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Examining the contribution of handwriting and spelling to written expression in kindergarten children

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Abstract

In this study, we examined the development of beginning writing skills in kindergarten children and the contribution of spelling and handwriting to these writing skills after accounting for early language, literacy, cognitive skills, and student characteristics. Two hundred and forty two children were given a battery of cognitive, oral language, reading, and writing measures. They exhibited a range of competency in spelling, handwriting, written expression, and in their ability to express ideas. Handwriting and spelling made statistically significant contributions to written expression, demonstrating the importance of these lower-order transcription skills to higher order text-generation skills from a very early age. The contributions of oral language and reading skills were not significant. Implications of these findings for writing development and instruction are addressed.

Keywords

Handwriting; Kindergarten; Literacy; Spelling; Writing

Introduction

The ability to read and write is necessary to both succeed in school and the work place. In the last few years, researchers have gained much knowledge about reading and what skills contribute to successful acquisition of reading (National Reading Panel, 2000). Compared to evidence on beginning reading, relatively less evidence exists about the skills that contribute to beginning writing (National Commission on Writing for America's Families, Schools, and Colleges, 2003; Treiman, 1993; Troia, 2009). Hence, the primary purpose of this study was to examine the relations between two different transcription skills—namely handwriting and spelling—to written expression at the end of kindergarten.

Background and context

Learning to write

One of the most influential models of writing proposed thus far is the one developed to describe mature writers by Hayes and Flower (1980, 1987) and Hayes (1996). According to this model, mature writers go through a three-step process; they plan, they translate, and

they review or edit what they have written. These three processes were identified as adult, skilled writers thought out loud and explained how they composed. Importantly, these processes did not unfold in a linear sequence; rather they occurred recursively, interrupting and interacting with each other. Hayes and Flower specified sub-processes for the planning and reviewing phases in their model, but did not include subprocesses for the translating phase. Sub-processes for the planning phase include generating ideas to write about, setting goals for writing and organizing ideas such that writing goals are achieved. Sub-processes involved in reviewing include reading what has been written, editing and revising to ensure that the writer's goals have been met.

Since the original Hayes & Flower model (Hayes & Flower, 1980, 1987; Hayes, 1996), Berninger and her colleagues conducted a series of interdisciplinary, multivariate assessment studies with children to statistically model the development of written expression using an array of neuropsychological and language measures from first through ninth grades (Berninger, Yates, Cartwright, Rutberg, Remy, & Abbott, 1992; Berninger, Cartwright, Yates, Swanson, & Abbott, 1994; Berninger, Whitaker, Feng, Swanson, & Abbott, 1996). Using a variety of statistical techniques, their models demonstrated that for children in elementary school grades, the translation process involves two separate sub-components: text-generation and transcription. Text-generation refers to the process of translating thought into different levels of language (words, sentences, discourse) in memory, whereas transcription refers to "translating language representations in memory into written symbols" (p. 273, Berninger et al., 1994). Specifically, their model suggests that transcription skills, namely handwriting and spelling, were related to composing in each grade one through six, with handwriting explaining unique variance in length and quality ratings. Therefore, Hayes and Berninger (2009) recently proposed a revised developmental model of the cognitive processes of written expression that includes both text generation and transcription.

Whereas writing is difficult for most children (NAEP, 2007), learning how to write adult-like texts involves challenges related to both text generation and transcription (Graham & Harris, 2000). A lack of adequate foundational skills in either text generation or transcription are thought to constrain higher-order skills such as planning and revising; both of which are essential components of writing (e.g., Berninger, 2000; Graham, et al., 1997, Graham & Harris, 2000). Text generation can only evolve from the word to the sentence and discourse level after transcription skills become sufficiently established (Alamargot & Fayol, 2009). When children lack adequate transcription skills, they consciously devote their attention to forming letters and spelling words, taking away considerable attentional and cognitive resources from composing text (McCutchen, 1996). Thus, theoretically, there is good reason to believe that transcription skills (spelling and handwriting) are important elements and play a crucial role in early written expression.

Transcription skills and writing

Being able to spell words is an important step in the writing process where children demonstrate knowledge of phonological awareness skills and knowledge of letters and letter-sound correspondences to mimic conventional writing. For children in elementary school, the length and quality of their written compositions are strongly related to their spelling ability (Aram, 2005; Graham et al., 1997). In longitudinal and cross-sectional studies conducted with children from first through fifth grades, spelling was found to be the most consistent longitudinal predictor of writing (Abbott, Berninger, & Fayol, 2010; Graham et al., 2000), perhaps because having a precise representation of a word's spelling in memory, frees up resources that children could use during writing (Berninger et al., 2002).

In addition to spelling skills, another transcription skill that may influence children's writing ability is handwriting skills. Handwriting, particularly handwriting fluency (writing letters of the alphabet or copying text under timed conditions), has been shown to be causally related to writing (Graham, Harris, & Fink, 2000). Automatic letter writing has been shown to be the best predictor of both text length and text quality for elementary school children (Graham et al., 1997; Jones & Christensen, 1999). Evidence for the important role of handwriting to writing output includes studies that have examined the effects of transcription skills on written output when the demands of transcription skills are removed. Young children show an improvement in their ability to compose then they are asked to dictate their compositions to adults versus write them (Bourdin & Fayol, 1994; King & Rental, 1981; Reece & Cumming, 1996). Thus, reducing the processing and production demands of transcription skills has a positive influence on the quality and amount of written text children produced. Transcription skills demand even greater amount of resources for children than for adults, which is why McCutchen (1996) suggested that young emergent writers resort to a knowledge telling strategy when lower-level transcription skills are not yet automatic, leaving limited resources for higher-order composing processes in text generation.

