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Examining Alphabet Writing Fluency in Kindergarten: Exploring the Issue of Time on Task

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Abstract

Curriculum-based measures (CBMs) are necessary for educators to quickly assess student skill levels and monitor progress. This study examined the use of the alphabet writing fluency task, a CBM of writing, to assess handwriting fluency—that is, how well children access, retrieve, and write letter forms automatically. In the current study, the alphabet writing fluency task was administered at both the beginning and end of the kindergarten school year. Scores were calculated for two time increments, 15 and 60 s, and compared with an alphabet writing, untimed task. All three scores were compared with criterion measures of writing, including both standardized writing assessments and compositional CBMs of writing. Results indicate that measuring alphabet writing fluency using either timed tasks (15- or 60-s) at the beginning or the end of kindergarten may not be a useful or valid endeavor. In contrast, the alphabet writing, untimed task measure showed stronger correlations to criterion writing measures in comparison with the 15- and 60-s alphabet writing fluency tasks and also showed greater concurrent and predictive validity. Limitations and further areas of study are discussed.

Keywords

alphabet writing fluency, curriculum-based measures, emergent literacy, handwriting fluency, transcription, writing

Literacy, the ability to read, write, and speak English at adequate levels of proficiency, is necessary to successfully function in school, on the job, and in society (Snow, Burns, & Griffin, 1998). That is why it is alarming when data from the most recent National Assessment of Educational Progress (National Center for Education Statistics, 2012) indicate that only 30% of students in Grades 8 and 12 performed at or above the "proficient" level (defined as solid academic performance) in writing. Children with early learning difficulties in areas related to literacy continue to experience problems with reading and writing throughout school and into adulthood (e.g., Maughan et al., 2009; Protopapas, Sideridis, Mouzaki, & Simos, 2011). Therefore, it is imperative to assess and identify problems with writing beginning in very early grades before deficits become stable and are resistant to intervention efforts. The primary purpose of the present study is to examine the validity of a measure of handwriting fluency, a transcription skill that is considered important to the writing process, at the kindergarten level.

Components of Fluent Writing for Beginning Writers

Current theory on writing development draws from the seminal work of Hayes and Flower (1987) with adult writers, whose model of writing specified three key writing processes: planning, translating, and reviewing/revising. Since that time, researchers (e.g., Berninger, 1999, 2009; McCutchen, 2006) have further expanded on this model for beginning writers. Berninger (1999) examined the processes involved in the development of compositional skills and identified two crucial processes in elementary school children: text generation and transcription. Text generation is a higher-level process in which ideas are translated into language representations in memory (Berninger et al., 1992). Children are able to generate ideas for writing by generalizing oral language; however, they must learn new processes to transcribe mental representations into written language.

Furthermore, development of the transcription and text generation components of writing occurs at multiple levels of language, including subword, word, sentence, and

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discourse levels (Whitaker, Berninger, Johnston, & Swanson, 1994). At the subword or letter level, children develop awareness of features of writing: letter names, letter shapes, and other early conventions of writing such as linearity (Puranik & Lonigan, 2011). At the word level, children develop awareness of the alphabetic principle and phoneme–grapheme relationships, and begin to encode letters and sounds to spell words (Ehri, 1986). As children's awareness of writing conventions increases, they begin to separate words with spaces and thoughts with punctuation (Tolchinsky, 2006), and thus, they begin to generate text at the sentence level. As they continue to gain content knowledge and knowledge of different genre structures, they begin to produce longer units of writing at the paragraph/discourse level (McCutchen, 2006). Therefore, transcription is a foundational component of text generation at all levels of language from subword to discourse (Berninger et al., 1992).

Constraints on Writing

A longitudinal study of students from first through fourth grade showed that students who are poor writers at the end of first grade remain poor writers through fourth grade (r = .38; Juel, 1988), indicating that writing skills and deficits are relatively stable from a very early age. As mentioned, transcription is a lower-level writing skill that is necessary for children to produce written language (Berninger et al., 1992). Transcription is generally considered to have two separable components, handwriting fluency and spelling. Both require a great deal of cognitive and physical effort for a child in the developmental stages of writing (Berninger, 1999). The combination of these skills enables the complete translation of language representations in memory to representations in written form. Research has shown that developing writers have a larger number of ideas of what they would like to write than what they are able to physically produce (Hayes & Berninger, 2009). Their ability to write down their many ideas is constrained by lack of fluency in transcription skills.

Berninger et al. (1992) researched the relation between the lower-level skill of handwriting and the higher-level skill of composition with first-, second-, and third-grade students. Their results showed that both lower-level developmental skills (e.g., alphabet letter production, orthographic coding, orthographic-phonological mapping, neuromotor function, and visual-motor integration) and the lower-level writing skill of transcription provided a critical foundation in the beginning stages of writing. The development of these skills affected the degree to which higher-level composition skills were achieved in subsequent stages of writing development.

Graham, Berninger, Abbott, Abbott, and Whitaker (1997) further demonstrated the contribution of lower-level transcription to text generation for compositional writing. Handwriting fluency and spelling were investigated separately to determine their relation to compositional fluency and quality. Handwriting fluency was found to have a significant effect on both length and quality of composition for students in primary and intermediate grades. Spelling was also found to have direct effects on the length of composition in the primary grades and on the quality of composition in the intermediate grades. In beginning writers, handwriting fluency appears to have a significant effect not only on the ability to compose text (Puranik & Al Otaiba, 2012) but also on spelling skills (Kim, Al Otaiba, Puranik, Folsom, & Greulich, 2014). For example, Puranik and Al Otaiba reported that handwriting and spelling made statistically significant contributions to written expression after accounting for cognitive, oral language, and reading skills in a large group of kindergarten children. Similarly, Kim et al. showed that handwriting fluency was moderately related to spelling in kindergarten children after accounting for phonological awareness, letter name and letter sound fluency, and vocabulary.

With these relationships in mind, Graham et al. (1997) developed an intervention designed to provide students with training specifically in transcription. First-grade students were instructed to practice naming and writing letters, skills intended to improve handwriting fluency. As a result, these students showed improvement in handwriting fluency. Students also showed improvement in compositional fluency. Another group of students in second grade received instruction focusing specifically on the transcription element of spelling. This instruction, which specifically included teaching phoneme mapping onto one- or two-letter units and modeling of alternative units for sound spelling corresponding in words, improved the students' abilities to spell trained words, write longer compositions, and correctly spell more words within compositions.

These results led Berninger (2002) to consider transcription, a foundational component of text generation affecting all levels of language from subword to discourse and a fundamental process to each student's ability to generate text. Writing instruction specifically targeting the lower-level skills of handwriting fluency and spelling can directly influence students' abilities to compose text, affecting both length and quality of compositions (Graham et al., 1997).

Handwriting Fluency

Fluency—how quickly and accurately a task can be completed—is considered an important component of good literacy skill (Ritchey et al., 2016). Fluency in reading is generally assessed by having children read letter names, produce letter sounds, or read single words as quickly and accurately as they can in a specified period of time. In curriculum-based reading measures, such as the *Dynamic Indicators of Basic Early Literacy Skills* (DIBELS; Good & Kaminski, 2002) and AIMSWeb (Howe & Shinn, 2002), children are shown a page with letters, words, or nonsense

words and are required to produce letter names, segment letter sounds, or read the words and nonsense words as quickly and accurately as possible in 1 min. Similar to fluency in reading, fluency in writing is also considered an important ingredient to overall scholastic success.

