Scaffolds and Spelling in Preschool: Using a Movable Alphabet to Measure Early Literacy

Scaffolds and Spelling in Preschool: Using a Movable Alphabet to Measure Early Literacy

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Abstract

Understanding young children's spelling abilities may provide unique insight into their overall linguistic development as well as assist in identifying children at risk for reading difficulties in ways that typical reading assessments cannot (Chua, Rickard Liow, & Yeong, 2016; Clemens, Oslund, Simmons, & Simmons, 2014; Hofslundsengen, Hagtvet, & Gustafsson, 2016; McBride-Chang, 1998; Ouellette & Sénéchal, 2017). Yet, spelling assessments are not commonly conducted before Kindergarten (age 5) and no normed instrument exists for 3- to 4-year-olds.

When spelling assessments designed for 5-year-olds are administered to younger children, young children get lower scores (Clemens et al., 2014; Puranik & Apel, 2010). These lower scores may reflect their less developed spelling ability (typical development) but they may also be influenced by aspects of development unrelated to spelling: lack of motor ability to write letters, working memory limitations, poor word choice of items to be spelled, and/or insensitive scoring systems (Apel, Wolter, & Masterson, 2006; Clemens et al., 2014; Diamond, 2013; Puranik & Apel, 2010). These latter possibilities raise the question of what would happen if we controlled these factors. Would a preschool spelling assessment that did not require handwriting and that minimized working memory demands result in higher spelling scores than a handwritten assessment? Specifically, is a movable alphabet spelling assessment a more reliable, valid, and sensitive way of measuring spelling abilities in children younger than 5 than is a handwritten assessment?

The present study employed a within-subjects quasi-experimental design in which the spelling of 3- to 4-year-old children was assessed using a movable alphabet and handwriting. Results indicated that (1) preschoolers scored higher on a movable alphabet spelling assessment than on a handwritten assessment, (2) word choice did influence results, (3) movable alphabet spelling scores were a significantly stronger predictor of phonemic awareness and letter knowledge scores than handwritten spelling scores, (4) children were more willing to attempt to spell words with the movable alphabet than with handwriting, and (5) assessment scores were not closely tied to age or measures of behavior.

To date, few if any other studies have specifically evaluated the influence of different tools on capturing the spelling abilities of preschoolers. This study expands current knowledge about the influence of motor and working memory scaffolds on the word-building capacities of 3- to 4-year-olds.

Dedication

I dedicate this thesis to my husband and children who have supported me in innumerable ways as I have pursued my studies. Further, I dedicate this to the teachers I have worked with who have had the curiosity and courage to ask questions and seek a scientific understanding of and response to what they see. Finally, I dedicate this work to the cause of the young child. The young child is in the midst of an enormous undertaking—that of creating the human they will become. When we as a culture approach them with an understanding of and reverence for this great work before them, we will know peace. May all beings benefit.

Acknowledgments

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Definition of Terms

Invented spelling: words are spelled using letters that do not correspond to a word's actual spelling but do reflect some phonetic and/or syllabic aspect(s) of the word (e.g., bt for beet or kat for cat) (Martins & Silva, 2006). Invented spelling is theorized to be an important developmental stage in learning to read and write (Martins & Silva, 2006).

Letter knowledge: refers to knowing information (names and/or sounds) about the letters of the alphabet. Letter knowledge is considered an important indicator of future reading and spelling ability (Shanahan & Lonigan, 2010; Share, Jorm, Maclean, & Matthews, 1984) and may develop in tandem with phonemic awareness once a rudimentary knowledge of phonemic awareness is acquired (Foy & Mann, 2006).

Phonemes: are the individual sounds within words. For example, the word ship has three phonemes: sh-i-p.

Phonemic awareness: describes the ability to notice the phonemes in words. This capacity is believed to be a key predictor of future reading and spelling abilities (Cummings, Kaminski, Good III, & O'Neil, 2011; Ehri et al., 2001; Melby-Lervåg, Lyster, & Hulme, 2012).

Preschool: includes children who are ages three or four and not yet enrolled in a kindergarten program.

Spelling: is the ability to link the letters of the alphabet to create words. Young children often use invented and approximate spellings before they master accurate spellings (Clemens et al., 2014).

Working memory: is the ability to maintain and manipulate information that one needs in a short amount of time (like memorizing a phone number) in a temporary storage buffer (Diamond, 2013).

Chapter I

Introduction

Most typically-developing preschoolers are pre-readers and pre-writers. This means that their reading and spelling abilities are not directly measured. Instead, they are tested on their understanding of the sounds in words (phonemic awareness) and the letters that make those sounds (letter knowledge). These measures are considered key predictors of future reading and spelling ability (Bradley & Bryant, 1983; Byrne & Fielding-Barnsley, 1995; Clemens et al., 2014; Hoover & Gough, 1990; Hulme et al., 2002; Piquard-Kipfer & Sprenger-Charolles, 2013; Shanahan & Lonigan, 2010; Share et al., 1984; Shaywitz & Shaywitz, 2001).

Spelling requires both phonemic awareness and letter-sound knowledge (Clemens et al., 2014; Richgels, 1986). In fact, spelling, phonemic awareness, and letter-sound knowledge may develop in tandem, each influencing the other (Foy & Mann, 2006; Martins & Silva, 2009; Milburn et al., 2017; Puranik, Lonigan, & Kim, 2011; Strattman & Hodson, 2005). Indeed, some researchers have suggested that spelling may be a proxy for phonemic awareness (McBride-Chang, 1998). Thus, having a way to measure preschool spelling abilities has implications for understanding developing literacy overall.

Developing Handwriting Skills

One primary challenge to accurately measuring preschool spelling abilities is that spelling assessments often rely on handwriting. Letter writing ability correlates strongly ($r = 0.63$; $p < 0.001$) (see BMJ, 2017 for ranges of correlation strength) with handwritten spelling ability in 4- to 5-year-olds (Puranik, Lonigan, & Kim, 2011; see also Milburn et al., 2017). However, very young children may not yet be able to write letters. Puranik and Lonigan (2011) found that 23.3% of 3-year-olds and 9.9% of 4-year-olds could not write any letters at all. It was not until around age 5 that most children could write more than 19 letters (Puranik & Apel, 2010). Indeed, once children could write 19 letters of the alphabet, they performed equally well on spelling assessments that were handwritten, oral, or used a movable alphabet/letter tiles (Puranik & Apel, 2010).

It is important to note that an inability to form letters with the hand does not necessarily imply a lack of knowledge about the letters (Puranik & Lonigan, 2011). In a study of 114 preschoolers, Drouin and Harmon (2009) found that preschooler ability to write their names did not correlate with their knowledge of the letters in their names. For example, of the 32 children who could not write any letters in their name, 21 knew the names of some or all of those letters. Similarly, of the 36 children who could write all of the letters in their name, only 21 knew the names of all of those letters. The authors concluded that name writing was more of a mechanical skill than a linguistic development indicator. Thus, the ability of a child to write letters with their hand does not necessarily reflect their ability to understand and use those letters with their mind. Any

spelling assessment offered to very young children must be sensitive to this developmental variability in preschool cognitive versus motor abilities.

Self-Efficacy

Young children have a developing understanding of their own abilities (Schunk & Pajares, 2001). Children's individual beliefs about their own skills and capacities are related to their willingness to attempt and persist with a new task; if they believe they are likely to succeed, they may be more willing to persist or begin something new (Zimmerman, 2000). As stated by Bandura, "…accomplishments require not only skills but self-beliefs of efficacy to use them well." (Bandura, 1993, p. 119).

Young children with little handwriting experience may not believe that they are capable of writing letters properly. As such, they may be unwilling to begin or make ongoing effort to handwrite letters. Scaffolds and guided examples, thus, may increase the child's expectancy of success and play an important role in initiating the young child into a new activity.

Attempting to spell words with a spelling scaffold may, in fact, be preferred by preschoolers. A study by Aram and Bar-Am (2016) found that when asked their preference between writing words with their mothers using a pencil and paper or a computer, 69% of the preschoolers preferred the computer. As such, it is possible that using a scaffolded spelling assessment would increase the number of attempts children would be willing to make.

Working Memory

Working memory requirements may be an additional limitation of spelling assessments (Puranik & Lonigan, 2011; Strattman & Hodson, 2005). Working memory is the ability to keep track of and manipulate information that must be used in some way (Diamond, 2013). For example, when asking a child to spell a word orally, the child must keep track of the word they were asked to spell along with the letters they use to spell it and the order in which they are to organize those letters. As such, spelling tasks require working memory capacity in addition to cognitive spelling ability (Castles, Wilson, & Coltheart, 2011).

Working memory capacity begins to form in infancy but undergoes a prolonged and extended developmental period (Diamond, 2013). This is illustrated by a study that found that children could keep significantly ($p = 0.008$) fewer items in working memory at age 3 ($M = 4.1$) than at age 6 ($M = 6.8$) (Roman, Pisoni, & Kronenberger, 2014). Overall, working memory abilities appear to be intertwined with a child's global developing linguistic abilities. For example, in a study of four- to five-year-olds, working memory scores correlated moderately with phonological awareness scores ($r = 0.50$; $p < 0.01$) (Alloway et al, 2005). Similarly, in a separate study of seven-year-olds, working memory scores correlated strongly with phonemic awareness scores (Leather & Henry, 1994). A study of second graders, however, found that scores on working memory assessments predicted some phonemic awareness scores (i.e., sound categorization) but not others (i.e., phonemic deletion) (Oakhill & Kyle, 2000). It may be that this relationship is stronger at younger ages.