Further evidence for the importance of transcription skills in writing comes from treatment studies. Converging evidence indicates that improving handwriting automaticity or spelling improves children's text generation and composing quality (Berninger et al., 1997, 1998; Graham, et al., 2000; Graham, Harris, & Chorzempa, 2002; Jones & Christensen, 1999). Jones and Christensen (1999) showed that instruction aimed at improving first grader's letter formation and handwriting fluency improved both handwriting and their ability to generate text. In addition, experimental studies have shown that improving spelling leads to improved writing (Berninger et al., 1998; Graham et al., 2002).

Being able to write requires more than transcription skills; it requires the coordination and integration of a myriad of language and cognitive skills (Hayes & Flower, 1980; Scott, 2005). The goal of the current study was to assess the impact of transcription skills on the ability to generate text in kindergarten children after accounting for a range of these cognitive-linguistic factors. Specifically, we accounted for oral language, reading, and cognitive skills, and student characteristics based on their theoretical importance.

Oral language, reading skills, and writing

Previous research has shown strong relations between oral and written language skills which reciprocally influence each other (e.g., Harrell, 1957; O'Donnell, Griffin, & Norris, 1967; Juel, 1988; Scarborough, 2001; Shanahan & Lomax, 1986; Shanahan, 2006). Although, oral (listening and speaking) and written (reading and writing) language systems have overlapping developmental patterns and do not develop in discrete stages (Berninger, 2000), writing comes later (Vygotsky, 1978) and is thus affected by oral language and reading skills (Shanahan, 2006). For example, oral vocabulary skills could play a role as young writers attempt to generate words to convey their ideas in writing. Reduced oral vocabulary or a lack of vocabulary would mean that a writer has fewer words or no words available in the translation process, possibly resulting in ideas that are less precise or simpler, or writing shorter text. Similarly, lack of adequate grammatical skills could impede sentence construction during writing. Additionally, the ability to remember and restate (imitate) sentences could reflect difficulty holding words or ideas coherently long enough in memory to allow conversion to paper. Recently, Hooper, Roberts, Nelson, Zeisel, & Kasambira-Fannin (2010) followed 65 African American preschoolers longitudinally in order to identify predictors of writing. Children's oral language abilities assessed at kindergarten was one of three critical predictors of narrative writing skills in grades 3–5. Therefore, in this study, we

included a broad range of potentially important oral language skills (i.e., vocabulary, syntactic knowledge, and sentence imitation).

Children's reading skills also have the potential to impact writing output (e.g., Abbott & Berninger, 1993; Berninger, et al., 1994). Researchers have reported connections between reading and writing (Abbott, et al., 2010) and significant correlations between reading-related and writing-related skills (Berninger, 2000; Shanahan & Lomax, 1986, 1988). Additionally, past research indicates that children who were poor readers also tended to be poor writers (Chall & Jacobs, 1983; Juel, 1988). This is likely because they share and draw upon some common underlying cognitive process (Berninger et al., 1994). Also because children's reading skills affect spelling; and in turn, spelling skills impact writing in elementary school children (e.g., Berninger, et al., 1992; Berninger, et al., 1994; Graham et al., 1997). The National Early Literacy Panel (NELP; Lonigan, Schatschneider, & Westberg, 2008) reported strong to moderate correlations between spelling and various reading skills ranging from .54 for decoding to .40 for phonological awareness and moderate correlations between spelling and writing ($r = .36$). Hence, reading measures used in this study included phonological awareness and word reading (decoding and sight words).

Student background characteristics and writing

In addition to the transcription, oral language, reading, and spelling skills just described, several factors including demographics (socio-economic status [SES], gender, and age) and cognitive (verbal and nonverbal IQ) variables have also been shown to impact writing. Typically, at school entry, children from low SES backgrounds who live in poverty, including many from minority backgrounds, have impoverished language skills and fewer home literacy experiences than students from middle and higher SES backgrounds and are more likely to have difficulties reading, spelling, and writing (Hecht, Burgess, Torgesen, Wagner, & Rashotte, 2000; Nicholson, 1997; Snow, Burns, Griffin, 1998).

There is also considerable evidence in regards to gender differences in the writing of school age children (e.g., Coker, 2006). Girls write more than boys (Malecki & Jewell, 2003; Swanson & Berninger, 1996), are more inclined to engage in literacy related activities and have more favorable attitudes toward reading and language than boys (e.g., MacMillan, Widaman, Balow, Hemsley, & Little, 1992; McKenna, Kear, & Ellsworth, 1995). In a recent epidemiological study of written language disorders, Katusic, Colligan, Weaver, & Barbaresi (2009) reported that boys are likely to be at least twice as affected as girls.

Age is another important factor that influences written language performance. Studies done with children in elementary grades show that older children write more than younger children and children in higher grades have an advantage over children in lower grades (e.g., Olinghouse & Graham, 2009; Puranik, Lombardino, & Altmann, 2008). Finally, research suggests that cognitive processes and skills impact the ability to reflect upon and produce written language (e.g., Hayes, 1996; Stanovich, Cunningham, & Freeman, 1984) and is consistently used as a control variable in studies examining writing (e.g., Abbott et al., 2010; Berninger et al., 1992, 1994).

Purpose of present study

Although children in kindergarten are increasingly expected to spell and write about experiences, stories, people, objects, or events (e.g., Common Core State Standards for English Language Arts & Literacy), overall there is little research on how writing develops in kindergarten. Most studies have been case studies (e.g., Clay, 1985; Sulzby & Teale, 1985; Sulzby, 1986) or have been conducted on a restricted sample, that is, in one classroom with a small number of children (e.g., Brock & Green, 1992; Sulzby & Teale, 1985). Using

a large sample of children from a large number of classes could extend results from small sample studies and improve generalization of findings. Furthermore, the scant research examining early writing skills has been done with slightly older children in first through third grades (see Edwards, 2003 for a review).