Handwriting fluency refers to how well children access, retrieve, and write the letters of the alphabet reliably and automatically (Berninger & Fuller, 1992; Ritchey et al., 2016). As discussed, research indicates that handwriting fluency constrains children's ability to compose text (e.g., Berninger et al., 1992; Graham et al., 1997). This constraint begins as early as kindergarten (Puranik & Al Otaiba, 2012) and continues at least through ninth grade (Graham, Berninger, Weintraub, & Schafer, 1998). Furthermore, Berninger et al. (1997) have shown that training in handwriting fluency transfers to an increase in compositional fluency in first-grade students. As students' handwriting fluency develops, they are able to devote less effort to maintaining letter forms in working memory (McCutchen, 2000). Rather, they use this capacity for higher-level processes needed to improve composition. Therefore, beginning-writing assessment and instruction should focus not only on teaching and assessing the formation of alphabet letters but also on automatization of the retrieval and production of alphabet letters.

Assessment of Handwriting Fluency

Throughout the literature, handwriting fluency is referred to by a variety of names including alphabet fluency, orthographic fluency, letter writing automaticity, and letter writing fluency. For the purposes of this study, handwriting fluency will be used in reference to the skill of how quickly and accurately children can access and produce letter forms. This study looks specifically at one measure of handwriting fluency—that is, the alphabet writing fluency task, which requires students to write from memory the letters of the alphabet in order. This task is one of many measures used to assess handwriting fluency in younger and older elementary school children (e.g., Berninger et al., 1992; Parker, McMaster, Medhanie, & Silberglitt, 2011).

In studies with elementary school children, various curriculum-based measures (CBMs) of handwriting fluency have been used, including assessment of writing at text, sentence, word, and subword levels. A task at the text level with first-, second-, and third-grade students involves students copying as much of a short story as possible in 90 s (Berninger et al., 1992). A similar task used at the sentence level with first graders is the sentence-copy task in which students copy as many sentences as possible within 1 min (Parker et al., 2011). Handwriting fluency at the subword (i.e., letter) level is often assessed by having children write sequential lowercase letters of the alphabet from memory in a given amount of time (Berninger & Rutberg, 1992).

Coker and Ritchey (2013) recently conducted a study to determine the most appropriate language level to target when screening kindergarten students for writing difficulties. They assessed students' early writing abilities using letter writing, sound spelling, word spelling, and sentence writing tasks. Scores on these CBMs were collected in the winter of the kindergarten year and were compared with scores from a standardized measure of early writing skills (*Test of Early Written Language, Second Edition* basic writing subtest; TEWL-2), a commonly used CBM of reading (DIBELS), and teacher ratings of student abilities collected in the spring. Results indicated that word and subword level measures (i.e., letter writing, sound spelling, and word spelling) were more accurate predictors of end-of-year abilities than sentence writing. These results are in accordance with theoretical accounts of writing development, which emphasize the importance of transcription skills in beginning writers (e.g., Berninger, 1999). Therefore, alphabet writing fluency, a measure of writing at the subword level, is likely to be a more appropriate indicator of a kindergartener's developing writing abilities and a more accurate predictor of end-of-year ability than sentence- or text-level tasks.

Berninger and Rutberg (1992), who researched handwriting fluency with first-, second-, and third-grade students, instructed students to write the letters of the alphabet in sequential order for 15 s. A strong correlation between the alphabet writing fluency task and all criterion writing measures (handwriting, spelling, and composition) was found. They used these correlations as evidence to conclude that the alphabet writing fluency task as measured in 15 s has concurrent validity for assessing beginning writing. Since that time, Berninger and other writing researchers have continued to use the alphabet writing fluency task within 15 s to measure handwriting fluency (e.g., Abbott & Berninger, 1993; Berninger, Nielsen, Abbott, Wijsman, & Raskind, 2008; Berninger et al., 2000; Graham, Harris, & Fink, 2000).

Recently, other researchers have modified the alphabet writing fluency task by extending the time to 60 s, including with kindergarten students (e.g., Kim et al., 2011; Puranik & Al Otaiba, 2012; Wagner et al., 2011). Currently, there is no consensus regarding which time increment is most appropriate (i.e., 15 s vs. 60 s). Whereas the 15-s alphabet writing fluency task may be a valid measure for children in first through third grades, the 60-s alphabet writing fluency task may be more appropriate for kindergarten children. Alternatively, it is possible that a timed measure of alphabet writing fluency may not be appropriate in kindergarten and that an untimed measure that assesses alphabet writing might be more appropriate. Given the young age and the developmental level of kindergarten children, memory and fine motor control would affect their ability to write letters fluently in a short time frame or in a timed task.

Therefore, the purpose of the present study was to examine this issue of timing for the alphabet writing fluency task

and to compare it with an untimed measure of alphabet writing at the kindergarten level. To that end, the alphabet writing fluency and the alphabet writing tasks were administered at the beginning and end of kindergarten. Two scores were calculated, one within 15 s of writing, one within 60 s of writing, and one on an untimed task. To explore whether a timed or untimed measure was a more useful and appropriate measure for kindergarten students, scores were compared with criterion measures of writing. The following research questions were investigated.

Research Question 1: Is handwriting fluency, as measured by the alphabet writing fluency timed task (15 or 60 s) or alphabet writing as measured by an untimed task, a valid predictor of early writing skill?
Research Question 2: Which alphabet writing fluency task, a timed measure (15 or 60 s) or alphabet writing as measured by an untimed task, is a more valid measure at the kindergarten level?

We hypothesized that a 15-s alphabet writing fluency task would not be a useful or valid indicator of kindergarten children's overall early writing either at the beginning or the end of year. The 60-s alphabet writing fluency task would be a more valid indicator of children's writing at the beginning and end of kindergarten.

Method

Participants

Participants for this study included 134 kindergarten students who were recruited from eight kindergarten classes in four public and charter elementary schools in Western Pennsylvania. Data for these students were collected as part of a larger intervention study aimed at improving writing skills of kindergarten children. The schools were selected to represent a range of socioeconomic status (SES) backgrounds. Two schools were low-SES and one school was mid-SES, as determined by the number of students with free and reduced lunch. A university laboratory school was also included where the SES was generally mid to high. There were comparable numbers of males (53%) and females (47%). The population included 41% Caucasians and 43% African Americans. The remaining 16% consisted of Hispanics, Asians, and students classified as "Other." The age of the students, as recorded at the beginning of kindergarten, ranged from 5 years 2 months to 6 years 5 months. The average age was 5 years 9 months (SD = 4 months).

Measures

Students were assessed using both CBMs and standardized tests of writing at the beginning and end of kindergarten. Administration of all CBMs was conducted by trained research assistants (RAs) and took place in the students' regular classrooms with all students in attendance participating. Instructions were provided by a lead RA, and three to four RAs were present in the classroom to assist the students. Approximately, 60 min were dedicated to instruction and completion of the CBMs battery. Because the CBMs tested multiple levels of language, they were always given in the same testing order starting with the subword level and ending at the discourse level. Standardized assessments were administered individually, also by trained RAs, and required approximately 60 min per student. These assessments were administered in predetermined orders, varying randomly between students, to reduce possible order effects (e.g., from fatigue).

Alphabet writing fluency. To measure handwriting fluency, students were instructed to write the lowercase letters of the alphabet as fast and as carefully as possible until told to stop. They were also instructed to cross out any mistakes they made (as opposed to erasing) and continue writing. After 15 s of writing, the students were told to stop writing, and their papers were marked with a line or stamp after the last letter written by the student. Once each paper had been marked, the students were instructed to continue writing the lowercase letters of the alphabet from where they had stopped at the 15-s mark. After 45 more seconds (a total of 60 s of writing), students were again instructed to stop writing, and each paper was marked after the last letter written. From this point on, there were no more stopping points, and the students continued to write the alphabet until completed, or until they were unable to continue due to lack of letter knowledge.