Working memory demands can be decreased with the help of scaffolds.

Specifically, visual memory aids are known to reduce working memory load and thus free up cognitive resources for other tasks (Gathercole & Alloway, 2006). According to Dynamic Skill Theory (Fischer & Yan, 2002), scaffolds help reveal an individual's growing knowledge rather than their baseline, unsupported knowledge (see Figure 1). According to this theory, individuals follow a predictable path of progressions and regressions as they master new knowledge/skills (see the top, curving line in Figure 1). Assessments that do not include scaffolds (see the bottom, straight line in Figure 1) reveal a lower, functional level of understanding rather than the actual, dynamic one. Thus, scaffolded preschool spelling assessments may provide a more sensitive measure of optimal preschool spelling ability than unscaffolded assessments.

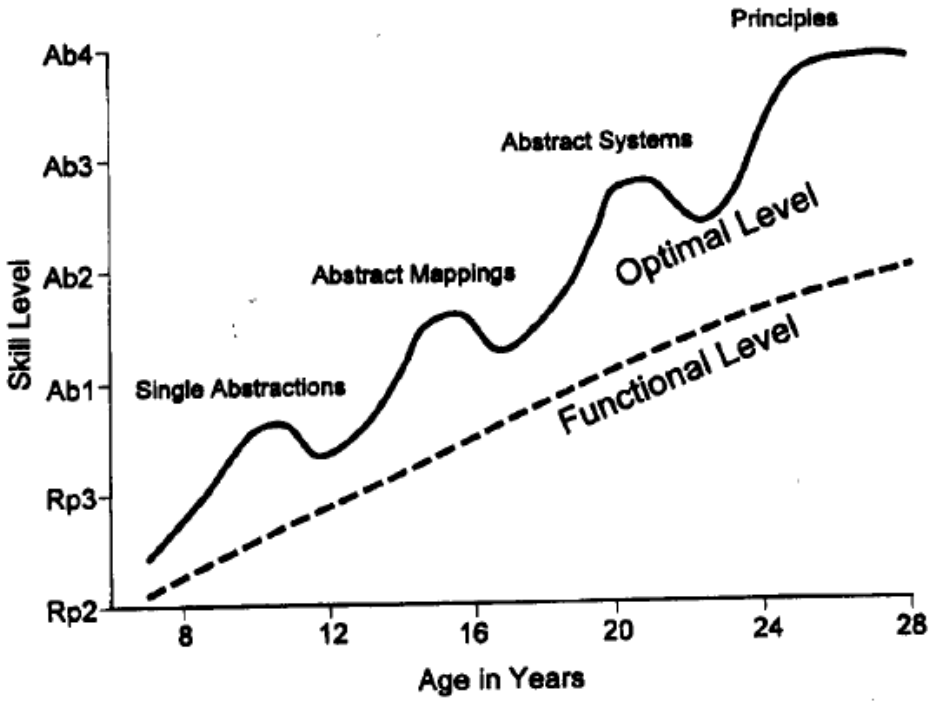


Figure 1: Acquisition of Knowledge According to Dynamic Skill Theory (reproduced from Fischer & Yan, 2002)

A question the present study was designed to address is whether a movable alphabet serves as a working memory scaffold that allows preschoolers to demonstrate a higher spelling ability than would be possible using unscaffolded assessments. A study in 2010 by Puranik and Apel (discussed in detail below) lends support to this idea. It found that preschoolers scored higher on spelling assessments that used a movable alphabet than on handwritten or oral ones.

Movable Alphabets

A movable alphabet is a physical representation of alphabet letters. Individual letters may be printed (see Figure 2) or cut-out (e.g., magnetic letters). Using a movable alphabet to "write" words provides a motor and working memory scaffold for spelling activities. First, the alphabet removes the need for children to handwrite letters. Instead, they choose and place printed letter cards to build words. Second, it decreases working memory requirements; with a finite selection of letters before them, children do not have to keep all of the symbols of English actively in mind when seeking letters.

Figure 2: Movable Alphabet

Using alphabet letters or tiles in spelling assessments of young children is not a new concept (Cunningham & Stanovich, 1990; Puranik & Apel, 2010; Richgels, 1986; Wood & Terrell, 1998). However, only Puranik and Apel (2010) have explicitly considered the influence of spelling with alphabet tiles on assessment outcomes.

Puranik and Apel studied 104 children between the ages of 3 and 5 (m = 4.3 years) from varied economic backgrounds (low, mid, and high SES). In individual assessments, children were asked to handwrite a list of spoken words, handwrite letters, orally spell a list of spoken words, and use letter tiles to spell a list of spoken words. The first and last two tasks were conducted in different sessions that were approximately one week apart. Spelling was scored based on a scale developed by Tangel and Blachman (1992) (see Appendix A and scoring discussion below).

The researchers found that preschoolers scored highest when asked to spell words with tiles as opposed to oral or handwritten spelling (see Figure 3; medians for each group not otherwise reported). Figure 3 shows that 3-year-old children using the movable alphabet had higher mean spelling scores than 4-year-old children spelling via handwriting. This supports the idea that the movable alphabet may be a more sensitive spelling assessment tool than handwritten assessments.

This study also found that the ability of the 3- to 4-year-old child to spell was correlated strongly with their ability to write the letters of the alphabet (as opposed to just the letters of their name as in the Drouin and Harmon [2009] study). Those who could write more letters received higher scores on the spelling tasks (handwriting r = 0.73; letter tiles r = 0.60; oral spelling r = 0.61; $p < 0.001$ for all). Once children could write 19

letters (around age 5), the mode of spelling assessment did not matter. Similarly, a study comparing typing, handwriting, and using letter tiles in first-grade found no benefit of using letter tiles over handwriting (Cunningham & Stanovich, 1990). This suggests that movable alphabets may be a more sensitive spelling assessment only in preschool-aged children.

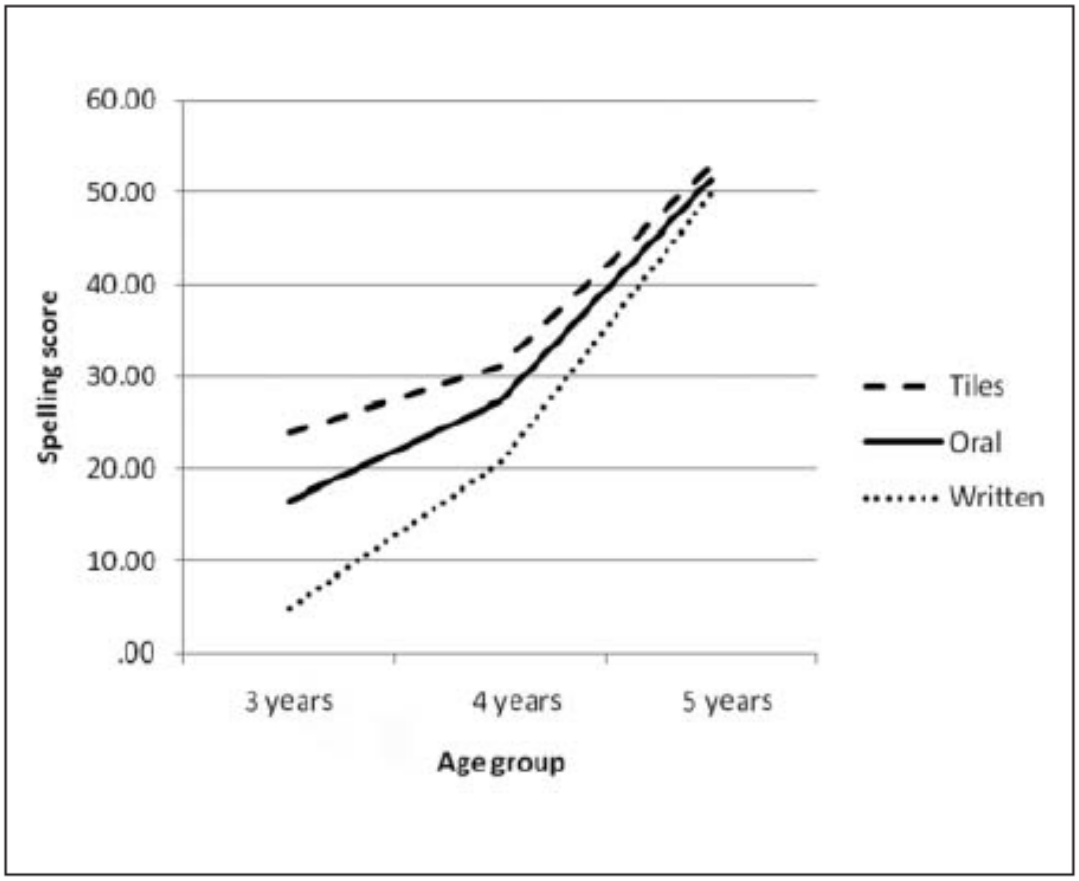


Figure 3: Mean Spelling Performance by Age/Assessment. Three- and four-year-old children had higher mean spelling scores when using a movable alphabet than when writing by hand (reproduced from Puranik & Apel, 2010).