We attempted to address some of the gaps in current research by examining children's ability to compose a short text in response to a prompt. This task was designed to be similar to curriculum-based writing assessments (e.g., McMaster, Du, & Pétursdóttir, 2009). Given that children at this stage, resort to a knowledge telling approach to writing (McCutchen, 1996; Scardamalia & Bereiter, 1986), we chose a prompt that would be conducive to that style of writing. Namely, we asked them to tell us about what they had learned in kindergarten. In assessing the relationship between transcription skills to written expression, we controlled for several factors: oral language (including vocabulary, syntactic knowledge, and sentence imitation), reading skills (phonological awareness, decoding, word reading, and reading fluency), student background characteristics (age, gender, and SES), and cognitive skills (verbal and nonverbal IQ).

We hypothesized that similar to older students, the ability to write the letters of the alphabet and the ability to spell words could affect the ability to generate text in kindergarten. Further, we anticipated that early on, transcription skills may be even more important compared to later in the elementary years, as many children at this early stage are still developing spelling and letter writing skills; thus, transcription skills might constrain generation of text to an even larger extent. Specific research questions were as follows: (a) What are children in the spring of kindergarten able to express in writing? (b) Which skills uniquely contribute to kindergarten children's written expression?

Method

Sample and sites

Participants for this study were part of a larger longitudinal study that was a randomized control trial (RCT) examining the effects of individualizing student instruction within 14 public schools in a moderate sized city in north Florida. Schools were matched on percent of children receiving free and reduced price lunch, reading first participation, and third grade reading scores. The goal of this larger study is to learn the extent to which reading disabilities can be prevented through effective primary (Tier 1) core reading instruction. Spelling and writing instruction was not the focus of this intervention.

For the present study, resources did not allow testing for spelling and writing in all schools; thus we recruited 9 of the 14 schools that served students from a diverse range of socioeconomic status. Participants for the present study included a total of 242 kindergarten children from 21 teachers, ranging from one to five teachers per school. Demographic data for the participating students is presented in Table 1. Children qualifying for free and reduced lunch at these participating schools ranged from 8.2 to 92.6%. Children at these participating schools attended a full-day kindergarten program which included 90 min of core reading and language arts instruction using *Open Court* (Bereiter et al., 2002). *Open Court* provides systematic and explicit instruction in phonological awareness and phonics as well as vocabulary and comprehension. Across the classrooms we did not observe teachers using any writing or spelling instructional programs; nor did we observe models of Writing Workshop or computer-based instruction. The limited writing and spelling instruction we did observe consisted of either journal-writing with invented spelling or explicit grapheme-phoneme spelling strategies taught in relation to decodable words. These observations were consistent with informal reports from teachers about their own instruction.

Procedures

Three writing measures were collected in the spring of the kindergarten year. These measures were group administered in one session (in the same order described below) by project Research Assistants (RAs) with the classroom teachers present and assisting if needed. For the writing measures, RAs provided children primary-lined paper for each of the three tasks. Within the larger study, cognitive, oral language, and reading assessments took place in the Fall and Spring and were individually administered by trained RAs. Specifically, the cognitive, oral language, and phonological awareness assessments reported in this study were conducted during the Fall of kindergarten; whereas reading measures were administered during Spring.

Measures

Written expression—RAs introduced the task and attempted to orient children to task expectations through a brief group discussion. For example, The RAs said, “*You have been in kindergarten for almost a whole year. Today we are going to write about kindergarten. Let’s think about what you enjoyed about being in kindergarten. What did you learn in school? Did anything special happen to you in kindergarten?*”? The RAs were instructed not to write these questions or any student responses on the board. Next, the RAs instructed children to keep writing until they were told to stop. They said, “*If you get to a word you do not know how to spell, sound it out and do your best. I’m not going to help you with spelling today. If you make a mistake, cross out the word and keep writing. Don’t erase your mistake. Keep writing until I say stop*”. Students had 15 min to complete the task, however, some students stopped writing before the end and were not forced to continue. Soon after administering the writing task, the RAs read all of the writing samples to ensure that they could be understood. In case of doubt, either due to illegible writing or incorrectly spelled words, the RAs asked the students to read their samples. RAs wrote the word the children intended to write below the incorrect spelling or illegible word written by the student (see Figs. 2, 3).

Two variables widely used by researchers when measuring productivity in written language were calculated from children’s writing samples: (a) total number of words written (TNW) and (b) number of ideas expressed (Ideas). TNW was the number of words produced in writing by the subject and “is a consistently good predictor of holistic quality ratings of writing” (Scott, 2005, p. 264). One consistent finding across many research studies is that children who have difficulty writing produce shorter texts and hence TNW has been frequently used by researchers when measuring productivity in writing (e.g., Berman & Verhoevan, 2002; Houck & Billingsley, 1989; Mackie & Dockrell, 2004; Nelson, Bahr, & Van Meter, 2004; Nelson & Van Meter, 2002; Puranik, Lombardino, & Altmann, 2007; Scott & Windsor, 2000). Words or phrases that did not pertain to the prompt such as “The end” were not included when calculating total number of words. In rare instances, children wrote random words which were often copied from the spelling wall or what they saw around the classroom. In such cases, the child was not awarded any points and TNW was calculated as zero because in line with previous research TNW was used as a measure of productivity and a reflection of writing quality. We did not use a holistic or quality rating scale because of less than optimal validity and reliability of these scales for beginning writers. Obtaining holistic ratings may not be valid because the text produced by young children are short (McMaster & Espin, 2007) and because it is very difficult to obtain inter rater reliability.