When scoring the alphabet writing fluency task, each letter written by the student was evaluated and scored to represent the accuracy of letters written. Individual letters received a score of 0 points, 0.5 points, or 1 point. Coders made scoring judgments based on four possible types of errors: formation/control, reversal/inversion, uppercase, or unrecognizable. Letters without any of the listed errors were given 1 point. Letters with only one formation/control, reversal/inversion, or uppercase error were given 0.5 points. Scores of 0 points were given to letters with multiple errors or letters that were unrecognizable. Letters in random order (i.e., not in an alphabetical sequence of at least two letters) did not receive a score. Final scores were calculated by adding the number of points received. Three final scores were calculated: one score of letters written in 15 s (AWF15), one score of letters written in 60 s (AWF60), and one score of all the letters written (AW untimed).

The alphabet writing fluency and the alphabet writing tasks were exhaustively scored by two RAs, who completed extensive training on how to use the scoring rubric including coding of many examples. Differences in scoring were

discussed, and a final score agreed upon by both RAs was recorded. Inter-rater reliability of scoring across all classes was 88% (determined by the number of agreements divided by total agreements and disagreements).

Sentence writing. Two CBMs of writing were chosen to assess students' ability to compose text. For the sentence writing task, students were provided with two sheets of paper containing four picture-word prompts similar to the task used by Parker et al. (2011) with first-grade students. These prompts included a small graphic of a three- or four-letter word with the word typed under the picture. Students were instructed to generate sentences based on the picture and include the target word in their sentences. Two sets of lines were placed below the picture prompt for students to write their responses. Students were given 5 min to write responses to four prompts. Upon completion of the task, students were asked to read the sentences they had written and responses were transcribed by RAs beneath the students' writing. Alternate-form reliabilities for 5-min samples have been reported as $r > .70$ for correct word sequences, and criterion-related validity ranged from $r = .50$ to .60.

Scoring of the sentence writing task was conducted by two trained RAs. Multiple methods of scoring were used. For a quantitative measure, the number of words written (WW) was counted for each response (four responses per child). Responses needed to include student-generated words in addition to the word provided in the original prompt. If a response included random letters or only the word given in the prompt, it received a score of 0. Each word was scored individually without considering correct or incorrect usage in context. Intraclass correlation coefficients (ICCs) were used to determine inter-rater reliability. These coefficients were calculated separately for the sentence writing task at the beginning of kindergarten (ICC = .97) and at the end of kindergarten (ICC = .99).

A qualitative score was also given for each response. This score was included to evaluate each student's ability to compose meaningful text. Qualitative scoring was completed by two RAs. RAs were trained to score responses following a rubric developed by Coker and Ritchey (2010). This rubric included five categories: response type, spelling, mechanics, grammatical structure, and relationship to prompt. Each response was given a rating of 0 to 3 in each category.

Response type ratings were used to evaluate each student's ability to generate an appropriate length of response. Students who wrote complex sentences received ratings of 3, simple sentences received ratings of 2, incomplete sentences received ratings of 1, and responses that did not contain any legible words received ratings of 0.

When rating spelling, 75% of words in the response needed to be spelled correctly to receive a 3. If more than 50% of words were spelled correctly, ratings of 2 were given, and ratings of 1 were given when less than 50% of words were spelled correctly. Ratings of 0 were given for responses that did not contain any correctly spelled words.

Mechanics were scored based on the use of capital letters at the beginning of the sentence, correct capitalization in the rest of the sentence, and appropriate punctuation at the end of the sentence. Responses with all three components received a rating of 3, and responses with two out of three components (initial capitalization, remainder of sentence capitalization, and punctuation) received a rating of 2. Responses with either correct capitalization or correct punctuation, or sentences that contained both components but were not complete sentences, received a rating of 1. If a student did not use correct capitalization or punctuation, or had one correct but did not write a complete sentence, the response was given a rating of 0.

Grammatical structure ratings were given based on the number of grammatical errors in each response. Responses that were entirely grammatically correct received ratings of 3. Responses with one grammatical error received ratings of 2, whereas responses with multiple grammatical errors, or with one error that changed the sentence's meaning received a rating of 1. Ratings of 0 were given to responses that included multiple grammatical errors that changed the sentence's meaning and to responses that were not complete sentences.

The final category, relationship to prompt, evaluated each student's ability to respond to the prompt given. Ratings of 3 were given to responses that were directly and appropriately linked to the prompt and were elaborated upon. Ratings of 2 were given if responses were not elaborated but were directly and appropriately linked to the prompt. A response received a rating of 1 if it was linked to the general idea of the prompt, and a rating of 0 was given if the response was not related to the prompt or was unclear.

Ratings for each category were summed to determine the total qualitative score for each response. ICCs were used to determine inter-rater reliability. These coefficients were calculated separately for the sentence writing task at the beginning of kindergarten (ICC = .98) and at the end of kindergarten (ICC = .97).

Essay task. To assess students' ability to compose at the text level, students were given the essay prompt, "I like kindergarten because . . . ," a task similar to one used by Graham et al. (1997) with first-, second-, and third-grade students. In the current study, the lead RA led a short period of brainstorming with the entire class. This brainstorming involved the lead RA asking the students three questions: (a) What do you enjoy so far about being in kindergarten? (b) What are you learning in school? (c) Has anything special happened to you in kindergarten? The lead RA did not write students' responses on the board. Then students were instructed to write until the lead RA said stop. They were also told that they would not be getting help with spelling and that they just needed to try their best to sound it out. Then, students

were given 5 min to write. Student responses were transcribed by RAs upon completion of the task.

Essay responses were also scored for WW. The procedures used to determine this score were similar to those used to score sentence writing responses. ICCs were calculated to determine inter-rater reliability. These coefficients were calculated separately for the essay task at the beginning of kindergarten (ICC = .99) and at the end of kindergarten (ICC = .997).

Essay responses also received a qualitative score. Coker and Ritchey's (2010) rubric for qualitative scoring of sentence writing was adapted to be used with essay prompt responses. Coker and Ritchey's rubric was modified to maintain parity between scoring of the sentence writing task and the essay writing. Two RAs were trained to use this rubric and determine each qualitative score. The adapted rubric included the same categories as used in the sentence writing task: response type, spelling, mechanics, grammatical structure, and relationship to prompt. Again, each response received a rating of 0 to 3 in each category.

To receive a rating of 3 for response type, students needed to write multiple simple or complex sentences, or a single complex sentence. A rating of 2 was given for a recognizable complete sentence, a rating of 1 given for at least one legible word, and a rating of 0 was given if no legible words were written. When rating this category, the semantic information contained in the sentence was considered. Nonsense sentences, those deemed semantically incorrect, could not receive a rating higher than 1. Ratings for spelling and mechanics were given following the same scoring guidelines as in the sentence writing task.

For a response to receive a 3 in the category of grammatical structure, the sentence(s) of the response needed to be 100% grammatically correct. A rating of 2 was given if at least 50% of the sentences were grammatically correct. If more than 50% of the response contained grammatical errors, the response contained grammatical errors that changed the meanings of the sentences, or the meanings were unknown, ratings of 1 were given. Incomplete sentences were always given a rating of 0.

When rating the relationship to prompt category, attention was paid to the number of reasons provided. With the prompt "I like kindergarten because . . . ," students should have identified things or activities they enjoyed that occur in kindergarten. If three reasons were provided, a rating of 3 was given. Students who provided one or two reasons were given ratings of 1 or 2, respectively.

To determine a student's overall qualitative score, ratings of each category were summed. ICCs were calculated to determine inter-rater reliability. These coefficients were calculated separately for the essay task at the beginning of kindergarten (ICC = .97) and at the end of kindergarten (ICC = .98).