While the Puranik and Apel study provides evidence in support of preschool spelling assessments with a movable alphabet, it did not specifically evaluate the influence of working memory scaffolds on preschooler spelling. A question the present study is designed to address is if the advantage seen in Puranik and Apel's movable alphabet group will be neutralized if each group has the working memory scaffolds of (1) a complete alphabet in front of them, and (2) a picture of the object they are being asked to spell.

It is worth looking at two other preschool studies that included a movable alphabet component. These studies demonstrate the need for a reliable, precise preschool spelling assessment that includes working memory scaffolds.

In the first study, Richgels (1986) assessed 30 four- to five-year-olds on several literacy tests including spelling spoken words with a movable alphabet made of plastic, upper case magnetic letters. In this study, four-year-olds achieved lower mean scores, 39 out of 100 (SD = 31.9), than older Kindergartners (mean age 68-71 months) in a lab school (M = 68.38) or a private school (M = 84.82). It is unclear if this significant difference indicates typical development or a lack of sensitivity of the assessment. Specifically, scores may have been lower because spelling words were presented orally rather than visually (e.g., the researcher said, "peanut butter comes in a ____; the child was meant to say the word jar); thus, the presentation lacked a working memory scaffold. Further, the words chosen could not be accurately spelled phonetically (e.g., dirt, nose), the scoring system was confusing (e.g., 'e' received full credit if used as the 'i' in kitten), and the alphabet included one copy of most letters but two copies of some (i.e., d, e, l, n,

o, p, r, s, and t) (see discussions below on inconsistent alphabet procedures, word choice, and scoring developing spelling).

Of note is that the study found that four-year-old spelling scores were moderately correlated ($r = 0.581$; $p < 0.001$) with letter name knowledge. This suggests that spelling abilities are related to letter knowledge. If this proves to be true, direct, developmentally-appropriate instruction of letter names and/or sounds during the preschool years may prove to be an important contributor to developing literacy.

In the second study, Wood and Terrell (1998) assessed the spelling and reading abilities of 30 preschool children. Children were given a battery of assessments including the British Ability Scales Spelling Assessment (BAS-SA), an assessment validated only for children over age 5. The researchers asked children to complete the BAS-SA spelling tasks with a movable alphabet rather than by handwriting. The results (see Figure 4) demonstrated that 4- to 5-year-old children had consistently higher spelling than reading abilities; children were able to apply grapheme-phoneme conversion rules to spelling tasks but not to reading tasks. This suggests that the act of creating or building words may precede the ability to read words. If this holds true, giving children practice building words at an early age (i.e., using a movable alphabet for developmentally-appropriate instruction and practice) may be a useful early reading activity (Martins & Silva, 2009). Again, this underscores the need for a sensitive assessment tool to help us accurately understand early spelling abilities.

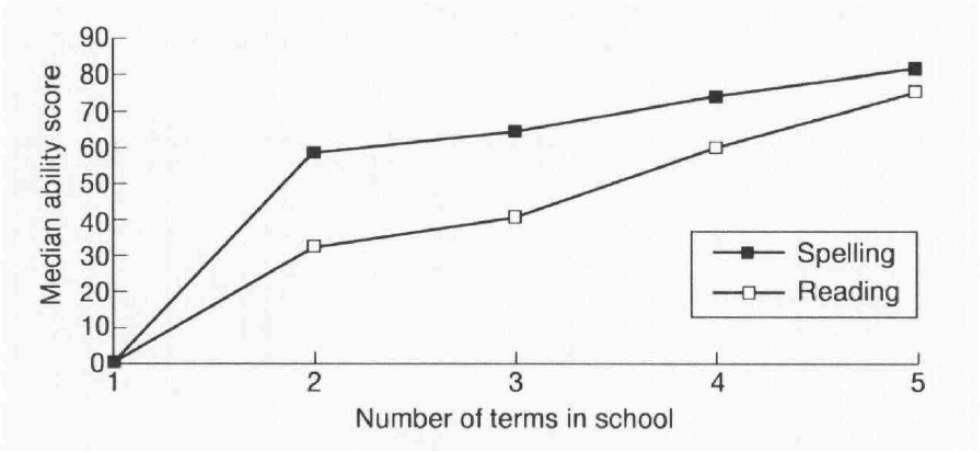


Figure 4: Scores of Spelling and Reading over Time in 4- and 5-year-old Children. Young children had consistently higher spelling than reading scores (reproduced from Wood & Terrell, 1998).

Inconsistent Alphabet Procedures

While these studies point to the possibilities of movable alphabet spelling assessments, the manner in which movable alphabets have been employed is inconsistent, adding a possible confounding variable to building understanding across studies. For example, Richgels (1986) used a magnetic letter board with Fisher Price capital magnet letters which included two of some letters and one of all others. Puranik and Apel (2010) used one of each uppercase letter tiles (but with two 'L's) that were kept "in a pile" and "scrambled" after each word was spelled. Wood and Terrell (1998) placed one of each lower-case, printed letter card in alphabetical order laid out in a double arc; when one letter was used, it was replaced with a duplicate. A consistent visual organization for the alphabets is lacking in current research and is necessary not only for the rigorous aggregation of knowledge but also for the development of a reliable instrument. Further, current research does not have a consistent approach to the use of upper- and/or

lowercase letters. There is significant variability among uppercase and lowercase letter recognition among preschoolers (Bowles, Pentimonti, Gerde, & Montroy, 2013). Some research suggests that children who have not received explicit letter knowledge instruction may be able to recognize and write uppercase letters better than lowercase ones (Bowles et al., 2013; Worden & Boettcher, 1990). But some widely used early assessment tools (e.g., the WJ IV Early Cognitive and Academic Development [ECAD] assessment) (Schrank, McGrew, & Mather, 2014) use lowercase letters.

Further research is needed in this area. In the absence of clear guidance, it is logical to match the letter case used in assessment with the case used in instruction. For example, if children are taught lowercase cursive letters at school, the assessment alphabet should be made up of lowercase cursive letters. If they are taught uppercase manuscript, the alphabet should be uppercase manuscript.

In the present study, an alphabet that matched the approach used in the children's preschool (i.e., uppercase manuscript) was used. The alphabet comprised printed letter cards (10 of each letter) housed in a 30-compartment box that provided a clear location for each letter and organized the letters alphabetically. Further, the scoring of the handwritten spelling assessment gave equal credit for uppercase and lowercase letters.

Word Choice

In spelling assessments, the selection of words to be spelled may be based on (1) research conducted in children ages 5 and older (e.g., Test of Written Spelling-3; Hammill, Larsen, & Moats, 1994), (2) commonly used word lists (e.g. Bear, Invernizzi, Templeton, & Johnston, 2000), or (3) the researchers 'best guess.' An example of the

latter can be found in Richgels (1986). Richgels chose words that could be spelled accurately using phonetically inventive spelling (e.g., 'jr' for 'jar', 'tabl' for 'table') rather than conventional spelling. Richgels' scoring system did not distinguish between inventive and conventional spelling. In another example, Martins and Silva (2009) asked children to spell, "…36 disyllabic words beginning with B, D, F, P, T and V. In half of the words the initial consonant was followed by an open vowel and in half of them by a closed one." (Martins & Silva, 2009, p. 231).

Research by Apel, Wolter, and Masterson (2006) shows that five-year-olds (1) learn conventional spellings quickly after minimal exposure to written words and (2) make spelling attempts that are influenced not only by past visual exposure to spellings (i.e., probabilities of frequent letter combinations) but also by their letter knowledge. Whether this is also true for three- and four-year-olds is currently unknown.

In the present study, words were chosen based on the likelihood that they would be known by very young children, that they were objects that could be isolated in a photo (e.g., 'cat' but not 'run'), that they follow the predictable CVC format, and that it be possible to spell them accurately using phonetics alone (e.g., no long vowel sounds like 'ee', phonograms like 'ch', or double letters as in 'bell'). However, challenge words that included digraphs (e.g., tree, fish) were used to help avoid a possible ceiling effect. The test words also favored the letters most commonly learned first by preschoolers (i.e., C, A, B, P, T, S, D, F, K, O, J, M, E, G) and avoided the letters children generally learn last (i.e., H, I, W, X, U, Y) (Piasta, Phillips, Williams, Bowles, & Anthony, 2016). Two questions this study addresses are if (1) the described approach to word selection is

appropriate for the very young child and (2) the young child's ability to handwrite specific words differs from their ability to create those words with the alphabet.

Scoring Developing Spelling

The method of "grading" a spelling test seems straightforward—the words are either accurately spelled or not. However, young children often use invented spelling; they choose letters that might logically create the required phoneme (e.g., the letter 'r' for the 'ar' phoneme) but do not reproduce the word's conventional spelling (Martins & Silva, 2006). Young children also go through a predictable developmental stage of mirror writing where letter reversals are common (Dehaene, 2009). A valid preschool spelling assessment must, therefore, be sensitive to these typical developmental representations of early literacy.

The Richgels (1986) study used a novel scoring system that included points for invented spelling; one point was given for each phoneme that was correctly identified (e.g., spelling cake as "kak" would result in full credit, 3 points). Letter reversals were ignored. This scoring system has been found to be reliable but not sensitive; words that were spelled conventionally were scored the same as those spelled inventively (e.g., the same score was achieved for spelling the word 'sock' as 'soc' or 'cic') (Tangel & Blachman, 1992).