Ideas were calculated to examine the number of unique propositions that children were able to express in writing. Given the age of the children, their compositions were very simple and often included a list or reasons why they liked kindergarten or a list of things they did in

kindergarten. Hence, we calculated an idea as the number of things/reasons the child provided about what they did or liked in kindergarten. It generally included a subject and a predicate (e.g., “I like kindergarten [1 idea] because we get to go to art [1 idea]). However, children were also given points when their ideas had a common subject and were joined by conjunctions (e.g., “And we get to go to housekeeping [1 idea] and eat snacks [1 idea]. I like kindergarten”). Sometimes children repeated themselves; as in the case of “I like kindergarten” in the above example. These repetitions were not counted as an idea.

Spelling—To assess students’ ability to spell single words, we administered a list of 14 words, used in prior literacy studies (e.g., Byrne & Fielding-Barnsley, 1989; Byrne et al., 2006). The list included decodable, sight, and nonsense words (e.g., *dog, man, plug, limp, tree, one, said, blue, come, went, ig, sut, frot, yilt*). RAs introduced the spelling task by pointing to the answer sheet and saying, “*I would like you to spell some words. Some are real and some are made-up words. If you don’t know how to spell a word, sound it out and do your best. First, I am going to say the word, then I will use it in a sentence, and then I will say the word one more time. Ready, begin. Remember to write the word next to the correct number on your answer sheet.*” Then the RA read each word, read the sentence with the word, and then repeated the spelling word (e.g., “Dog. I took my dog to the park. Dog.”). The nonsense words were repeated three times (e.g., *ig, ig, ig*).

The spelling task was scored on a 6-point scale using a modified version of the Tangel and Blachman (1992) spelling rubric. Given the age of the children, using conventional methods to assess spelling (correct vs. incorrect) would not be a valid; very few children would have scored points. Instead we used a developmental scoring system because it captures sophistication in children’s spelling attempts. Developmental scoring systems such as the one used in this study have been widely used in previous studies in kindergarten children (e.g., Treiman & Bourassa, 2000; Treiman, Kessler, & Bourassa, 2001). With this system children are given more points for representing phonological and orthographic features of the word. The possible scores ranged from 0 to 6 (highest). A 0 indicated a random string of letters or no response; 1 was a single phonetically related letter (e.g., for *dog* student wrote an *o* or a *g*); 2 was a correct first letter followed by other unrelated letters (e.g., *dib*); 3 was more than one phoneme that was phonetically correct (e.g., *do*); 4 was all letters represented and phonetically correct (e.g., *dawg*); 5 was all letters represented and phonetically correct, and the student made an attempt to mark a long vowel (e.g., *blew* or *bloo* for *blue*; only two words in the list, *blue* and *tree* had long vowels); 6 was the word was spelled correctly (e.g., *dog*). Children’s scores on the 14 target spelling words were aggregated to form a single spelling score.

Handwriting fluency—There is no consensus on how handwriting is best assessed. In studies with older children, various different methodologies have been used, ranging from having children copy a sentence containing all of the letters of the alphabet as many times as possible in 1 min (e.g., Olinghouse & Graham, 2009), having children copy a short story in 90 s (e.g., Berninger et al., 1992, 1994; Swanson & Berninger, 1996), having children write letters of the alphabet from memory in 15 s (e.g., Berninger & Rutberg, 1992) to having children write letters of the alphabet from memory in 60 s (Christensen, 2009; Hudson, Lane, & Mercer, 2005; Wagner et al., 2011).

In this study, we asked children to write all the letters of the alphabet in order, using lower case letters to measure how well children access, retrieve, and write letter forms automatically. RAs introduced the task by providing the following directions, “*We’re going to play a game that will show me how well and quickly you can write your abc’s. First, you will write the lowercase of small abc’s as fast and carefully as you can. Don’t try to erase any of your mistakes, just cross them out and go on*”. The RAs then demonstrated writing

lower case letters *a, b, c*. They also demonstrated making a mistake by writing “A” and crossing a line through it on the board. Finally, they ensured that everyone followed the instructions by asking the participants if they had any questions. Questions were appropriately addressed by the RAs and classroom teachers. The RA then continued with the directions, “*When I say ready begin, you will write the letters. Keep writing until I say stop. Ready, begin.*” After 60 s, the RA told the students: “*Stop and put down your pencils*”.

Traditionally, the rubric for the handwriting task relates mostly to penmanship and letter formation and is scored as either correct (score 1) or incorrect (score 0). We modified the scoring system to account for the age and developmental level of the participants in this study. Children’s responses were scored as 0 if a letter was missing, incorrect, or not recognizable; scored as .5 if the letter was recognizable but poorly formed or reversed; scored as 1.0 if the letter was well formed and recognizable. Students’ scores on the individual letters they wrote were aggregated to form a single handwriting fluency score.

Cognitive measures—The Kaufman Brief Intelligence Scale (K-BIT-2; Kaufman & Kaufman, 2001) is a brief, individually administered measure of verbal and nonverbal intelligence. We administered two subtests: Matrices (students look at six pictures for the answer to an analogy; e.g., *car goes with road; boat goes with ocean*; 46 items) as a measure of nonverbal intelligence and Verbal Knowledge (students look at a series of six pictures and when asked a question, point to the correct picture; 60 items) as a measure of verbal intelligence. The average reported reliability across all age groups is .90.