Standardized measures. Two standardized measures of writing were used in this study, the *Test of Early Written Language, Third Edition* basic writing subtest (TEWL-3; Hresko, Herron, Peak, & Hicks, 2012) and the *Woodcock–Johnson, Third Edition* spelling subtest (WJ-III; Woodcock, McGrew, & Mather, 2007). Both measures are norm-referenced and have strong psychometric properties. The TEWL-3 is normed for students ages 4 to 12 years old. Two forms of this test were used: Form A at the beginning of the year and Form B at the end of the year. The alternate-form reliability of this test has been reported to exceed .85 for all coefficients.

The TEWL-3 has two subtests, basic writing and contextual writing. The contextual writing subtest was not used in this study, as it requires advanced compositional skills not acquired by the majority of kindergarten students, especially at the beginning of the year. The basic writing subtest, which contains 70 items of increasing difficulty, was used to provide an indication of students' general writing abilities (Hresko et al., 2012). Students were initially instructed to execute simple tasks that focus on lower-level writing skills, such as holding a pencil and tracing a letter. For these lower-level skills, answers received 0 points if incorrect and 1 point if correct. As the testing continues, higher-level skills including composition were assessed. Responses to higher-level questions received a score of 0, 1, or 2. Incorrect responses received a score of 0, correct but incomplete responses received a score of 1, and correct and complete responses received a score of 2. Testing was discontinued when a student received 0 points over five consecutive questions. Test–retest reliability for the TEWL-3 basic writing was reported to be 0.95 for children between 4 and 7 years old. It showed concurrent validity with the *Wechsler Individual Achievement Test, Second Edition* (WIAT-II) with a coefficient of 0.75.

The second standardized measure used in this study was the WJ-III spelling subtest (Woodcock et al., 2007). This subtest measures students' abilities to copy forms, produce letters, and write correctly spelled words. Students were first instructed to copy shapes such as lines and squiggles. Students were then asked to spell words. Each response to a question received a score of 0 (incorrect) or 1 (correct). Items increased in difficulty, and testing was concluded when a student produced six consecutive errors. Test–retest reliability of this subtest was reported to be 0.91 for children between 4 and 7 years old. Spelling, as measured by the WJ-III, showed a correlation of 0.77 with the *Kaufman Test of Educational Achievement* spelling subtest.

Scoring for the TEWL-3 and the WJ-III spelling subtest were completed by RAs as outlined in the assessment scoring manual. During administration of the assessment, the RA giving the test scored the assessment to determine when to conclude testing. Following administration, two additional RAs reviewed the scores given to ensure accuracy of raw scores. Scores for both standardized measures were double-entered into separate spreadsheets, compared, and compiled into one agreed-upon dataset to ensure each score

was entered correctly. Raw scores were converted to standard scores. Only standard scores were used in this study's statistical analyses.

Letter naming fluency. When students are writing the alphabet, it is possible that their fluency may be constrained not only by their handwriting abilities but also by their letter knowledge. If a student has difficulty remembering letters, it is likely that he or she will have difficulty writing those letters as a result. To control this possibility and ensure that the alphabet writing fluency task was measuring handwriting fluency rather than letter knowledge, a CBM of letter naming fluency was included in the assessment battery. The assessment used was one subtest of the DIBELS (Good & Kaminski, 2002). For this CBM, students were presented with a page of 110 letters presented in random order. Each student was instructed to place a finger below the first letter, read across each row, and name the letters. Students were timed and had 60 s to name as many letters as possible. Letters presented were both capital and lowercase. Students received one point for each letter named correctly. Self-corrections were scored as correct responses. Final scores were calculated by adding the number of correct letter names. Each score was calculated by the RA testing the student, and later checked and entered by two additional RAs. Different forms were used at the beginning of kindergarten and the end of kindergarten, both of the same format but with a different order of letters. This subtest has been shown to have high inter-rater reliability (.94), test–retest reliability (.90), and alternate-form reliability (.80; Elliott, Lee, & Tollefson, 2001).

Analytic Procedures

Statistical analyses were aimed at investigating the validity of the alphabet writing fluency task at two time increments, within 15 s and within 60 s, and as an untimed task. These scores were compared with criterion writing measures (standardized assessments and compositional CBM). To answer the first research question, "Is handwriting fluency, as measured by the alphabet writing fluency task during a timed task (15 or 60 s) or an untimed measure, a valid predictor of early writing skill?" We examined the distribution of scores and the significance of Spearman correlations. To answer the second research question, "Which time increment of the alphabet writing fluency task, a timed measure (15 or 60 s) or an untimed measure, is a more valid measure of handwriting at the kindergarten level?" first, Fisher's Z transformations were conducted to examine potential differences in the correlation coefficients among the three measures of alphabet writing: at 15 s, at 60 s, and untimed. To examine the predictive validity of the alphabet writing measures, hierarchical multiple regression analyses were conducted. For each of the eight dependent measures (i.e., AWF15, AWF60, AW untimed, WJ-III spelling, sentence writing WW, sentence writing quality, essay WW, and essay quality), the predictors were entered in two steps. First, the control variables (i.e., age, gender, race, letter naming fluency) were entered. Second, the alphabet writing fluency measure at the beginning of kindergarten was entered for 15 s, 60 s, and the untimed measure separately. Then, the change in R^2 between each step was examined for 15 s, 60 s, and the untimed measure separately to determine how much more variance was explained with a specific focus on the contribution of handwriting fluency (see Table 5).

We also conducted a series of three-level, hierarchical linear regression models for each of the eight dependent measures mentioned above. In only a few models could a significant proportion of variance be attributed to the class or the school. Moreover, the results from these hierarchical linear modeling (HLM) models were very similar to the hierarchical multiple regression analyses. Therefore, for simplicity, we chose to report only the hierarchical multiple regression analyses.

Results

Descriptive Statistics

At the beginning of kindergarten, scores of AWF15 ranged from 0 to 17 letters with a mean of 1.54 letters (SD = 1.94). As shown in Figure 1, the scores were highly positively skewed. Thirty-five of the 134 students (26.1%) assessed received a score of 0, whereas only two students (1.5%) received a score greater than 2 SDs from the mean (i.e., score of 5.5 or higher). For AWF60, the variability of scores was wider (range = 0–23.5; M = 4.75; SD = 4.28). Again, the distribution was highly positively skewed. Twenty-six students (19.4%) received a score of 0, whereas eight students (6%) received a score greater than 2 SDs from the mean (i.e., score of 13.5 or higher). For AW untimed, although students were able to write more letters (M = 11.34; SD = 7.71), the variability of scores was similar to AWF60 (range = 0–23.5). However, the distribution for AW untimed was not skewed. Only ten students (7.5%) received a score of 0.