The Puranik and Apel (2010) study used a modified version of the Tangel and Blachman (1992) handwritten spelling scoring system (see Appendix A). That 9-point system gave credit for the graphic development of early handwriting (e.g., 1 point was awarded for a scribble) and for demonstrating an understanding of print concepts (e.g., 4

points were awarded for the use of a random string of letters that were not phonetically related to the target word). Letter reversals were ignored. This scoring system was shown to be reliable ($r = 0.98$; $p < 0.001$) (Tangel & Blachman, 1992) and to have internal consistency ($\alpha = 0.96$) (Puranik & Lonigan, 2012).

The present study used a further refinement of the Tangel and Blachman (1992) system (see Table 1) that is similar to the scoring rubric employed in several other studies (Byrne & Fielding-Barnsley, 1993; Clemens et al., 2014; Hindson et al., 2005; Liberman, Rubin, Duque`s, & Carlisle, 1985). This scoring rubric gives credit for invented spelling, phonemic awareness, and letter reversals. In a study of kindergartners, Clemens and colleagues (2014) found this rubric to have a Cronbach's alpha of 0.93 for the study sample and to correlate strongly with word reading and phonemic awareness scores (ranging from $r = 0.74$ to $r = 0.77$).

Table 1

Spelling Assessment Scoring Rubric used in the Present Study (adapted from Byrne & Fielding-Barnsley, 1993; Clemens et al., 2014; Hindson et al., 2005; Liberman, Rubin, Duque`s, & Carlisle, 1985)

Score	Response	Example: cap*
6	Correct conventional spelling	cap
5	Includes all phonemes with phonetically accurate letters	kap
4	Includes all phonemes with phonetically related letters	kab
3	Includes at least 2 phonetically accurate but not all phonemes	ka or cp
2	Includes one phonetically accurate phoneme	k or p
1	Includes one related phoneme	g or b

*Letter reversals (e.g., b for d) are ignored as they are common and a sign of typical development at this age

Of note, this scoring rubric gives no points for the graphic stages of handwriting development (e.g., a scribble or drawing a circle to represent a letter) (Puranik & Lonigan, 2012; Tangel & Blachman, 1992). By so doing, identical scores were possible for the handwritten and movable alphabet spelling assessments.

Conclusion

A new approach to preschool spelling assessments is needed that can differentiate among handwriting ability, working memory capacity, and cognitive spelling ability. The present study compares a novel preschool spelling assessment that uses a movable alphabet to a spelling assessment that requires children to handwrite their responses.

This study tests the hypothesis that 3- to 4-year-old children will score as well or better on movable alphabet spelling tests than on handwritten ones. It was also expected the movable alphabet assessment scores would positively correlate with standardized tests of phonemic awareness and letter knowledge thus indicating it is a valid measure of developing literacy.

Only one other study to date has specifically evaluated the possibilities of a movable alphabet in preschool writing assessments (Puranik & Apel, 2010). That study did not (1) present the alphabet in a consistent, orderly way, (2) provide a working memory scaffold of a picture of the word to be spelled, and (3) allow children in the handwriting group to see an alphabet (a working memory scaffold) when writing words.

In sum, early spelling is an important indicator of developing literacy but research on preschool spelling abilities is lacking. By creating a reliable spelling instrument for

three- and four-year-olds, we can gain a clearer understanding of typical preschool spelling abilities. A reliable instrument must control for the very young child's developing motor skills and limited working memory capacity. Such an instrument will shed light on whether the ability to handwrite words develops later than, before, or in tandem with the cognitive ability to build words (i.e. with letter tiles).

The following specific questions are addressed in this study: (1) Do preschoolers score higher on spelling assessments using a movable alphabet than they do on those that are handwritten? (2) Does word choice influence spelling scores? (3) Are movable alphabet spelling scores a stronger predictor of phonemic awareness and letter knowledge scores than handwritten spelling scores? (4) Are children more willing to attempt to spell words with the movable alphabet than with handwriting? (5) Are assessment scores related to age or measures of behavior?

Chapter II

Method

The present study employed a quasi-experimental, within-subjects design to examine a movable alphabet spelling assessment in preschoolers.

Participants

After receiving approval from the Harvard Committee on the Use of Human Subjects, the 10 public schools in Western Massachusetts with preschool enrollment of 70 or more were contacted (see Table 2). Two schools agreed to participate (see Table 3). Students who were English Language Learners, had a known family history of reading disability, and/or with documented disabilities (e.g., communication, intellectual, motor) that would prevent them from following study procedures were excluded. After consideration of exclusion criteria and parental consent, 80 students ranging in age from 3.33 to 4.92 were invited to participate in the study.

Two children refused to begin. All other students (n=78) completed at least one of the four planned assessments. Sixty-one of the students were 4-years old and 17 were 3-years old with a mean age of 4.3 (ranging from 3.3 to 4.9). Thirty-five students were in morning-only classes, 20 were in afternoon-only classes, and 23 were in full day classes. Parental consent was gained using an opt-out form (see Appendix B).

Teachers provided the researcher with a class roster (including month and year of birth) of children eligible (i.e., who did not meet exclusion criteria and whose parents did not opt-out) to participate in the study. This roster included a coded student identifier for

Table 2

Public Schools in Western MA Invited to Participate in the Present Study. All have 70 or more preschoolers enrolled (Massachusetts Department of Elementary & Secondary Education, 2016)

District	PreK Enrolled	% First Lang Not English	% English Lang Learner	% Students With Disablts	% High Needs	% Econ. Disadv	Acctblty Level
Hampden-Wilbraham	73	3.1	0.8	15.4	24.8	12	2
Northampton	79	8.4	4.3	21.5	38.6	22.7	3
Agawam	168	7.5	4.4	16.3	38.2	25.2	2
Mohawk Trail	112	0.4	0.2	18.8	41.2	30.2	2
Westfield	178	7.5	4.7	18.2	45	32.7	3
West Springfield	105	27.1	8.3	20.1	54.2	40.5	3
Greenfield	110	7.3	3.8	16.5	54	45.6	2
Chicopee	287	12.9	4.8	18.9	58.2	48.1	3
Springfield	1,216	26.1	16.3	19.8	77.7	67.1	4
Holyoke	213	46.3	24.6	23.9	79.6	67.6	5

Table 3

Information Regarding Participating Public Schools (Massachusetts Department of Elementary & Secondary Education, 2016)

District	Total PreK Enrollment	Economically Disadvantaged (%)	Accountability Level
Mohawk Trail	112	30.2	2
Chicopee	287	48.1	3

each child and a tear-off portion for the children's names and assessment results. Each assessment packet was identified with the coded student identifier. The researcher maintained the roster under lock-and-key until (1) all data had been collected and linked with a coded student identifier, and (2) all assessment results had been shared with teachers. Once these events occurred, the researcher maintained only the tear-off portion

of the roster which included the coded identifier and month/year of birth. Only coded, de-identified data was thereafter maintained by the researcher.

Materials

The primary investigative material was the movable alphabet (see Figure 2). The box contained 10 printed cards for each letter of the alphabet. Because both schools taught children print, uppercase letters, the alphabet contained uppercase letters only. Letters were printed with black ink on 32# white paper, laminated with a 5 mil food-grade laminate, and cut so that each card was approximately 1.25” W x 2” H with rounded corners.

Additionally, the spelling assessments included a picture card for each of the 20 words on the spelling list (see Figure 5). Each picture card featured a color photo that isolated its subject (e.g., a cat on a white background, not a cat on grass) and was printed on 32# white paper, laminated with a 5 mil food-grade laminate, and cut so that each card was approximately 3.75” W x 3” H with rounded corners.

Measures

Students in all groups were evaluated using four assessments as summarized in Table 4. Children were taken to a separate testing area in an order determined by their preschool teacher (so as not to disturb children engaged in an activity). The assessments for each child took approximately 20 minutes to complete.

Figure 5: Movable Alphabet (left) and Handwritten (right) Spelling Assessments

Phonemic Awareness

Phonemic awareness was evaluated using the PALS-PreK Beginning Sound Awareness subtest. The assessor showed children a picture, named the item featured (e.g., milk) while emphasizing its initial sound, and asked the child to say the first sound of the item (1 point per correct response; 10 points maximum). This assessment was validated in a study of 289 preschool children and has a reliability rating of Cronbach's alpha = 0.83 for the study sample (Invernizzi, Sullivan, Meier, & Swank, 2004).

Letter Knowledge

Letter knowledge was evaluated using the Brief Letter Sound Knowledge Assessment (Piasta et al., 2016). The assessor showed children a list of 8 upper and lowercase letters and asked children to name each letter's sound. One point was given for each correct answer (Piasta, Phillips, Williams, Bowles, & Anthony, 2013). This

assessment was studied in 968 children and results correlated very strongly with standardized scores of letter-sound ($r = 0.84$) and letter-name ($r = 0.71$) knowledge (Farley, Piasta, & O'Connell, 2014). The three-form version, form-2, used in this assessment, was shown to have a reliability of 0.93 (Piasta et al., 2016).