Oral language—The Picture Vocabulary subtest of the Woodcock Johnson, Third Edition (WJ-III; Woodcock, McGrew, & Mather, 2001) was used to assess expressive word knowledge. In this subtest, students name pictured objects which increase in difficulty. The WJ-III is a widely used, validated, and reliable assessment with a median reliability of .77. Additionally, two subtests of the Test of Language Development-Primary: Third Edition (TOLD-P:3; Newcomer & Hammill, 1997) were used to measure oral language. The TOLD-P:3 was designed to be administered to children between 4;0 and 8;11 years of age and can be used to identify children who are significantly below their peers in language proficiency and can determine children’s specific strengths and weaknesses in language skills. The Sentence Imitation (SI) subtest assesses a child’s familiarity with grammatical markers and word order. The examinee is required to repeat sentences of increasing length and difficulty spoken by the examiner (e.g., “I went home”, “Her friends walked to school”). The Grammatical Completion (GC) measures the production of language by testing the child’s ability to use various English morphological forms. The examiner reads an unfinished sentence which the examinee is required to complete. For example, “Here is a cat. Over there are four more _____.” Average reliability for the both subtests across all age groups is .90.

Phonological awareness—Two subtests from the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, & Rashotte, 1999) were used to measure children’s phonological awareness skills. The CTOPP Elision subtest (20 items) requires the student to listen to the word and then pronounce the word without a segment, for example, “Say popcorn; say it again without corn. Say cup; say it again without/c/.” The Blending subtest (20 items) requires the student to listen to a series of real words that are spoken in segments and earn a point for each word they blend correctly (e.g., /num//ber/or/j/u//m//p/). For both subtests, internal consistency exceeds .80; test–retest coefficients range from .70 to .92.

Reading measures—Two subtests of the standardized norm-referenced WJ-III (Woodcock, McGrew, & Mather, 2001) were used: Word Identification and the Word

Attack subtest. The Word Identification subtest consists of 76 increasingly difficult words; reliability is .91; concurrent intercorrelations with the Word Attack and Passage Comprehension subtest are .80 and .79, respectively. The Word Attack subtest measures the ability to decode pseudowords of increasing difficulty (32 items); reliability is .87. Using the WJ-III compuscoring program, scores on these two subtests are combined to create a Basic Reading Standard Score (BRSS).

Reliability

For the handwriting and spelling measures, inter-scorer agreement was established through a four-step process. First, we created a scoring rubric for the two measures. Second, the RAs were trained to use the rubric with a small subset of children. Once they reached 100% agreement, then each individually scored the writing samples. Third, 15% of the entire data set was randomly selected to calculate inter-rater reliability. For the handwriting measure, inter-rater reliability was 99% and Cohen's kappa was .98; for spelling inter-rater reliability was 94.8% and Cohen's kappa was .92. Finally, all discrepancies in scoring across the entire sample were resolved through discussion.

For the writing task, the first author and two trained RAs discussed the scoring rules for the writing variables and used the first 40 writing samples to practice and discuss any issues with scoring. After the initial discussion, the two RAs independently scored all of the written narratives. To ensure uniformity in scoring, approximately 20% ($n = 48$) of the written samples were chosen to obtain a measure of inter-rater reliability. Inter-rater reliability was calculated for the two writing variables scored and was 88 and 85% for TNW and Ideas, respectively. All discrepancies in scoring across the entire sample were resolved through discussion.

Results

Data analysis

Analyses were first directed at examining the distributional properties of the writing measures. An examination of the distributional properties of the variables (e.g., skew) did not reveal any major departures from normality, and inspection of histograms did not reveal the presence of any obvious outliers for the writing and reading measures except for TNW. Cases with standardized residuals greater than +3 were identified as outliers and removed from the analysis (four cases were removed). Although the larger study was a RCT that compared an intervention and control condition, not surprisingly, the intervention was not related to spelling or writing and there were no significant differences between the experimental and control groups on the spelling or writing measures. Therefore, data were collapsed and analyzed as a group.

Writing in kindergarten

Table 2 contains the descriptive statistics for cognitive, oral language, reading, and writing measures for the entire sample. The means and standard deviations for cognitive, oral language, and reading measures appeared to be within normal limits when compared to national norms. This performance is notable, given that we had a diverse sample of students, a majority of whom were receiving free and reduced lunch (FARL). On the handwriting task, only one child was able to write all 26 letters in the allotted time; most wrote between 9 and 17 letters. Seven children obtained a score of 0. Children appeared to spell decodable ($M = 18.38$, $SD = 7.93$) and sight words ($M = 17.23$, $SD = 7.25$) equally well. Pseudowords ($M = 13.41$, $SD = 6.95$) were more difficult to spell than decodable or sight words. There was a range of performance on the spelling task with some children spelling words correctly and some children unable to write any letters. Most children were able to use initial and/or

final letters to spell words. The easiest word to spell was *dog* and the most difficult word was *said*.

As shown in Table 2, wide variability was noted in children's ability to express ideas; with some children being unable to express a single idea in writing to one child who expressed 24 ideas. Large variability was noted for TNW as well, with some children able to write only a few words to one child writing 90 words. Figures 1, 2, 3 contain samples of a poor, average, and good writer based on the number of ideas generated and total number of words produced in writing. As can be seen in Fig. 1, the student was unable to produce a single real word through writing. Instead this child produced a series of unrelated letters when asked to write about experiences in kindergarten. In contrast, the average writer (Fig. 2) had 23 TNW and four ideas whereas the writing of a good writer (Fig. 3) contained 44 TNW and nine ideas.

