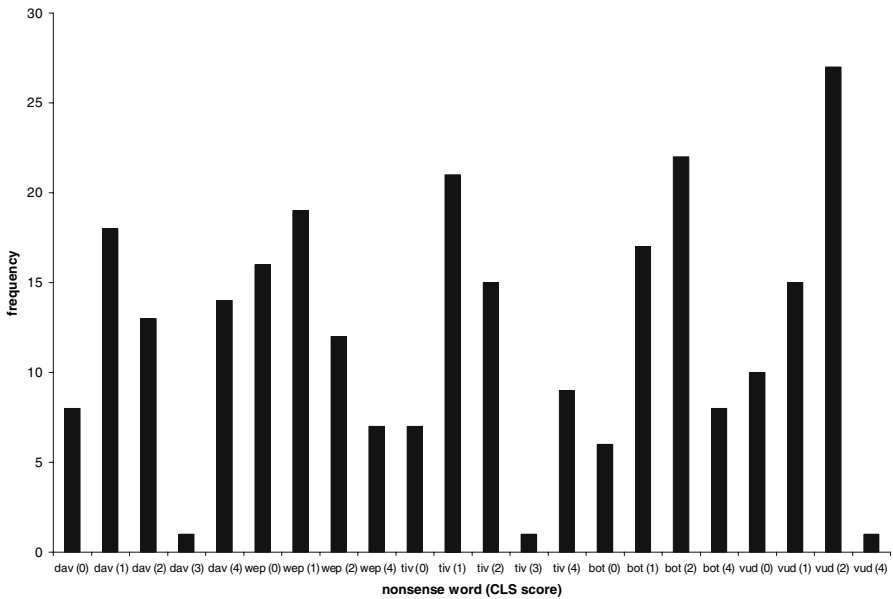**Fig. 3** Frequency of spelling score (CLS) for each real word

Fig. 4 Frequency of spelling score (CLS) for each nonsense word

Table 2 Correlations among writing and reading performance

		1	2	3	4	5	6	7	8	9
1	Letter Writing	–								
2	Sound Spelling	.79**	–							
3	Real Word Spelling	.43**	.65**	–						
4	Nonsense Word Spelling	.35*	.57**	.92**	–					
5	Letter Name Fluency	.72**	.66**	.50**	.54**	–				
6	Letter Sound Fluency	.60**	.77**	.81**	.78**	.66**	–			
7	Phoneme Seg.Fluency	.27	.41**	.58**	.62**	.39**	.57**	–		
8	Word Reading	.54**	.57**	.45**	.41**	.63**	.50**	.31*	–	
9	CTOPP	.24	.43**	.64**	.68**	.34*	.57**	.56**	.35**	–
10	TERA	.61**	.53**	.59**	.53**	.59**	.52**	.36**	.63**	.51**

Note: $**p < .01$; $*p < .05$

TERA Test of Early Reading Ability, *CTOPP* Comprehensive Test of Phonological Processing

and .77, respectively). Real Word Spelling and Nonsense Word Spelling also were strongly correlated ($r = .92$).

Predicting of beginning writing

Multiple regression analyses were conducted to determine the predictive relationship of reading and writing skills in kindergarten. The predictors for each model were selected by considering the developmental progression of writing development. The early reading measures were examined as predictors of each writing outcome. For writing models, successively more difficult writing abilities were entered so that letter writing was included in the prediction of sound spelling and word spelling and that letter writing and sound spelling were included in the prediction of word spelling (real and nonsense words). Variables were entered simultaneously to determine significant predictors in the presence of all other variables in the model. For all analyses, cases with standardized residuals greater than ±3.00 were identified as outliers and removed from analysis (one case was removed from the first model). Additionally, tolerance indices were examined to identify potential issues related to multicollinearity. All values were greater than .20. The results of regression models are presented in text; unstandardized (*b*) and standardized (*β*) coefficients and test of significance for the prediction of (a) Letter Writing, (b) Sound Spelling, (c) Real Word Spelling, and (d) Nonsense Word Spelling are presented in Table 3.