Table 4

Assessments Used in the Present Study

Assessed Measure	Assessment Used
Phonemic Awareness	PALS Pre-K Beginning Sound Awareness Subtest (Invernizzi, Sullivan, Meier, & Swank, 2004)
Letter Knowledge	Brief Letter Sound Knowledge Assessment (Piasta et al., 2016)
Handwritten Spelling	Adapted from Puranik & Apel (2010)
Movable Alphabet Spelling	Adapted from Puranik & Apel (2010)
Child Behavior	Preschool Readiness Assessment: Task Orientation Subtest (PSRA-13) (Smith-Donald, Raver, Hayes, & Richardson, 2007) Preschool Behavior Assessment Rubric (PBAR)

Spelling

All scored spelling assessments drew randomly from the same pool of four practice words (i.e., pig, hat, web, gum), eight possible basic phonetic words (i.e., bat, bed, cap, cat, dog, mat, net, pot), four possible longer phonetic words (i.e., basket, cactus, magnet, sunset), and four possible challenge words that include digraphs (i.e., fish, tree, pie, boat) for a total of eight scored words used in the handwriting trials and eight used in the movable alphabet trials. (See earlier discussion on word choice for details on how these words were selected). Initially, four additional words (i.e., bag, map, mop, rat) were included in the pool of basic phonetic trial words. After the initial assessments exceeded

the desired 20-minute length, these four words were dropped. These words were excluded because three of them were repeated from the phonemic awareness assessment (i.e., bag, map, mop) and one (i.e., rat) caused aversion responses from some children.

Spelling Procedure. The researcher said she would have a turn first and then the child would have a turn. She then showed the child a picture and demonstrated how to spell the word by choosing letters from the alphabet or writing them with a pencil. For each word, the researcher carefully articulated the word, had the child repeat the word, and then emphasized each phoneme as it was written. For example, "Cat. Kuh, aaaa, tuh. We need the kuh first." Each phoneme was repeated by the researcher many times while it was written or found in the alphabet box. This procedure was the same whether the researcher was writing the practice words or the child was writing the trial words. The researcher did not indicate in any way which letter the child should choose or write. If the child asked for help, she would repeat the sound and say, "See if you can find the kuh. It's one of the letters in here." Or, "Draw the kuh." If the child was reluctant, she said, "Choose/draw the one you think is right."

Self-Efficacy. The researcher anticipated that all children would be scored on eight words for each assessment as follows: four basic words, two longer words, and two challenge words. As the assessments began, it became clear that all children were not willing to attempt all words. The researcher encouraged children to attempt all words but would stop if the child showed signs of stress or said they did not wish to do anymore. Those who were scoring high seemed more likely to attempt more words while those who had lower scores were often resistant to continuing. Based on this observation, the number of words children were willing to attempt was used as a measure of self-efficacy.

Scoring Reliability. To establish inter-rater reliability, the researcher and a trained assistant scored each of the spelling assessment results separately.

Child Behavior

Child attention and impulsive behavior during the testing sessions was assessed using the 13-item Assessor Report from the Preschool Readiness Assessment (PSRA-13) (Smith-Donald et al, 2007) (see Figure 6). The PSRA-13 was scored on a 4-point scale with 1-point given for "a" responses and 4-points given for "d" responses for a total of 52 possible points. Lower scores indicate behavioral challenges (i.e., behaviors may have interfered with testing) and higher scores indicate more regulated behaviors (e.g., behaviors did not appear to influence testing).

1. Pays attention to instructions and demonstration
   a) Child spends most of time off-task, inattentive.
   b) Child's attention frequently drifts and requires frequent prompts.
   c) Child's attention occasionally drifts, particularly at the end of activities, but is responsive to prompts.
   d) Child looks closely at pictures to distinguish between them. Child attends to and complies with interviewer.

Figure 6: Sample PSRA-13 Question

Because the PSRA-13 is a two-page form (see Figure C-4), a second, one-page matrix titled the Preschool Behavior Assessment Rubric (PBAR) (see Figure C-5) was created by the researcher in an effort to streamline the behavior assessment process without substantially changing the PSRA-13. The PBAR consolidates the PSRA-13 into 9 domains (as opposed to 13 for the PSRA-13). Like the PSRA-13, each domain is scored

on a scale of 1 to 4 with lower scores indicating more challenging behavior (see Figure 7). The researcher completed both forms immediately upon conclusion of each testing session. Significance of each assessment was calculated based on an alpha of 0.95.

Domain	Score			
	1	2	3	4
Attention	Mostly off-task, inattentive	Attention *frequently* drifts; requires frequent prompts	Attention *occasionally* drifts; responsive to prompts	Attends closely without prompting

Figure 7: Sample PBAR Question

Procedures

All assessments were administered by the researcher. Data collection forms were used to keep a detailed record of assessment results (see Appendix C).

The researcher individually escorted students from their classrooms to a designated, quiet testing area that was free from distractions. Student consent was gained by using the following interview script: “My name is Ms. Julia. Would you like to come with me and play some games with sounds and letters?” The assessments began with phonemic awareness followed by letter knowledge.

At that point, the children were shown the movable alphabet and told they would be spelling words with the alphabet letters and with a pencil. The children chose which assessment to attempt first. (*Note*: For the first four assessments, children received the handwriting spelling assessment before the movable alphabet spelling assessment. Due to the length of the initial assessment and the resultant fatigue in the child, this procedure was changed to allow the child to choose the order of the spelling assessments and,

therefore, help minimize any weighted fatigue effect.) When the children were finished, the researcher offered them a sticker to thank them for participating. While the children chose their sticker, the researcher completed the PSRA-13 and PBAR behavioral assessments. The researcher then escorted the children back to their rooms.

If a child became tired during the assessment or appeared stressed, the researcher asked the child if s/he wanted to stop and take a break or go back to their classroom.

Chapter III

Results

All data were entered into an Excel spreadsheet and quadruple-verified for accuracy. Data were then uploaded to SPSS for analysis. Key descriptive statistics are presented in Table 5. A total of 338 words were attempted with the movable alphabet while 285 words were attempted via handwriting. Forty-five children chose to attempt the movable alphabet assessment before the handwriting assessment and twenty-seven chose the reverse order. Choosing the alphabet or handwriting assessment first did not correlate significantly with any other study variable.

Two children refused to complete the Phonemic Awareness assessment. Four children refused to attempt the movable alphabet assessment and ten children refused to attempt the handwriting assessment. The researcher stopped both spelling assessments due to signs of stress in the child four times; the handwriting assessment was also stopped with one additional child. As shown in Table 6, these children had a mean letter-sound knowledge score near zero (out of 8 possible points) suggesting a relationship between letter sound knowledge and willingness to make spelling attempts.

Because children made different numbers of attempts (e.g., not all children attempted to spell all 8 test words), the analysis was run not only on their total score but also on their percentage correct. For example, if a child attempted all words (48 possible points with 6 possible points per word), and received a score of 40, their percent correct

Table 5

Descriptive Statistics

	Mean			N			Std. Deviation		
Variable	All	Age 4	Age 3	All	Age 4	Age 3	All	Age 4	Age 3
Age	4.330	4.483	3.779	78	61	17	0.385	0.273	0.151
Alphabet attempts [a]	4.330	4.610	3.350	78	61	17	2.729	2.673	2.783
Handwriting attempts [a]	3.650	3.920	2.710	78	61	17	2.837	2.789	2.889
Alphabet total score [b]	14.360	15.960	8.470	70	55	15	13.960	14.316	11.070
Handwriting total score [b]	11.050	12.120	6.920	63	50	13	13.662	13.881	12.426
Alphabet % correct	0.401	0.440	0.259	70	55	15	0.275	0.273	0.242
Writing % correct	0.296	0.326	0.179	63	50	13	0.282	0.282	0.260
Phonemic Awareness [c]	7.930	8.360	6.470	76	59	17	3.008	2.802	3.319
Letter Knowledge [a]	2.460	2.610	1.940	78	61	17	2.383	2.410	2.277
PSRA-13 [d]	41.470	42.300	38.530	78	61	17	10.131	10.029	10.248
PBAR [e]	29.010	29.530	27.180	77	60	17	6.225	6.207	6.116

[a]8 maximum. [b]48 maximum. [c]10 maximum. [d]52 maximum. [e]36 maximum.

Table 6

Spelling Assessments Not Begun

	Movable Alphabet Assessment			Handwritten Assessment		
Reason	N	Mean PA	Mean LSK	N	Mean PA	Mean LSK
Child Refused	4	6	0	10	7.2	0.8
Researcher Stopped	4	5.25	0.5	5	6.2	0.4

Notes: One child refused all assessments except the Letter Sound Knowledge assessment; his mean PA score is unknown and therefore was not included in the calculation of the PA mean. PA = Phonemic Awareness; LSK = Letter Sound Knowledge

was 83% (40 out of 48). If a child attempted 4 words (24 possible points) and received a score of 6, their percent correct was 25% (6 out of 24). To maintain the fidelity of the

statistical computations, the data were maintained and are reported in their decimal format (e.g., 83% is reported as 0.83).

On the following pages, results are reported by study question as follows: (1) Do preschoolers score higher on spelling assessments using a movable alphabet than they do on those that are handwritten? (2) Does word choice influence results? (3) Are movable alphabet spelling scores a stronger predictor of phonemic awareness and letter knowledge scores than handwritten spelling scores? (4) Are children more willing to attempt to spell words with the movable alphabet than with handwriting? (5) Are assessment scores related to age or measures of behavior?