At the end of kindergarten, the scores of AWF15 ranged from 0 to 10 with a mean of 3.47 letters (SD = 2.34). The distribution of scores was less skewed at the end of kindergarten with thirteen students (9.7%) receiving a score of 0, and five students (3.7%) receiving a score greater than 2 SDs from the mean (i.e., score of 8.5 or higher). Variability of scores was large for AWF60 also (range = 0–25.5; M = 10.42, SD = 6.44). The distribution of scores was close to normal with only five students (3.7%) who received a score of 0 and six students who received a score greater than 2 SDs from the mean (i.e., score of 25.5 or higher). Again, the variability of scores for AW untimed was similar to AWF60 (range = 0–25.5), and students were able to write more

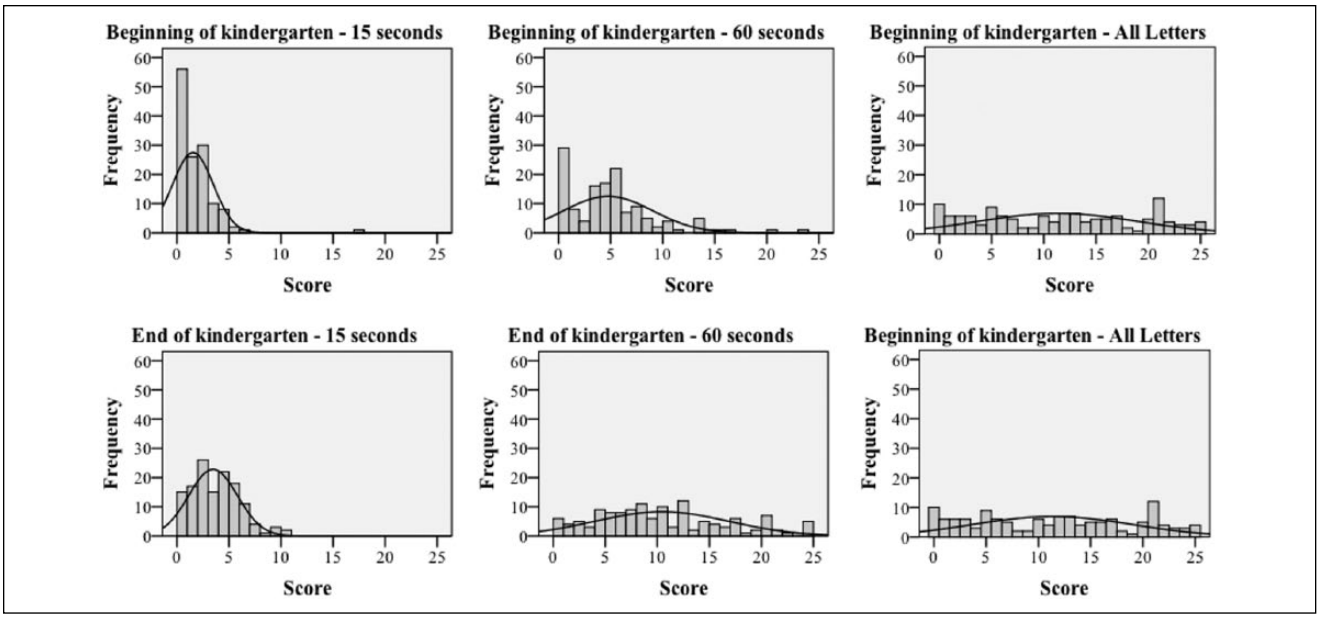

Figure 1. Distributions of alphabet fluency scores at the beginning and end of kindergarten.

Table 1. Descriptive Statistics for Writing Variables.

	Beginning of kindergarten					End of kindergarten				
Variable	*M*	*SD*	Range	Skew	Kurtosis	*M*	*SD*	Range	Skew	Kurtosis
AWF15	1.54	1.94	0–17	4.14	29.34	3.47	2.34	0–10	0.55	−0.01
AWF60	4.75	4.28	0–23.5	1.45	3.18	10.42	6.44	0–25.5	0.48	−0.53
AW untimed	11.34	7.71	0–25.5	0.09	−1.26	17.37	7.20	0–25.5	−0.94	−0.19
WJ-III spelling	103.27	14.21	58–134	−0.28	0.38	107.75	12.55	83–135	0.03	−0.34
TEWL-3 basic	104.75	10.79	85–129	0.39	−0.47	115.08	11.33	81–140	−0.56	0.48
Sentence writing WW	4.98	6.38	0–22	1.02	−0.21	11.32	7.03	0–34	−0.17	−0.35
Sentence writing quality	4.55	3.74	0–12	0.57	−0.99	8.09	3.76	0–14	−0.72	−0.55
Essay WW	3.89	7.07	0–36	2.28	5.53	9.22	9.85	0–46	0.99	0.88
Essay quality	3.73	4.27	0–14	0.86	−0.66	7.19	4.22	0–14	−0.27	−1.28

Note. AWF = alphabet writing fluency; AW = alphabet writing; WJ-III = *Woodcock–Johnson Tests of Cognitive Abilities, Third Edition* standard score; TEWL-3 = *Test of Early Written Language, Third Edition* standard score; WW = words written.

letters ($M = 17.37$; $SD = 7.20$). The distribution was slightly more skewed at the end of kindergarten with only four students (3%) who received a score of 0. Descriptive statistics for all of the measures are shown in Table 1.

Relations Between Alphabet Writing Fluency and Other Writing Variables

In Table 2, Spearman correlation coefficients between all measures of writing at the beginning and the end of kindergarten are displayed. Table 3 includes specifically the alphabet writing fluency correlations to criterion measures of writing and the magnitudes of differences between the correlation coefficients for AWF15, AWF60, and AW untimed. At the beginning of kindergarten, scores of AWF15 were significantly correlated with all criterion CBMs but not with the standardized measures ($ps < .01$). Scores of AWF60, however, were significantly correlated with all writing measures, including CBMs and standardized measures ($ps < .01$). Similarly, scores of AW untimed were also significantly correlated with all CBMs and standardized measures. Furthermore, for the Fisher's Z comparisons of correlation strengths between the criterion and alphabet writing fluency measures, both AWF60 and AW untimed had stronger correlations with criterion measures than AWF15. There were no differences in the magnitudes for the correlations between AW untimed and the criterion measures and the corresponding correlations with AWF60.

Table 2. Correlations Among Writing Measures at the Beginning and End of Kindergarten.

Measure		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Beginning of kindergarten																				
1.	TEWL-3 basic	—																		
2.	WJ-III spelling	.71**	—																	
3.	LNF	.55**	.59**	—																
4.	AWF15	.24	.21	.26**	—															
5.	AWF60	.55**	.47**	.56**	.63**	—														
6.	AW untimed	.55**	.49**	.62**	.50**	.82**	—													
7.	Sentence writing WW	.58**	.50**	.56**	.42**	.63**	.66**	—												
8.	Sentence writing quality	.65**	.56**	.60**	.41**	.63**	.62**	.87**	—											
9.	Essay WW	.65**	.57**	.59**	.26**	.58**	.61**	.73**	.70**	—										
10.	Essay quality	.69**	.53**	.53**	.37**	.59**	.58**	.69**	.67**	.77**	—									
End of Kindergarten																				
11.	TEWL-3 basic	.70**	.74**	.62**	.42**	.62**	.63**	.52**	.64**	.60**	.56**	—								
12.	WJ-III spelling	.60**	.77**	.46**	.37**	.48**	.50**	.35**	.40**	.46**	.40**	.79**	—							
13.	LNF	.39**	.29	.83**	.19	.46**	.49**	.50**	.52**	.47**	.37**	.49**	.35**	—						
14.	AWF15	.33**	.39**	.34**	.29**	.43**	.40**	.29**	.36**	.18	.23**	.48**	.46**	.31	—					
15.	AWF60	.45**	.48**	.46**	.36**	.55**	.59**	.39**	.44**	.37**	.39**	.51**	.46**	.39**	.77**	—				
16.	AW untimed	.41**	.49**	.45**	.34**	.52**	.64**	.39**	.42**	.41**	.42**	.57**	.45**	.33**	.67**	.80**	—			
17.	Sentence writing WW	.31**	.40**	.41**	.28**	.42**	.48**	.34**	.36**	.30**	.35**	.46**	.43**	.45**	.39**	.52**	.59**	—		
18.	Sentence writing quality	.48**	.45**	.46**	.26**	.50**	.58**	.47**	.49**	.43**	.51**	.58**	.54**	.32	.39**	.56**	.57**	.67**	—	
19.	Essay WW	.23	.34**	.34**	.22	.39**	.50**	.38**	.39**	.37**	.41**	.34**	.24	.22	.41**	.58**	.63**	.55**	.56**	—
20.	Essay quality	.39**	.50**	.32**	.28**	.44**	.53**	.42**	.48**	.40**	.53**	.58**	.53**	.17	.38**	.60**	.53**	.44**	.62**	.74**

Note. TEWL-3 = *Test of Early Written Language, Third Edition* standard score; WJ-III = *Woodcock–Johnson Tests of Cognitive Abilities, Third Edition standard score*; LNF = letter naming fluency; AWF = alphabet writing fluency; AW = alphabet writing; WW = words written.
**$p < .01$.