Table 3 contains the correlations among cognitive, oral language, reading, and writing measures. All correlations were statistically significant ($p < .001$) with the exception of the correlation between handwriting fluency and vocabulary. Correlations between TNW and spelling, handwriting fluency, word reading, decoding, and reading fluency were in the moderate to strong range whereas correlations between TNW and verbal and nonverbal IQ, oral language, and phonological awareness measures were moderate to weak. A similar pattern of correlations was noted between Ideas and other cognitive-linguistic variables. Handwriting showed a moderate to strong relation to spelling and moderate to weak correlation to verbal and nonverbal IQ, reading, and oral language measures. Spelling showed a moderate to strong relationship with oral language (TOLD-SI), phonological awareness, and reading measures. Correlations between spelling and verbal and nonverbal vocabulary, oral language (TOLD-GC), and vocabulary were moderate to weak.

Predictors of writing

Multiple regression was used to examine the joint and unique contributions of cognitive, language, reading, and transcription skills to written expression (TNW). Given that TNW and Ideas, our two measures of writing, were strongly correlated ($r = .94$), the regression analyses was only conducted for TNW and given the high correlations between the CTOPP blending and elision scores ($r = .70$), for the sake of parsimony, the scores were averaged to form the CTOPP-PA score. Prior to performing the regression analyses, tolerance indices were examined to identify potential issues related to multicollinearity. An examination of the variance inflation index (VIF) showed no multicollinearity in the data. To examine whether handwriting fluency and spelling made a significant and unique contribution to the prediction of students' writing performance, we conducted our hierarchical regression analysis in two steps.

We first entered the control variables into the equation as a block. These control variables were age, gender, FARL, cognitive, oral language, and reading measures. The results showed that the control variables accounted for a substantial proportion of variance in the writing outcome; $F(10, 221) = 10.19$, Adjusted $R^2 = .29$, $p < .000$. Specifically, the following variables accounted for a significant amount of unique variance: age (2.8%), FARL (1.8%), and word reading skills (BRSS; 4.2%).

Next, we entered handwriting fluency and spelling as a block to determine whether they accounted for a statistically significant increase in amount of variance after accounting for the control variables. As predicted, handwriting and spelling added significant unique variance to the prediction of writing, explaining an additional 9.6% of the variability ($DF = 17.86$, Adjusted $R^2 = .386$, $p < .000$) after accounting for age, gender, SES, cognitive, oral language, and reading abilities. Once all of the variables were entered into the analysis, three variables accounted for unique variability above the contributions of other measures (see

Table 4). Handwriting accounted for approximately 4.1% unique variance, spelling accounted for 2.3% unique variance, and FARL (proxy for SES) accounted for 2% unique variance for the writing outcome.

Discussion

Research by Berninger and her colleagues (Berninger, 1999; Berninger et al., 1992, 1994; Berninger & Swanson, 1994) support the proposition that the translating process of writing in children consists of text generation and transcription skills. In elementary school children, transcription skills such as handwriting and spelling play an important role in text generation. Transcription skills could also play an important role in text generation for beginning writers, but this proposition has not been tested empirically before. In this study, we specifically examined the relationship between two transcription skills (handwriting and spelling) and written expression in kindergarten children. We did this after first controlling for three oral language skills (including vocabulary), three reading skills (phonological awareness, decoding, and word reading), three student characteristics (SES, gender, and age), and two cognitive (verbal and nonverbal IQ) factors which also account for variance in young children's writing performance.

Learning to write begins early. Children in kindergarten exhibited a range of competency in spelling, handwriting, written expression, and in their ability to express ideas. By the end of kindergarten, children were able to write an average of 10 lower case letters fluently under timed conditions with most children writing between nine and 17 letters. Additionally, children were able to spell words using initial and final letters as well as spell several words correctly. As expected, children did better on spelling words with simple letter sound correspondences than spelling words with final blends (e.g., yilt). A majority of the children were able to respond to the prompt and express ideas in writing. Per Common Core Standards, children in kindergarten are expected to produce complete sentences in writing and to write about experiences, stories, people, objects, or events. In this study, children exhibited a range of performance when writing about their experiences in kindergarten, with some exceeding and some falling behind these Common Core standards. Consistent with McCutchen's (1996) and Scardamalia & Bereiter's (1986) description, kindergarten children show a proclivity to use a knowledge telling strategy when writing. As can be seen in the examples of the average and good writers (Figs. 2, 3), they tended to write a list of things they liked or did in their classrooms. Children also appeared to use letter sound knowledge to spell words they did not know when expressing ideas in writing (e.g., *speshul* for special in Fig. 3).

The findings from this study support the theoretical proposition that handwriting and spelling are important ingredients in early writing development. After first controlling for an array of cognitive-linguistic variables and student background characteristics, we found that handwriting, spelling, and FARL status made unique and significant contributions to written expression. These three measures accounted for an additional 4.1, 2.3, and 2% of unique variance in the total number of words, respectively. Writing for young emergent writers is dependent on their ability to form and write letters fluently and spell words. The importance of handwriting and spelling is consistent with research in writing for older (e.g., elementary, middle and junior high school) students (Berninger et al., 1992, 1994, 1996; Graham et al., 1997; Wagner et al., 2011) and is consistent with expert contention that "writing development is dependent on the mastery of transcription skills" (Graham & Harris, 2000, p. 10).

Results of our study highlight the important role of handwriting for beginning writers. Of the three variables that made a unique contribution to writing, handwriting accounted for the

most amount of unique variance. Handwriting requires the integration of orthographic knowledge and the physical act related to form the letters of the alphabet on paper, especially in beginning writers. As one kindergartener responded when asked if he would help mow the lawn, "I had to write two pages at school today and my hands hurt". Whereas the physical demands of writing are real especially for beginning writers, past research indicates that poor letter writing fluency is more a reflection of weak letter knowledge rather than due to motor difficulties (Abbott & Berninger, 1993). Additionally, letter writing is an excellent indicator of orthographic knowledge (Puranik & Apel, 2010) and orthographic knowledge in turn has been shown to contribute to writing (Kim, 2010, Ouellette & Sénéchal, 2008). Lack of letter knowledge and poor orthographic knowledge would make text production a difficult process.