Letter Writing

The following predictors were entered to predict Letter Writing: LNF, LSF, PSF, CTOPP Composite, and TERA Reading Quotient. TERA was the only significant

Table 3 Prediction of writing and spelling

	B	β	t	p
Model 1: *Letter Writing*				
Letter Name Fluency	.113	.239	1.700	.0960
Letter Sound Fluency	.235	.260	1.873	.0670
Phoneme Seg. Fluency	−.076	−.124	−1.116	.2700
TERA	.364	.492	3.997	.0001
CTOPP	−.075	.071	−1.056	.2960
Model 2: *Sound Spelling*				
Letter Name Fluency	.044	.122	1.132	.2630
Letter Sound Fluency	.190	.269	2.453	.0180
Phoneme Seg. Fluency	.023	.048	.582	.5640
TERA	−.069	−.121	−1.148	.2570
CTOPP	.086	.200	2.066	.0440
Letter Writing	.401	.587	5.565	.0001
Model 3: *Real Word Spelling*				
Letter Name Fluency	.009	.024	.197	.0845
Letter Sound Fluency	.222	.293	2.157	.0370
Phoneme Seg. Fluency	.072	.150	1.558	.1270
TERA	.150	.263	2.107	.0410
CTOPP	.087	.201	1.685	.0990
Letter Writing	−.069	−.099	−.617	.5400
Sound Spelling	.277	.264	1.482	.1460
Model 4: *Nonsense Word Spelling*				
Letter Name Fluency	.005	.013	.100	.9210
Letter Sound Fluency	.274	.376	2.699	.0100
Phoneme Seg. Fluency	.071	.154	1.564	.1250
TERA	.116	.211	1.646	.1070
CTOPP	.120	.290	2.373	.0220
Letter Writing	−.058	−.086	−.524	.6030
Sound Spelling	.111	.110	.601	.5510

Note: *TERA* Test of Early Reading Ability Reading Quotient, *CTOPP* Comprehensive Test of Phonological Processing Phonological Awareness Composite

variable ($p < .0001$). These predictors explained 52.5% of the variance in letter writing (adjusted $R^2 = .475$; $p < .0001$).

Sound Spelling

To predict sound spelling, the same predictors plus Letter Writing were entered into a regression equation. Letter Writing, LSF, and CTOPP were significant predictors. These predictors explained 74.3% of the variance in Sound Spelling (adjusted $R^2 = .710$; $p < .0001$).

Real Word Spelling

To predict real word spelling, the same predictors plus Sound Spelling were entered into a regression equation. TERA and LSF predicted real word spelling. These predictors explained 69.4% of the variance in Real Word Spelling (adjusted $R^2 = .643$; $p < .0001$).

Nonsense Word Spelling

The same predictors were included in the model to predict Nonsense Word Spelling. CTOPP and LSF were significant predictors. These predictors explained 67.8% of the variance in Nonsense Word Spelling (adjusted $R^2 = .625$; $p < .0001$).

Discussion

As young children learn to write and spell, they master components that are the building blocks of writing. Similarly, reading skills, such as letter knowledge and letter-sound knowledge, and reading-related skills, such as phonological awareness, contribute to writing ability. The purpose of this study was to investigate the writing and spelling skills of children in kindergarten, including examining the concurrent relationship between basic writing and reading skills.

Writing in kindergarten

Children in kindergarten, especially by the end of kindergarten, have learned much about the English phonological and orthographic systems, and writing development follows a developmental progression. Students' ability to write alphabet letters represents one aspect of their orthographic knowledge, and this skill is one of the earliest skills students learn. In this group of children, the majority of students were able to write many alphabet letters. Students had difficulty with visually similar letters (e.g., *b* and *d*, *u* and *v*), letters with directional shifts (e.g., *z* and *s*), and less frequently occurring letters (e.g., *q* and *w*). Students also substituted upper and lower case letters. In some cases, children wrote the same upper or lower case letter but with one letter slightly smaller to indicate the lower case letter. Many of these letters that children were unable to write or made errors are included in letters cited by Graham, Weintraub, and Berninger (2001) as the letters that were most likely to be written illegibly by first grade children. Graham et al. reported that 5.5% of letters were not written at all, and students substituted upper and/or lower case letters ∼5% of responses. These kindergarten writers exhibited errors that were consistent with Graham et al.'s results. Similar patterns of errors in kindergarten and first grade suggest that certain letters may require additional instructional attention from teachers as these difficulties may continue into first grade.