Movable Alphabet versus Handwritten Spelling Results

All statistical analyses (see following tables) indicate that children achieved significantly higher scores on the movable alphabet assessment than on the handwritten assessment. (*Note*: For *t*-tests, cases were excluded analysis by analysis. Similar results were found in separate analyses that excluded cases listwise [data not reported]).

A paired samples *t*-test was first performed on all students who completed both spelling assessments (see Table 7). Next, it was performed only on students ($n = 41$) who completed an equal number of spelling attempts with both the movable alphabet and handwriting (e.g., attempted four words with the alphabet and four words with handwriting) (see Table 8). In both cases, the means were significantly different.

An additional *t*-test was performed (see Table 9) that controlled for the possibility of random success with the movable alphabet. During the assessments, the researcher noted if a child appeared to randomly choose letters from the alphabet (n=11) or write

Table 7

Paired Samples T-Tests (All Attempts)

	Mean Difference			St. Deviation			*t*			df			Sig. (2-tailed)		
Pairs	All	Age 4	Age 3	All	Age 4	Age 3	All	Age 4	Age 3	All	Age 4	Age 3	All	Age 4	Age 3
Alphabet – Handwriting % correct	0.118	0.121	0.107	0.192	0.203	0.146	4.883	4.205	2.644	62	49	12	0.000	0.000	0.021
Alphabet – Handwriting attempts	0.679	0.689	0.647	1.624	1.766	0.996	3.696	3.045	2.678	77	60	16	0.000	0.003	0.017
Alphabet – Handwriting score	4.524	4.980	2.769	8.004	8.594	5.019	4.486	4.098	1.989	62	49	12	0.000	0.000	0.070

Note: Percent correct scores are reported in their decimal format (not multiplied by 100). For example, 0.118 represents 11.8%.

Table 8

Paired Samples T-Tests of Children Making an Equal Number of Attempts on Alphabet and Handwritten Spelling (n=41)

Pairs	Mean Diff	St. Deviation	*t*	Df	Sig. (2-tailed)
Alphabet – Handwriting % correct	0.0695	0.1645	2.707	40	0.01
Alphabet – Handwriting total score	1.976	4.809	2.631	40	0.012

Note: Percent correct scores are reported in their decimal format (not multiplied by 100). For example, 0.0695 represents 6.95%

random letters with the pencil (n=8). For example, one child with a letter knowledge score of 2 out of 8 took out the whole stack of Qs when attempting to spell the word pot. For these children, the percent correct ranged from 0 to 0.33. This final *t*-test analyzed the scores only of children who received a score higher than 0.33 percent correct on the movable alphabet assessment. Again, the means for the two forms of assessment were significantly different (see Table 9).

Finally, a paired samples *t*-test was conducted on the subset of children who (1) scored higher than 0.33 percentage correct on the movable alphabet, and (2) made an equal number of alphabet and handwriting attempts. The mean differences remained statistically significant (see Table 10).

Word Choice

Each of the test bank words was analyzed to see if there was a difference between its mean score in the movable alphabet versus handwritten trials (see Table 11). A significant difference was not found for the frequency of words chosen but was found for the mean score (see Table 12). An independent samples *t*-test was then performed on the mean and standard deviation of each individual word score (see Table 13). A significant difference in the mean alphabet versus handwritten score was found for the words net ($p < 0.024$) and pot ($p < 0.004$) (both when equal variances were assumed and when they were not assumed). All other mean differences did not reach statistical significance.

To account for a possible influence of the words net and pot on the data analysis, the paired samples *t*-test analyzing alphabet versus handwritten scores was performed again while excluding the results for the words net and pot (see Table 14). This analysis still identified a statistically significant difference in the means.

Table 9

Paired Samples T-Tests of Children Scoring Greater than 33% Correct with the Movable Alphabet (n=33)

Pair	Mean Diff	St. Deviation	*t*	df	Sig. (2-tailed)
Alphabet – Handwriting % correct	0.187	0.215	4.978	32	.000
Alphabet – Handwriting total score	8.242	9.277	5.104	32	.000

Note: Percent correct scores are reported in their decimal format (not multiplied by 100). For example, 0.187 represents 18.7%.

Table 10

Paired Samples T-Tests of Children (n = 21) Scoring Greater than 33% Correct with the Movable Alphabet and Making an Equal Number of Attempts with the Movable Alphabet and Handwriting

Pair	Mean Diff	St. Deviation	*t*	df	Sig. (2-tailed)
Alphabet – Handwriting % correct	0.124	0.185	3.068	20	0.006
Alphabet – Handwriting total score	3.810	5.546	3.148	20	0.005

Note: Percent correct scores are reported in their decimal format (not multiplied by 100). For example, 0.187 represents 18.7%.

Scoring Reliability

The researcher and a trained assistant scored each of the spelling assessment results separately. Inter-rater reliability was established by averaging the scores for each word and then conducting a bivariate Pearson's correlation between both raters mean scores to determine the correlational level of agreement. The trained assistant's scores correlated very strongly ($r = 0.914$, $p < 0.001$) with the researcher's scores (see Table 15).

Table 11

Word Choice Descriptive Statistics

Word	Alphabet N	Writing N	Alphabet Mean Score	Writing Mean Score	Alphabet Std. Deviation	Writing Std. Deviation
Bat	32	24	2.75	2.83	2.185	2.220
Bed	33	23	2.70	2.30	1.704	2.077
Cap	23	34	2.26	2.03	1.738	1.977
Cat	35	24	2.71	2.92	2.023	1.909
Dog	35	22	2.37	1.86	1.832	2.315
Net	23	31	2.78	1.58	1.930	1.822
Pot	27	31	3.11	1.61	2.063	1.745
Rat	3	4	3.00	1.25	3.000	2.500
Mat	31	15	2.65	2.00	2.199	1.890
Basket	15	9	4.00	3.11	1.069	1.537
Cactus	7	12	3.71	3.25	1.254	1.485
Magnet	17	9	3.71	3.00	1.572	2.000
Sunset	13	10	2.92	3.50	1.038	1.780
Boat	10	10	4.40	4.40	1.265	1.075
Fish	12	9	3.08	2.00	1.379	1.414
Pie	9	8	4.44	4.88	1.130	0.354
Tree	13	7	3.92	3.57	1.441	1.134

Table 12

Word Choice Paired Samples T-Tests of Frequency and Mean Scores

Pair	Mean Diff.	St. Deviation	*t*	df	Sig. (2-tailed)
Alphabet – Writing # Times Chosen	2.94444	7.45553	1.676	17	.112
Alphabet – Writing Mean Score	0.49529	0.65454	3.120	16	.007

Table 13

Individual Word Summary Independent Samples T-Tests Comparing Mean Scores (equal variances assumed)

Word	Alphabet – Writing Score Mean Diff	St. Error Diff	*t*	df	Sig. (2-tailed)
Bat	-0.080	0.594	-0.135	54.000	0.893
Bed	0.400	0.507	0.790	54.000	0.433
Cap	0.230	0.509	0.452	55.000	0.653
Cat	-0.210	0.524	-0.401	57.000	0.690
Dog	0.510	0.552	0.923	55.000	0.360
Net	1.200	0.514	2.334	52.000	0.024
Pot	1.500	0.500	3.000	56.000	0.004
Mat	0.650	0.662	0.981	44.000	0.332
Basket	0.890	0.531	1.676	22.000	0.108
Cactus	0.460	0.670	0.687	17.000	0.501
Magnet	0.710	0.712	0.998	24.000	0.328
Sunset	-0.580	0.591	-0.982	21.000	0.337
Boat	0.000	0.525	0.000	18.000	1.000
Pie	-0.440	1.242	-0.354	15.000	0.728
Tree	0.350	0.631	0.554	18.000	0.586

Table 14

Paired Samples T-Tests Excluding the Words Net and Pot

Variables	Mean Diff	St. Deviation	*t*	df	Sig. (2-tailed)
Alphabet – Writing # attempts	0.635	1.716	2.937	62	0.005
Alphabet – Writing total score	4.524	8.004	4.486	62	0.000
Alphabet – Writing % correct	0.118	0.191	4.883	62	0.000

Table 15

Inter-Rater Reliability Descriptive Statistics

Rater	Mean Score per Word	St. Deviation
1	2.934	0.878
2	2.901	0.822

Measure of Developing Literacy/Concurrent Validity

The concurrent validity of the movable alphabet assessment was established by examining its associations with other measures (i.e., the PALS Prek, the Brief Letter Sound Knowledge Assessment, and the handwritten assessment) (Slentz, 2008). Pearson's correlations were conducted on all assessment parameters (see Table 16) and scatterplots were inspected for linearity and outliers. As shown in Table 16, for all spelling measures, correlations with phonemic awareness and letter knowledge were somewhat stronger for the movable alphabet assessment than for the handwritten assessment. Letter knowledge scores correlated very strongly with total movable alphabet assessment scores ($r = 0.849$, $p < 0.01$) and strongly with total handwritten assessment scores ($r = 0.696$, $p < 0.01$). A Fischer r to z transformation indicates that this difference is significant ($z = 3.164$; $p < 0.01$) (Lee & Preacher, 2013). Phonemic awareness scores were moderately correlated with total movable alphabet spelling scores ($r = 0.451$, $p < 0.01$), total handwritten spelling assessment scores ($r = 0.426$, $p < 0.01$), and letter sound knowledge scores ($r = 0.507$, $p < 0.01$).