Table 3. Correlations of Timed and Untimed Alphabet Writing Fluency Measures to Criterion Writing Measures and Corresponding Magnitudes (*p* values).

	Correlations			Magnitude (*p* values)		
Dependent variables	AWF15	AWF60	AW untimed	AWF15 vs. AWF60	AWF15 vs. AW untimed	AWF60 vs. AW untimed
Beginning of kindergarten						
WJ-III spelling	.21	.47**	.49***	.001	.001	.35
TEWL-3 basic	.24	.55**	.55***	.001	.001	.5
Sentence writing WW	.42**	.63**	.66***	.001	.001	.22
Sentence writing quality	.41**	.63**	.62***	.001	.001	.6
Essay WW	.26**	.58**	.61***	.001	.001	.24
Essay quality	.37**	.59**	.58***	.001	.001	.59
End of kindergarten						
WJ-III spelling	.46**	.46**	.45***	.51	.56	.56
TEWL-3 basic	.48**	.51**	.57***	.25	.08	.18
Sentence writing WW	.39**	.59**	.52***	.001	.001	.95
Sentence writing quality	.39**	.57**	.56***	.001	.001	.59
Essay WW	.41**	.63**	.58***	.001	.001	.89
Essay quality	.38**	.53**	.60***	.001	.001	.05

Note. AWF = alphabet writing fluency; AW = alphabet writing; WJ-III = *Woodcock–Johnson Tests of Cognitive Abilities, Third Edition* standard score; TEWL-3 = *Test of Early Written Language, Third Edition* standard score; WW = words written.
**$p < .01$. ***$p < .001$.

At the end of kindergarten, scores of AWF15, AWF60, and AW untimed were significantly correlated with all criterion measures of writing ($ps < .01$). Magnitudes of the differences in correlations between AWF15 scores and criterion measures, and AWF60 scores and criterion measures were significant for Curriculum Based Measures–Writing (CBM-W) measures only. Unlike the beginning of the year, the magnitudes of the correlations between alphabet writing fluency scores for the two timed tasks and the WJ-III spelling and TEWL-3 basic subtest were not statistically different. Similarly, there was only one difference in the magnitudes between AW untimed and AWF60—that is, the correlation between AW untimed and essay quality was stronger than the corresponding correlation for AWF60.

Contribution of Alphabet Writing Fluency on Timed and Untimed Tasks

To examine the predictive validity of the alphabet writing fluency measures, hierarchical multiple regression analyses were conducted on eight dependent variables (i.e., AWF15, AWF60, AW untimed, WJ-III spelling, sentence writing WW, sentence writing quality, essay WW, and essay quality). We examined the contribution of alphabet writing fluency at the beginning of kindergarten on these eight measures to the end of kindergarten.

First, we examined the contribution of alphabet writing fluency at the beginning of kindergarten on the alphabet fluency measures at the end of kindergarten. In these analyses, the control variables were entered first, and then each of the alphabet writing fluency measures were entered separately (see Table 4). The control variables explained 20% of the variance in AWF15 at the end of kindergarten. The timed alphabet writing fluency measures (AWF15 and AWF60) obtained at the beginning of kindergarten each explained an additional 4% unique variance in AWF15 at the end of kindergarten. However, AW untimed at the beginning of kindergarten did not significantly explain additional unique variance. The control variables explained 33% of the variance in AWF60 at the end of kindergarten. The alphabet writing fluency measures obtained at the beginning of kindergarten each explained an additional 4%, 3%, and 6% unique variance in AWF60 at the end of kindergarten. Finally, the control variables explained 26% of the variance in AW untimed at the end of kindergarten. Although AWF15 at the beginning of kindergarten explained an additional 6% unique variance in AW untimed at the end of kindergarten, AWF60 at the beginning of kindergarten did not significantly explain additional unique variance. Moreover, AW untimed at the beginning of kindergarten explained an additional 16% unique variance in AW untimed at the end of kindergarten.

Second, we examined the contribution of alphabet writing fluency at the beginning of kindergarten on spelling at the end of kindergarten. Again, the control variables were entered first, and then each of the alphabet writing fluency measures were entered separately. A significant proportion of the variance in spelling at the end of kindergarten was explained by the control variables (46%). AWF15 at the beginning of kindergarten explained an additional 9% of the variance. Similarly, AWF60 at the beginning of kindergarten explained an additional 4% of the variance on the WJ-III spelling subtest at the end of kindergarten. Furthermore, AW untimed at the beginning of kindergarten explained an additional 13% of the variance.

Third, we examined the contribution of alphabet writing fluency at the beginning of kindergarten on sentence writing (i.e., WW and quality) at the end of kindergarten. As with the previous models, the control variables were entered first, and then each of the alphabet writing fluency measures were entered separately. The control variables explained 29% of the variance in sentence writing WW at the end of kindergarten. However, the timed alphabet writing fluency measures at the beginning of kindergarten did not account for significantly more variance. By contrast, AW untimed at the beginning of kindergarten explained an additional 3% of the variance in sentence writing WW at the end of kindergarten. The control variables explained 35% of the variance in sentence writing quality at the end of kindergarten. Again, although neither timed alphabet writing fluency measure at the beginning of kindergarten accounted for significantly more variance, AW untimed at the beginning of kindergarten accounted for 7% of the variance in sentence writing quality at the end of kindergarten.

Finally, we examined the contribution of alphabet writing fluency at the beginning of kindergarten on essay writing (WW and quality) at the end of kindergarten. Again, the control variables were entered first followed by each of the alphabet writing fluency measures. The control variables explained 15% of the variance in essay writing WW score at the end of kindergarten. Although neither timed alphabet writing fluency measure at the beginning of kindergarten accounted for significantly more variance, AW untimed at the beginning of kindergarten accounted for an additional 8% of the variance in essay writing WW at the end of kindergarten. The control variables explained 22% of the variance in essay writing quality at the end of kindergarten. AWF15 at the beginning of kindergarten significantly explained an additional 4% of the variance, and AW untimed at the beginning of kindergarten explained an additional 16% of the variance in essay writing quality at the end of kindergarten. However, AWF60 at the beginning of kindergarten did not significantly explain additional unique variance.

Discussion

In the last two decades, researchers have made great strides in developing CBMs and screening tools for reading.

Table 4. Standardized Regression Coefficients Predicting End-of-Year Writing Achievement.