In the predictive analysis, students' global reading knowledge, rather than the parallel letter-name knowledge measure, predicted letter writing. The TERA was used as a global reading assessment in the current study, and the TERA assesses

many aspects of reading, including letter knowledge, beginning word reading, concepts of print, and ability to gain meaning from printed material. However, the more specific measure of letter name knowledge was not a significant predictor of letter writing, despite relatively strong correlations. Hecht and Close (2002) reported that several aspects of emergent literacy (letter knowledge, vocabulary knowledge, phonemic awareness, and print concepts) predicted growth in invented spelling during an intervention. The TERA captures letter knowledge and print concepts, and the current results replicate Hecht and Close's findings. Students' broad knowledge of reading, as captured by the TERA, may indicate broader literacy knowledge or capture a range of experiences with early reading that are more important than a single discrete early reading skill for early writing development

Young children's ability to spell sounds also was examined, and students were less able to spell sounds than write alphabet letters. Students had more difficulty with vowel sounds than consonants, which is consistent with the letter sound knowledge literature in reading (McBride-Chang, 1999). The only vowel sound that children were typically able to spell was /a/, perhaps due to its prominent location in the alphabet. Substitution of vowels in reading and spelling is a common phenomenon, given the proximity of vowel sounds in the manner and place of articulation. An interesting phenomenon was the occasional tendency of students to be able to match the sound to a letter orally, but who were unable to write the letter or wrote an incorrect letter instead. This anecdotal finding was supported by the multiple regression analysis. Sound spelling was predicted by letter-sound knowledge, phonological awareness, and letter writing. Being able to spell a sound, or a word for that matter, necessitates being aware of the sounds in oral language, being able to link that sound to a letter, and being able to write the letter. As such, difficulty with letter-sound knowledge and writing letters may be the first indicator of potential problems in learning to spell. Further investigation is needed to examine whether children would be able to spell sounds if the letter writing requirement were eliminated by allowing students to spell using letter tiles or another response format. This would allow for more in depth analysis of the relationship between letter writing ability and beginning spelling ability under a variety of conditions.

Students were asked to spell both real and nonsense words in c-v-c patterns. Word spelling required students to be able to integrate different aspects of writing and phonological segmentation. Most students used an encoding strategy, in which they repeated the word, orally segmented the word into isolated phonemes, and wrote the letters that matched the sounds. As might be expected, letter-sound knowledge was a significant predictor both measures of word spelling. Similar to the findings of other research (Stage & Wagner, 1992; Uhry, 1999) and consistent with Ehri's (1997, 1998) stage model, more children were able to spell initial consonants, followed by final consonants and medial vowels. In several cases, students left a space for the consonant and vowel sounds they were unable to spell, indicating sufficient phonological segmentation and knowledge of spelling but developing acquisition of the letter-sound associations.

There were similar patterns of performance for the spelling of real and nonsense words and strong correlations between the two measures ($r = .92$). However, nonsense

word spelling (*M* 7.72 cls, *SD* 4.4) appeared to be a more difficult task than real word spelling (*M* 9.26 cls, *SD* 5.34). One possible explanation could be the demands on memory required during spelling. While spelling a word using an encoding strategy, the word must be held in working memory while segmentation and letter writing activities are conducted. Holding a nonsense word in memory may be more difficult because there is no match for the word in a student's lexicon. The students were able to ask that a word be repeated, but additional stress on working memory may account for slightly weaker performance when spelling nonsense words. Further investigation is needed to examine the role of working memory in learning to spell.