The results of this study emphasize the importance of spelling skills for kindergarten children. The correlations between spelling and total number of words written in this study ($r = .55$) were consistent with correlations reported for 1st graders ($r = .54$) by Abbot et al. (2010). However, these correlations are higher than those reported by Berninger et al. (1992) and Graham et al. (1997) for children in first through third grade (both $r = .22$). It is plausible that spelling constrains the ability to generate text more in the lower grades than in the higher grades. Both Graham et al. and the Berninger et al. reported aggregate correlations; no separate grade-wise correlations are available. Given that kindergarteners are beginning spellers, they are likely to have less precise representations of a word's spelling which taxes them to a greater extent during writing. Some evidence for this fact comes from Graham et al., who found that the paths from both handwriting and spelling to compositional fluency (amount of words written under a timed condition) were significant in the primary grades (first through third), but the path from spelling was not significant in the intermediate (fourth through sixth) grades.

Despite moderate correlations, the regression analysis showed that reading and oral language did not contribute to writing after accounting for handwriting and spelling skills. Perhaps the contribution of reading to writing may largely overlap with transcription skills at this beginning stage of writing. Similarly, perhaps oral language skills may not play a large role in writing during this phase as the expectations for writing are few. The contribution of oral language skills to writing may change with development analogous to the contribution of oral language skills to reading that appear to get stronger as children get older and read for meaning. Oral language skills may play a greater role in writing in the higher grades when the expectations on writing increase as opposed to lower grades where children appear to be consumed by the demands of lower level transcription skills.

Finally, the result of the regression analysis converges with theoretical frameworks suggesting that writing requires the coordination of several cognitive-linguistic skills (Hayes & Flower, 1980, 1987; Scott, 2005). Despite significant correlations among measures, contributions of the control variables (age, gender, cognitive, oral language, and reading skills) were not individually significant (with the exception of FARL), however, together they accounted for a substantial proportion of variance (29%) in the writing outcome. These findings underscore the complex nature of writing development.

Limitations and future directions

There are several strengths of this study including that we had a large and diverse sample of students who attended nine schools and 21 classrooms and who all received the same core reading curriculum. We included a comprehensive battery of cognitive, oral language, and reading measures. Yet, as with any study, some limitations must be mentioned. Most of our participants attended high poverty schools with a greater percentage of children on free and

reduced lunch. How these findings generalize to the population at large is thus unknown. Whereas the fact that all students received the same core reading curriculum, and that the curriculum had a strong code-focus, is a strength of this study, it raises the question regarding the possible role of the curriculum in affecting the findings of this study. It is possible that the findings of this study may not generalize to other curriculum programs using less systematic and explicit reading instruction. A future study examining the effect of classroom instructional practices and their impact on writing performance would be a good extension of this research. Another related extension would be to learn whether student performance on the writing task would be enhanced with more prior practice. In particular, although teachers and RAs were present during testing and answered students' questions, children may have performed differently if our assessment protocol had included a practice component. It is remarkable that despite including a large number of predictor variables, we were only able to account for a moderate proportion of variance in writing. This suggests the importance of investigating other potential factors that could contribute to writing. For example, we did not measure fine motor skills, which could very likely be an important contributor to writing and we did not measure orthographic and morphological awareness, two other skills that have been shown to be important to spelling (Kim, 2010; Ouellette & Sénéchal, 2008) and could affect writing expression. Including these skills when examining writing would be another avenue for future research.

Implications

The results of this study clearly show that lower order transcription skills of letter writing and spelling impact writing expression from a very young age. Previous research shows that some children struggle with becoming fluent handwriters throughout schooling (Berninger, 2008) and that some children, especially those with written language deficits may continue to struggle with spelling throughout their school years (Bishop & Clarkson, 2003; Mackie & Dockrell, 2004; Nelson & Van Meter, 2002; Puranik et al., 2007; Treiman, 1997), which in turn compromises their ability to compose text. Past research indicates that instruction aimed at improving handwriting fluency and spelling has a positive effect on children's writing (Berninger et al., 1997, Graham et al., 2000; Graham et al., 2002, Jones & Christensen, 1999) and that instruction aimed at teaching reading only does not guarantee children's mastery of spelling (Foorman, Chen, Carlson, Moats, Francis, & Fletcher, 2003). Conversations with school personnel indicated that no writing curriculum was in place in the schools where this research was conducted. Informal observations indicated that writing was not a predominant part of the reading program. Also, large variability was noted among and within schools in the amount of time spent on writing. However, overall, there was little writing instruction. Thus, all students might benefit from greater attention to screening for transcription problems and ongoing teaching of transcription skills to ensure that they are meeting grade-appropriate writing requirements. Increasing fluency in these transcription skills may help young emergent writers focus their cognitive-linguistic resources to higher-order writing tasks of text production. Integrating lower order transcription skills with higher order skills such as composing, which was shown to be promising with older children, could be beneficial even for children in kindergarten (Berninger 2008).

Another important implication of this study is identification of children who may be at risk for writing difficulties. We currently do not have a consistent definition for what constitutes a writing disability. However, some students could be considered at risk using current Common Core kindergarten standards as benchmarks. According to these standards, by the end of kindergarten, children are expected to write upper and lower case letters independently. Yet, there were seven students who did not write a single letter and over 40 students who wrote less than five letters in the handwriting fluency task. Although the numbers varied for each specific word that children were asked to spell, about 5–20% of

children either did not respond or wrote a random string of letters to spell words. In this study, the students were asked to write about their experiences in kindergarten, but there were some students who were unable to write a sentence. Clearly, these students would require greater teacher support and writing instruction to be prepared to meet academic demands in first grade.