		Model A		Model B		Model C	
		Pre AWF15		Pre AWF60		Pre AW untimed	
DV at end of kindergarten	Predictors at the beginning of kindergarten	β	*SE*	β	*SE*	β	*SE*
AWF15	Age	−.25*	0.06	−.24*	0.06	−.27**	0.06
	Gender	−.17	0.45	−.14	0.46	−.16	0.46
	Race	−.10	0.48	−.08	0.48	−.08	0.49
	Letter naming fluency	.30**	0.01	.23*	0.02	.26*	0.02
	Alphabet fluency	.21*	0.17	.24*	0.07	.19	0.04
AWF60	Age	−.17	0.14	−.15	0.14	−.20*	0.14
	Gender	−.31***	1.10	−.28**	1.13	−.28**	1.11
	Race	−.21*	1.19	−.19*	1.20	−.18*	1.18
	Letter naming fluency	.35***	0.03	.29**	0.04	.24*	0.04
	Alphabet fluency	.22*	0.43	.23*	0.17	.32**	0.09
AW untimed	Age	−.07	0.14	−.05	0.15	−.14	0.13
	Gender	−.18*	1.13	−.15	1.18	−.11	1.06
	Race	−.12	1.22	−.10	1.25	−.08	1.13
	Letter naming fluency	.36***	0.03	.33*	0.04	.14	0.04
	Alphabet fluency	.26*	0.44	.20	0.17	.53***	0.09
Spelling	Age	−.58***	0.30	−.58***	0.32	−.62***	0.28
	Gender	−.15	2.31	−.07	2.52	−.03	2.26
	Race	−.07	2.60	−.08	2.74	−.05	2.48
	Letter naming fluency	.45***	0.07	.38**	0.09	.27*	0.07
	Alphabet fluency	.32**	0.88	.26*	0.39	.48***	0.19
Sentence writing: WW	Age	−.09	0.15	−.08	0.15	−.11	0.15
	Gender	−.29**	1.20	−.27**	1.23	−.26**	1.20
	Race	−.04	1.29	−.03	1.30	−.02	1.28
	Letter naming fluency	.42***	0.04	.40***	0.04	.34**	0.04
	Alphabet fluency	.13	0.46	.11	0.18	.23*	0.10
Sentence writing: Quality	Age	−.12	0.08	−.12	0.08	−.17	0.08
	Gender	−.15	0.62	−.14	0.64	−.09	0.60
	Race	−.21*	0.67	−.20*	0.67	−.18*	0.63
	Letter naming fluency	.51***	0.02	.48***	0.02	.30**	0.02
	Alphabet fluency	.02	0.24	.07	0.09	.36**	0.05
Essay: WW	Age	−.01	0.25	−.01	0.25	−.07	0.25
	Gender	−.15	2.00	−.12	2.02	−.11	1.95
	Race	−.20	2.19	−.18	2.17	−.16	2.11
	Letter naming fluency	.21	0.06	.13	0.07	.04	0.07
	Alphabet fluency	.13	0.77	.21	0.30	.37**	0.17
Essay: Quality	Age	−.07	0.10	−.06	0.10	−.13	0.09
	Gender	.07	0.78	.09	0.81	.14	0.73
	Race	−.25*	0.85	−.24*	0.86	−.20*	0.78
	Letter naming fluency	.26*	0.02	.24	0.03	.01	0.03
	Alphabet fluency	.20*	0.30	.17	0.12	.54***	0.06

Note. DV = dependent variables; AWF = alphabet writing fluency; AW = alphabet writing; Spelling = spelling subtest from *Woodcock–Johnson Tests of Cognitive Abilities, Third Edition*; WW = words written.
*$p < .05$. **$p < .01$. ***$p < .001$.

Compared with measures for reading, we know less about CBMs for writing, although efforts are underway. One such study was by Coker and Ritchey (2013) who examined kindergarten student's early writing skills. Their results indicated that word (spelling) and subword level (letter writing) measures were more accurate predictors of end-of-year writing abilities than measures at the sentence or discourse level. However, as rightly pointed out by the authors, future research examining timed measures of early writing are still needed. The current study was conducted to evaluate a task

Table 5. Summary of ΔR^2.

		Change from Model A		
	Model A	Model B	Model C	Model D
DV at the end of kindergarten	Control variables	Pre AWF15	Pre AWF60	Pre AW untimed
AWF15	.20**	.04*	.04*	.02
AWF60	.33***	.04*	.03*	.06**
AW untimed	.26***	.06**	.03	.16***
Spelling	.46***	.09**	.04*	.13***
Sentence writing WW	.29***	.01	.01	.03*
Sentence writing quality	.35***	.00	.00	.07**
Essay WW	.15**	.02	.03	.08**
Essay quality	.22***	.04*	.02	.16***

Note. DV = dependent variables; AWF = alphabet writing fluency; AW = alphabet writing; Spelling = spelling subtest from *Woodcock–Johnson Tests of Cognitive Abilities, Third Edition*; WW = words written.
*p < .05. **p < .01. ***p < .001.

used to measure handwriting fluency—a timed measure of writing at the subword level.

Although researchers have demonstrated the validity of assessing handwriting fluency using the 15-s alphabet writing fluency task with students from first through third grade (Abbott & Berninger, 1993; Berninger et al., 2008; Berninger & Rutberg, 1992; Berninger et al., 2000; Graham et al., 2000), we hypothesized that 15 s might not be an appropriate amount of time to assess kindergarten students' handwriting fluency. Other researchers have assessed handwriting fluency using the 60-s alphabet writing fluency with kindergartners (Kim et al., 2011; Puranik & Al Otaiba, 2012; Wagner et al., 2011). However, the validity of either of these tasks has not been empirically tested or has it been compared with an untimed alphabet writing task. Therefore, the purpose of this study was two-fold: first, to determine whether handwriting fluency, as measured by a timed task (15 s vs. 60 s) or alphabet writing as measured by an untimed task was a valid predictor of early writing skill, and second, to determine which alphabet writing fluency task, a timed measure (15 or 60 s) or an untimed measure was a more valid measure at the kindergarten level.

Is the Alphabet Writing Fluency Task a Valid Measure of Kindergartener's Handwriting Fluency?

In this study, the majority of kindergarten students were not able to produce many letters within 15 s at the beginning of the year. On average, students wrote less than two letters during this time period. At the end of kindergarten, students were still not able to produce many letters averaging about three letters within 15 s. More concerning was the number of students who were not able to produce any letters—at the beginning of kindergarten, more than a quarter of the students were not able to produce a single letter, but by the end of kindergarten, the number of students who were not able to produce a single letter was reduced to 10%. The distribution of scores at the beginning of kindergarten and the end of kindergarten were not normal; there was a high, positive skew and high kurtosis.

By contrast, scores within 60 s were higher. At the beginning of kindergarten, students wrote on average five letters during this time period, and at the end of kindergarten, students wrote on average 10 letters. One notable difference between the scores at the beginning of kindergarten and the scores at the end of kindergarten was their distributions. At the beginning of kindergarten, the distribution was also not normal. The skew and kurtosis were lower at 60 s than at 15 s, but a substantial proportion of students (19.4%) still had scores of 0. At the end of kindergarten, the scores resembled a normal distribution with less than 4% of students receiving a score of 0. Students' performance at the end of the year was similar to other studies that have examined alphabet fluency in kindergarten children at the end of the year (e.g., Puranik & Al Otaiba, 2012). In comparison with both timed conditions, children were able to produce many more letters in the untimed condition both at the beginning and the end of kindergarten; an average of 11 and 17 letters, respectively. More importantly, the scores were fairly normally distributed.

The criterion validity of the two timed alphabet writing fluency tasks and the untimed task was assessed using Spearman correlations between the alphabet writing fluency scores and criterion measures of writing (both standardized and CBM-W). At the beginning of kindergarten and at the end of kindergarten, both the timed alphabet writing fluency tasks and the untimed alphabet writing task showed good concurrent validity—that is, in general, scores

from both timed and untimed tasks were positively related to each of the criterion measures of writing.

The predictive validity of the alphabet writing fluency tasks was assessed using hierarchical multiple regression. Scores on the 15-s alphabet writing fluency task at the beginning of kindergarten predicted scores on the alphabet writing fluency task, scores on the WJ-III spelling subtest, and quality of the essay task at the end of kindergarten but did not predict scores on the sentence writing task (quality and quantity) or WW on the essay task. Similarly, scores on the 60-s alphabet writing fluency task at the beginning of kindergarten predicted scores on the alphabet writing fluency task and scores on the WJ-III spelling subtest at the end of kindergarten. However, scores on the 60-s alphabet writing fluency task at the beginning of kindergarten did not predict scores on the sentence writing or essay task (quality and quantity). Again, in contrast to the 15- and 60-s alphabet writing fluency task, the untimed alphabet writing task at the beginning of kindergarten predicted scores on AWF60, AW untimed, WJ-III spelling, and quality and quantity for sentence writing and essay writing.