Table 16

Pearson's Correlations

Measure	Statistic	PA	LSK	PSRA-13	PBAR	Alphabet % correct	Alphabet Attempts	Alphabet total score	Writing % correct	Writing Attempts	Writing total score	Age
Phonemic Awareness	Pearson Correlation	1	.507**	.250*	.241*	.495**	.422**	.451**	.469**	.281*	.426**	.380**
	Sig. (2-tailed)		.000	.029	.037	.000	.000	.000	.000	.014	.001	.001
	N	76	76	76	75	69	76	69	62	76	62	76
Letter Sound Knowledge	Pearson Correlation	.507**	1	.287*	.266*	.832**	.743**	.849**	.705**	.606**	.696**	.273*
	Sig. (2-tailed)	.000		.011	.019	.000	.000	.000	.000	.000	.000	.016
	N	76	78	78	77	70	78	70	63	78	63	78
PSRA-13	Pearson Correlation	.250*	.287*	1	.966**	.204	.444**	.299*	.326**	.393**	.335**	.226*
	Sig. (2-tailed)	.029	.011		.000	.090	.000	.012	.009	.000	.007	.047
	N	76	78	78	77	70	78	70	63	78	63	78
PBAR	Pearson Correlation	.241*	.266*	.966**	1	.198	.431**	.275*	.300*	.393**	.297*	.263*
	Sig. (2-tailed)	.037	.019	.000		.103	.000	.022	.018	.000	.019	.021
	N	75	77	77	77	69	77	69	62	77	62	77
Alphabet % correct	Pearson Correlation	.495**	.832**	.204	.198	1	.692**	.909**	.767**	.490**	.716**	.349**
	Sig. (2-tailed)	.000	.000	.090	.103		.000	.000	.000	.000	.000	.003
	N	69	70	70	69	70	70	70	63	70	63	70
Alphabet Attempts	Pearson Correlation	.422**	.743**	.444**	.431**	.692**	1	.872**	.700**	.830**	.739**	.386**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000
	N	76	78	78	77	70	78	70	63	78	63	78
Alphabet total score	Pearson Correlation	.451**	.849**	.299*	.275*	.909**	.872**	1	.814**	.694**	.835**	.306**
	Sig. (2-tailed)	.000	.000	.012	.022	.000	.000		.000	.000	.000	.010
	N	69	70	70	69	70	70	70	63	70	63	70
Writing % correct	Pearson Correlation	.469**	.705**	.326**	.300*	.767**	.700**	.814**	1	.737**	.940**	.313*
	Sig. (2-tailed)	.000	.000	.009	.018	.000	.000	.000		.000	.000	.013
	N	62	63	63	62	63	63	63	63	63	63	63

Measure	Statistic	PA	LSK	PSRA-13	PBAR	Alphabet % correct	Alphabet Attempts	Alphabet total score	Writing % correct	Writing Attempts	Writing total score	Age
Writing Attempts	Pearson Correlation	.281*	.606**	.393**	.393**	.490**	.830**	.694**	.737**	1	.842**	.340**
	Sig. (2-tailed)	.014	.000	.000	.000	.000	.000	.000	.000		.000	.002
	N	76	78	78	77	70	78	70	63	78	63	78
Writing total score	Pearson Correlation	.426**	.696**	.335**	.297*	.716**	.739**	.835**	.940**	.842**	1	.245
	Sig. (2-tailed)	.001	.000	.007	.019	.000	.000	.000	.000	.000		.053
	N	62	63	63	62	63	63	63	63	63	63	63
Age	Pearson Correlation	.263*	.116	.154	.158	.273*	.191	.222	.214	.178	.155	1
	Sig. (2-tailed)	.022	.312	.177	.170	.022	.094	.065	.093	.120	.225	
	N	76	78	78	77	70	78	70	63	78	63	78

Note: PA = Phonemic Awareness. LSK = Letter Sound Knowledge

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Self-Efficacy

As shown in Table 16, the number of attempts children made on spelling correlated strongly with letter knowledge for the alphabet assessment ($r = 0.743$, $p < 0.01$) and moderately for the handwritten assessment ($r = 0.606$, $p < 0.01$).

Child Behavior and Age

There were weak but significant positive correlations among child behavior and all assessment results as measured by both the PSRA-13 and the PBAR (see Table 16). There was a very strong correlation ($r = 0.966$, $p < 0.01$) between these two behavioral assessments.

Both three-year-olds and four-year-olds scored significantly higher on the movable alphabet spelling assessment than on the handwritten spelling assessment in terms of number of attempts and percent total possible points (see Table 7). While the four-year-olds also scored significantly higher on total alphabet points than on total handwritten points, the three-year-olds did not (see Table 7); this difference highlights the fewer number of spelling attempts three-year-olds were willing to make.

There were weakly positive correlations between child age and both phonemic awareness and alphabet percent correct (see Table 16). A summary independent *t*-test was performed on the means and standard deviations of all results for four-year-olds as compared with three-year-olds (see Table 17). Again, there were significant differences only in the movable alphabet percentage correct score ($p < 0.023$) and the phonemic awareness score ($p < 0.021$).

Table 17

Summary Independent Samples T-Tests for 4-year-olds Compared with 3-year-olds

Variables	Mean Diff.	St. Error Diff	*t*	df	Sig. (2-tailed)
4yo – 3yo Alphabet # attempts	1.260	0.740	1.704	76	0.930
4yo – 3yo Writing # attempts	1.210	0.771	1.570	76	0.121
4yo – 3yo Alphabet total score	7.490	3.994	1.875	68	0.065
4yo – 3yo Writing total score	5.200	4.236	1.228	61	0.224
4yo – 3yo Alphabet % correct	0.181	0.78	2.328	68	0.023
4yo – 3yo Writing % correct	0.147	0.86	1.700	61	0.094
4yo – 3yo Phonemic Awareness	1.890	0.804	2.350	74	0.021
4yo – 3yo Letter Knowledge	0.670	0.653	1.026	76	0.308
4yo – 3yo PSRA-13	3.770	2.763	1.364	76	0.176
4yo – 3yo PBAR	2.350	1.700	1.382	75	0.171

Chapter IV

Discussion

This study examined a new preschool spelling assessment, the movable alphabet. The goal was to determine if a movable alphabet assessment would be a more sensitive measure of a child's cognitive spelling ability than a handwritten one because it removes the potential confounds of immature handwriting ability and immature working memory capacity.

This study demonstrates that, given developmentally appropriate scaffolds, preschoolers can spell. The study results support the hypothesis that a movable alphabet spelling assessment is a more reliable, valid, and sensitive way of measuring preschool spelling abilities than a handwritten assessment. Children had significantly higher scores with the movable alphabet assessment than with the handwriting assessment, even when controlling for word choice, the fewer handwritten attempts made, and/or random selection of letters. This suggests that the lower scores historically reported on handwritten preschool spelling assessments may not represent typical development. Instead, those lower scores may reflect aspects of development unrelated to spelling such as a lack of motor ability to write letters or working memory limitations.

The children included in this study received standard public preschool literacy instruction. Each day they would hear at least one book read aloud to them. They would sing songs, have their attention drawn to the beginning sounds in words, learn the names of alphabet letters, and learn to recognize those letters in words. They did not receive

explicit instruction in phonemic awareness segmenting (hearing *all* the phonemes in a word) or letter-sound knowledge. With this in mind, the critical question becomes, what spelling and later reading results would be seen in a population of students who did receive explicit, developmentally-appropriate phonemic awareness and letter-sound instruction? Is education missing a key developmental window for offering children the phonemic keys of English?

Scaffolds

Both the movable alphabet and handwritten spelling assessments used scaffolds. The primary scaffold, the movable alphabet, was visible, within the child's reach, and regularly accessed by the children during both assessments. The children would often sing the alphabet song as they looked through the movable alphabet letters in search of a specific phoneme. For the movable alphabet assessment, they then picked up the letters of interest and placed them on the table. For the handwritten assessment, several children took out the letter of interest and tried to copy its form with their pencil.

Even with the alphabet visible for both assessments, scores were still significantly higher for the moveable alphabet assessment. The Puranik and Apel (2010) study discussed earlier also found higher scores for alphabet spelling than handwritten spelling. However, that study did not allow the handwriting group to see the alphabet tiles. This raised the question of whether seeing the alphabet alone (a working memory scaffold) would be enough to improve handwritten spelling scores. In the present study, this was not the case. While the researcher observed the children using the alphabet as a scaffold

for the handwritten assessments, it alone was not enough to raise their handwritten scores to a level comparable with those seen with the movable alphabet.

Word Choice

The children were able to spell almost all of the words in the present study equally well whether by hand or with the alphabet. However, two of the words, net and pot, resulted in significantly lower scores when the children were asked to write them by hand. It could be that the ability to handwrite some of the letters in these words is typically mastered later than others. Since word choice can affect results, more research should be done on the words chosen for use in preschool spelling assessments.