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Figure 1.
Writing sample of a poor kindergarten writer

Figure 2.
Writing sample of an average kindergarten writer

Figure 3.
Writing sample of a good kindergarten writer

Table 1

Demographic information for participants

	Mean (SD)	Range
Age at testing (years)		
Fall (<i>M</i> / <i>SD</i>)	5.23 (.38)	5.0–7.0
Age at testing (years)		
Spring (<i>M</i> / <i>SD</i>)	5.85 (.46)	5.08–7.08
% Free and reduced lunch		
Yes	61.8%	
No	38.2%	
Race		
White	32.4%	
Black/AA	64.7%	
Asian	1.3%	
Gender		
Male	56.7%	
Female	43.3%	

N = 238

Table 2

Means and standard deviations for cognitive, oral language, reading, and writing measures

Construct	Measure	Mean	SD
Written Expression	TNW	14.37	15.62
	Ideas	3.32	3.55
Spelling	Spelling	49.01	20.38
Handwriting	Handwriting fluency	9.91	6.08
Cognition	KBIT (non verbal) ^a	92.08	14.85
	KBIT (verbal) ^a	92.24	11.80
Oral language	Picture Vocabulary ^a	99.68	9.86
	TOLD-SI ^b	8.26	8.26
	TOLD-GC ^b	8.10	8.10
Phonological awareness	CTOPP-Elision ^b	9.01	2.61
	CTOPP-Blending ^b	10.41	2.4
Reading	BRSS ^a	106.76	14.37

TNW, total number of words; KBIT(non verbal), Kaufman brief intelligence scale-2: matrices; KBIT (verbal), Kaufman brief intelligence scale-2: picture vocabulary, Woodcock Johnson, third edition (WJ-III); TOLD-SI/TOLD-GC, test of language development: third edition: sentence imitation/grammatic completion; CTOPP-Elision/CTOPP-blending, comprehensive test of phonological processing: elision/blending; BRSS, Woodcock Johnson, third edition (WJ-III): word attack and word identification

^aStandard score mean is 100, SD $\pm$ 15

^bStandard score mean is 10, SD $\pm$ 3

Table 3

Correlations among cognitive, oral language, reading, and writing measures

	1	2	3	4	5	6	7	8	9	10	11	12
1. TNW	–											
2. Ideas	.94	–										
3. Handwriting fluency	.44	.43	–									
4. Spelling	.55	.55	.48	–								
5. KBIT (non verbal)	.27	.29	.18	.36	–							
6. KBIT (verbal)	.28	.30	.23	.32	.47	–						
7. Picture vocabulary	.23	.25	.12*	.32	.68	.37	–					
8. TOLD-SI	.40	.40	.28	.44	.58	.36	.58	–				
9. TOLD-GC	.36	.35	.22	.33	.60	.31	.56	.65	–			
10. CTOPP-elision	.42	.41	.17	.46	.53	.41	.49	.59	.55	–		
11. CTOPP-blending	.38	.39	.23	.51	.42	.32	.44	.55	.41	.70	–	
12. BRSS	.44	.45	.24	.62	.38	.36	.45	.50	.38	.61	.62	–

TNW, total number of words; KBIT(non verbal), Kaufman brief intelligence scale-2: matrices; KBIT (verbal), Kaufman brief intelligence scale-2: verbal knowledge; picture vocabulary, Woodcock Johnson, third edition (WJ-III): picture vocabulary; TOLD-SI/TOLD-GC, test of language development: third edition: sentence imitation/grammatic completion; CTOPP-elision/CTOPP-blending, comprehensive test of phonological processing: elision/blending; BRSS, Woodcock Johnson, third edition (WJ-III): word attack and word identification

* NS, all other correlations significant at $p < .001$

Table 4

Predictors of written expression (TNW)

	Step 1					Step 2				
	B	SE	β	t	p	B	SE	β	t	p
Intercept	-76.63	22.34		-3.4	.001	-27.88	23.08		-1.23	.23
Age	8.19	2.75	.19	2.98	.003	1.97	2.87	.05	.70	.48
Gender	-1.96	1.89	-.06	-1.04	.30	-.76	1.78	-.02	-.43	.67
FARL	5.18	2.15	.16	2.41	.02	5.49	2.01	.17	2.73	.007
KBIT (non verbal)	-.07	.09	-.06	-.72	.47	-.11	.09	-.10	-1.23	.22
KBIT (verbal)	.15	.09	.11	1.69	.09	.08	.08	.06	.94	.35
Picture Vocabulary	-.22	.13	-.13	-1.60	.11	-.15	.13	-.07	-1.18	.24
TOLD-SI	.63	.46	.12	1.37	.17	.37	.43	.09	.88	.38
TOLD-GC	.58	.44	.12	1.30	.19	.46	.41	.14	1.12	.26
CTOPP-PA	1.06	.61	.15	1.66	.09	.92	.57	.10	1.63	.11
BRSS	.35	.09	.31	3.65	.000	.11	.10	.07	1.07	.28
Handwriting fluency						.62	.16	.24	3.86	.000
Spelling						.18	.06	.23	2.89	.004

FARL, free and reduced lunch; KBIT(non verbal), Kaufman brief intelligence scale-2: matrices; KBIT (verbal), Kaufman brief intelligence scale-2: verbal knowledge; picture vocabulary, Woodcock Johnson, third edition (WJ-III); picture vocabulary; TOLD-SI/TOLD-GC, test of language development: third edition: sentence imitation/grammatic completion; CTOPP-PA, blending and elision; BRSS, Woodcock Johnson third edition (WJ-III) word attack and word identification