Implications for understanding beginning writing and spelling

Learning to write and spell begins early, and is the result of acquiring knowledge of the phonological and orthographic rules of written language. The students involved in this research participated in classrooms that integrated reading and writing instruction, and students were provided with many opportunities during the school day to read and write. While this study assessed four specific writing skills, many of the students were beginning to master the building blocks of writing. Despite the relatively young age of students in kindergarten, being able to write letters automatically and legibility has implications for children's future writing proficiency. Spelling and text production in later grades will require that students can automatically and legibly write alphabet letters and match sounds in words to associated spelling patterns. As students engage in authentic writing experiences (such as sentence and story writing), having the basic writing skills automaticized will help students to focus cognitive resources on spelling and composition, rather than writing the individual letters.

An additional implication of this study is related to students who demonstrated significant difficulty with early writing skills and who may be at risk for reading and/or writing disabilities. Only 26% of fourth graders in US are proficient writers (National Center for Educational Statistics, 2001), and learning to write, and consequently having difficulty learning to write, begins early. By the end of kindergarten, children are expected to be able to write their first and last name, write and name upper and lower case alphabet letters, and spell several words using invented and/or conventional spelling (Snow et al., 1998). There were at least five students who could be considered at risk compared to these standards. These students were unable to identify alphabet letters, produce sounds for the letters, or write letters. Most frequently, the letters in their first name were the only letters they were able to name and write. Clearly these students are at risk for failure in literacy and require more intensive instruction to meet the demands of first grade and beyond. Integrating reading and writing instruction could offer one opportunity to simultaneously address building proficiency in both of these important areas and prevent future literacy disabilities.

Limitations and directions for future research

There are several limitations of the current study that should be considered when generalizing these results and point to direction for further study. Because this was,

in some respects, a study designed to explore this area of children's writing development, only a small subset of writing skills were assessed and the skills were assessed over a relatively brief time period (several months). A multi-year longitudinal study is an important extension of this work. In addition, there was not a measure of students' ability to construct sentences or phrases in more authentic experiences or classroom based settings, which may provide more information on a child's writing ability. Classroom teachers reported that there were some children who could spell many words and write sentences, but more advanced writing skills were not assessed and offer a direction for the extension of this line of research. For example, students' ability to dictate sentences, to write in journals, or to respond to literature by writing could provide more information related to the other writing skills that students demonstrate. A similar limitation is the exclusion of assessment of fine motor skills, an area important for beginning letter writing, and working memory, which may be another important consideration in spelling ability (Stage & Wagner, 1992; Swanson & Berninger, 1996).

There are limitations of this study related to data analysis and spelling assessments. To avoid overwhelming and frustrating young writers, only five words were selected for both spelling tasks. This small number of items has an impact on reliability and increasing the number of items may increase the reliability estimates. A small number of items also allows for including only a small number of the consonant sounds within each word. A pool of potential words was developed, and words were randomly selected for inclusion in probes. However, certain consonant sounds were over-sampled, other consonant sounds were under-sampled, and the difficultly of consonants or vowel-consonant combinations was not controlled for. Further revision of the spelling items, increasing the number of items included in the assessment, and additional analysis of the consonants that are sampled in real and nonsense words are important considerations in studying similar students' spelling abilities in future studies.

Finally, an in-depth analysis of the role of classroom instruction in writing, specifically, was not conducted as part of this study. All teachers reported using a balanced curriculum and teaching writing, but there were differences across the four classrooms with respect to the amount of time spent writing and the explicitness of the writing instruction provided.

Conclusion

The purpose of this study was to examine kindergarten children's letter writing and beginning spelling abilities in relationship to their reading abilities. Descriptive analysis, correlations, and multiple regression analysis support that the building blocks of writing begin to develop during kindergarten and are related to students' knowledge of different aspects of literacy. Future studies examining these relationships longitudinally may provide additional information about writing development.

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