One of the biggest challenges of examining writing in beginning writers is that students struggle to write and hence, have little output. Moreover, when they do write, they struggle with letter formation making it difficult to decipher what they wrote. In the current study, performance on both the 15-s and the 60-s alphabet writing fluency tasks were highly skewed at the beginning of the year, clearly indicating that a timed task may not be a very useful measure at the beginning of kindergarten. Performance improved at the end of kindergarten—children were able to write more letters, there was a larger variability in scores, and floor effects were reduced. Even so, on average, children were able to write only three and 10 letters, respectively, in the 15-s and 30-s task.

Which Alphabet Writing Fluency Task Is a More Valid Measure of Handwriting Fluency?

To determine which alphabet writing fluency task or whether an alphabet fluency task was a more valid measure of handwriting fluency, we first examined the magnitudes of differences between the correlation coefficients for the 15-s, 60-s, and the untimed alphabet writing task. Then, we examined how much more variance in performance at the end of kindergarten was explained by the task at the beginning of kindergarten.

At the beginning of kindergarten, the scores from the AWF60 timed task and AW untimed task were more strongly related to most of the criterion measures than the scores from the 15-s alphabet writing fluency task. There were no statistically significant differences between the strength of the magnitudes between the AWF60 and the AW untimed task. Similarly, at the end of kindergarten, the scores from the 60-s alphabet writing fluency and the alphabet writing untimed task were more strongly related to the criterion measures than the scores from the 15-s alphabet writing fluency task, but only for CBMs of writing. Similar to the beginning of kindergarten, there were no statistically significant differences between the strength of the magnitudes between the AWF60 and the AW untimed task at the end of kindergarten. These results replicate prior research, which has demonstrated that handwriting fluency is highly correlated with writing at the sentence and discourse levels (e.g., Berninger, 1999; Berninger et al., 1997; Puranik & Al Otaiba, 2012).

Given our contention that fluency performance at the beginning of kindergarten may not be a very good indicator of performance at the end of kindergarten, we ran a regression analysis post hoc to examine how much unique variance was accounted for by the two timed measures and the untimed measure at the end of the year. The amount of additional variance explained by the alphabet writing fluency tasks depended on the level of language. Pretest AWF15 and AWF60 predicted performance of AWF15 and AWF60 at posttest. Similarly, pretest AWF15 and AWF60 predicted performance at post-WJ-III spelling. However, the results for sentence and discourse writing were less convincing. Although the R^2 values were significant, the amount of additional variance explained by AWF15 and AWF60 ranged from nonsignificant to small. The exception being that the 15-s alphabet writing fluency task at the beginning of kindergarten explained 4% unique variance in the quality of the essay at the end of kindergarten. The findings for both timed tasks appear to be in contrast to writing theory and what has been found with older children-transcription skills, both alphabet fluency and spelling predict writing quantity and quality. Perhaps alphabet fluency explains greater variance in text generation after students have made considerable progress in achieving some level of mastery in lower order skills, which explains why the untimed alphabet writing fluency explained additional variance for various writing tasks: 13% for spelling, 3% for sentence writing WW, 7% for sentence writing quality, 8% for essay writing WW, and 16% for essay quality.

To summarize, our data clearly indicate that kindergarten students at the beginning of the year have far from mastered the letters of the alphabet. Children were able to write more letters in the 60-s task, there was larger variability in scores, and reduced floor effects. Yet, the average number of letters written by the students was still low. The issue of floor effects is important for several reasons. First, it prevents children from feeling like they have accomplished something; 15 s does not allow children that feeling as they were on average able to write only 1.5 and 3.5 letters at the beginning and end of kindergarten, respectively. Second, and more importantly, children's performance on the timed tasks defeats the purpose of CBMs, namely, allowing teachers and educators to determine which children are at risk, to

monitor children's progress in learning to write, and to tailor instructional support. If children write very few letters, teachers do not have enough information available to make informed decisions. Even at the end of the year, children on average only wrote four and 10 letters in the 15-s and the 60-s task, respectively. Thus, imposing a time constraint results in low output and does not provide the teacher with much useful information.

Furthermore, the timed tasks did not predict writing quantity and quality. However, the untimed task accounted unique variance on all of the writing measures. The untimed task also showed better concurrent and predictive validity compared with both timed tasks, supporting the findings of Coker and Ritchey (2013). The current study is the first to examine the validity of using the alphabet writing fluency task and comparing it with an alphabet writing task in kindergarten children. Taken together, our results suggest that neither of the timed tasks were useful or valid ways to measure alphabet writing fluency in kindergarten children, indicating that measuring fluency may not be useful at least in kindergarten. Instead, the untimed alphabet writing task appears to be a more valid measure of handwriting both at the beginning and end of kindergarten.

Limitations and Future Directions

This study was undertaken to examine the validity of the alphabet writing fluency task to assess children's early writing skills. However, to establish technical adequacy, future research should examine the reliability of the alphabet writing fluency task. Given the young age and the developmental level of kindergarten children, it is unclear how reliable a one-shot assessment of handwriting fluency would be. Many factors could affect a kindergartener's performance on brief tasks, including how they are feeling at the moment (e.g., fatigue or illness), how motivated or interested they are in participating, and the presence of any distractors (e.g., dropping the pencil, fellow classmates).

Future research should also determine whether the 15-s alphabet fluency task is a more valid measure of handwriting fluency compared with a 60-s task throughout the elementary level. Strong correlations between the performance on the 15-s alphabet fluency task seconds and criterion measures of writing have been found for older students, specifically first, second, and third graders (e.g., Berninger, 1999; Berninger & Rutberg, 1992). However, these studies did not make a direct comparison between the 15-s alphabet fluency task and the 60-s alphabet fluency task.

This study did not account for the diverse backgrounds and skills with which students enter kindergarten. Whether students had previously attended preschool, daycare, or educational classes could affect students' initial knowledge as well as how they progress throughout kindergarten. Home experiences and interactions are also crucial components of child development. Home experiences involving literacy could have a large impact on a student's writing development. In addition, we were not able to control for SES as no measures at the individual level were collected.

Perhaps the biggest limitation of this study is the manner in which alphabet fluency writing samples were collected. Because the students were already undergoing an extensive writing assessment battery, only one assessment was used to obtain AWF15, AWF60, and AW untimed scores. To obtain these scores, students were told to pause after 15 s and 60 s and then continue writing. This pause may have prevented full expression of each student's handwriting fluency abilities because of the break in writing. Students may have lost track of where they were in the alphabet and spent time restarting to write which may not have occurred without this pause.

Conclusion

Despite its limitations, this study was the first to empirically examine which time increment is a more valid measure of handwriting fluency in kindergarten children. The results of this study show that measuring alphabet fluency at either time points, AWF15 or AWF60, at the beginning of kindergarten may not be an ecologically and statistically valid task. Although students' performance at the end of the year was different, the data indicate that the untimed alphabet writing task may be a more useful, practical, and appropriate task. Furthermore, the untimed alphabet writing fluency task showed stronger evidence of concurrent validity compared with AWF15 and AWF60 at the end of kindergarten. Thus, assessment in kindergarten should focus on formation of alphabet letters and number of letters rather than fluency of writing letters. However, more research is needed including issues related to the reliability of the alphabet writing fluency task before that question can be answered definitely.

Authors' Note

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