Self-Efficacy

The children displayed a clear desire for their spellings to be accurate. For example, one child who received a letter knowledge score of 1, made only one attempt at the movable alphabet. When asked to complete the writing assessment, after the two practice trials, the child said, “I don’t know how to write that.” The researcher responded, “Just try your best.” The child returned emphatically, “I can’t do my best!” and refused to make a single mark with the pencil. Another child with a letter knowledge score of zero completed one movable alphabet word but refused to pick up the pencil and said flatly, “I can’t write.”

Indeed, children were more willing to try and spell words with the movable alphabet (338 words attempted) than with handwriting (285 words attempted). Moreover, children were more than two times more likely to refuse to begin the handwritten

assessment (n = 10) than the movable alphabet assessment (n = 4). This may demonstrate the children's developing sense of self-efficacy as driven by their awareness of their own immature handwriting skills. The children may have been less likely to attempt the handwritten words because they did not believe they would be able to write them accurately.

Many children made comments (see Table 18) that illustrate the role of self-efficacy in preschool spelling assessments. For example, one child said, "I don't know how to make an 'n.' I can't do it. I know how to make 'a's. 'A's are not as tricky." He then proceeded to draw an 'a' even though 'n' was the correct spelling choice. Thus, in handwritten spelling assessments, young children may write letters they can form instead of those that are phonetically accurate. They prioritize the letter's handwritten appearance over the accuracy of the letter chosen. As such, a movable alphabet assessment is a more sensitive measure of developing spelling than a handwritten one.

The comments in Table 18 not only reveal the importance of self-efficacy in preschool assessments, but also raise the question of whether unscaffolded assessments may contribute to the self-efficacy decline noted as children progress through school (Schunk & Pajares, 2001). Indeed, the researcher felt compelled to stop the spelling assessments with five children who appeared to be diminished and psychologically stressed by their uncertain spelling ability.

Table 18

Selected Comments Made by Children During the Spelling Assessments

Assessment	Comments
Movable Alphabet	• “I can’t find it by myself.”
	• Sang alphabet song while looking for letter
	• “Is it this one? I can’t find it. I don’t know what it is.”
	• “I don’t know what that is.”
Handwritten	• "Can I just draw any letter? I can do a ‘s’. I don't know what an ‘m’ makes."
	• "I don't know how to make an ‘n’. I can't do it. I know how to make ‘a’s. ‘A’s are not tricky."
	• "I never drawed a ‘e’ before. I made a three."
	• "Which letter is it? I can't make that. I know how to draw x."
	• “I don’t know how to write a ‘k’. It’s somewhere here…” Then searched the alphabet for the ‘k’ and attempted to copy its form with handwriting.
	• "Does this look like that? No, it has an up and down. It needs down and up. You show me the letters. I don't know."
	• Child: "I don't know how to write that." Researcher: "Just try your best." Child: "I can't do my best." Then refused to continue.
	• “I can’t write.” Then refused to begin.
	• "I don't know how to make ‘m's. Let's see if I can make an m again. That's not exactly m."
	• "What’s the ‘t’ look like? I can't do it. How do you do it?"
	• “I can’t try.”
	• “I can’t do it.”
	• "I don't know how to do it. I need help. Can you write it down for me? I don't know how to."
	• "I don't know how to make a t." Points at letters in alphabet box in order to find the T while singing the alphabet song.
	• "Is it a line down? Is it a circle? I don't know what the letter is."
	• "I can't. Maybe I'll draw grass."
	• "I can't do it. Can I just use the letter?"
	• “I don’t know what it looks like.”
	• “I don’t know how to make it.”
	• "I don't know how to write an m. I don't know how to write much."

Measure of Developing Literacy

The study findings suggest that a movable alphabet spelling assessment is a valid measure of developing literacy. Movable alphabet assessment results correlated strongly or very strongly with letter knowledge scores and moderately with phonemic awareness scores, two accepted measures of developing literacy. The finding that alphabet scores correlated more strongly with these measures than handwritten spelling suggests that it may be a more sensitive assessment for this age group.

The moderate correlations between phonemic awareness and both spelling measures is an unexpected finding that may be related to the limitations of the Beginning Sound Awareness subtest of the PALS Pre-K. There was a moderate correlation between phonemic awareness scores and letter knowledge scores ($r = 0.507$, $p < 0.01$) as compared with the very strong ones between letter knowledge and alphabet spelling ($r = 0.849$, $p < 0.01$). The Beginning Sound Awareness subtest does not consider a child's ability to hear all of the sounds in a word, only the initial sound. The spelling assessments, however, required them to notice each sound within each word (as scaffolded by the researcher's repeated articulation). The Beginning Sound Awareness subtest alone may lack sensitivity. Further research might evaluate whether a phonemic awareness assessment that considers beginning, ending, and middle sounds (segmenting) would correlate strongly with letter knowledge and spelling scores

Age

Curiously, age did not seem to exert a decisive influence on assessment outcomes. There were only significant differences between age and scores of (1) phonemic

awareness and (2) alphabet percent correct. This raises the possibility that three-year-olds are as capable as four-year-olds when it comes to orthographic understanding.

These findings also question the expectation that letter knowledge and spelling develop along a linear, age-related path. In fact, it appears that the capacity to spell words is not dependent on age but is instead dependent on letter sound knowledge as suggested by the very strong correlations found (see Table 16).

It may be that there is a unique developmental window when it is easiest for very young children to absorb and begin to use (via movable alphabet spelling) orthographic knowledge. Future studies with a larger population of three- and four-year-olds should investigate the implications of offering developmentally-appropriate, explicit instruction on letter sounds in preschool. Any such instruction must be tailored to the very young child's unique developmental needs (e.g., relationship-based learning, adequate rest, movement) and not delivered in a traditional 'academic' format.

Behavior

While there was great variability in the behavior scores of individual children (PSRA-13: $M = 41.470$; $SD = 10.131$; 52 possible points), there were only weak to moderate correlations between behavior and any of the assessment results. This unexpected finding suggests that not only is behavior highly variable in this age group but that it is not directly linked with cognitive capacity. This points to the need for preschool educators to remain flexible in terms of child behavior, overlooking much, so that the child's true capacities may be revealed. The strong correlation between the PSRA-13 and the PBAR suggests that the one-page nine-item PBAR form may be used

in lieu of the two-page 13-item form. Further studies on the validity of the PBAR are recommended.

Scoring Sensitivity

Overall, spelling scores were low (e.g., a mean of 40.1% correct for the alphabet and 29.6% correct for handwriting). This may be related to a lack of sensitivity in the scoring rubric. During the scoring, both raters noticed that the rubric did not (1) adequately account for the longer words included in the word bank (e.g., basket, magnet), and (2) give credit for a mix of phonetically-accurate and phonetically-related letters. For example, one child wrote "BLSKLT" with the movable alphabet when spelling the word basket. The child accurately received only 3 points even though she identified four of the phonemes in the word. Similarly, another child wrote "BAP" when spelling bed. He received only 2 points for the phonetically accurate "B" with no credit given for "A" (which is phonetically-related to "E").

A more sensitive rubric might use a higher scale that included the possibility of longer words and a mix of phonetically-accurate and phonetically-related phonemes. One possible rubric for future studies is included in Table 19.

Research Limitations and Future Directions

The key finding of this study, that children score higher with a movable alphabet spelling assessment than a handwritten one, raises the question of using the movable alphabet as an instructional tool rather than just an assessment tool. Would teaching preschoolers (in a developmentally-appropriate manner) to use a movable alphabet to

build words phonetically influence future reading ability? Future studies should specifically investigate this question.

Table 19

Revised Scoring Rubric to be Considered in Future Studies that Include Longer Words

Score	Response
10	Correct conventional spelling
9	Includes four or more phonetically accurate phonemes
8	Includes three phonetically accurate and at least one phonetically related phoneme
7	Includes three phonetically accurate phonemes
6	Includes two phonetically accurate and one phonetically related phoneme
5	Includes two phonetically accurate phonemes
4	Includes one phonetically accurate and one phonetically related phoneme
3	Includes two phonetically related phonemes
2	Includes one phonetically accurate phoneme
1	Includes one phonetically related phoneme

**Note*: Letter reversals (e.g., b for d) are ignored as they are common and a sign of typical development at this age. Uppercase, lower case, or a mix of letters are scored as equally acceptable

This study did not evaluate current reading ability. The question that remains is if invented spelling develops before or in tandem with reading? As Martins & Silva (2009) suggest, the cognitive capacity to build words may develop before the ability to decode/read them. Future studies should include a reading assessment to shed light on this.

This study included a small population of three-year-olds as compared with 4-year-olds. Future studies should aim to include a larger pool of younger children to confirm the findings on age.

This study did not directly assess working memory capacity. However, the scaffolds used were designed to decrease working memory load. Future studies should

include a working memory measure and randomized children to receive the assessment with or without the additional working memory scaffolds.

Studies suggest a significant influence of SES and vocabulary knowledge on literacy and brain development (Boles, 2011; Hart & Risley, 1992). This study considered socioeconomic status only on a school-wide basis. Future studies may directly assess the influence of SES on spelling scores at the individual-level.

The assessments took approximately 20 minutes to complete with the spelling assessments being administered last. As noted in the Methods section, a fatigue effect was sometimes observed in the children. Future studies may omit the phonemic awareness and letter-knowledge assessments in order to shorten total assessment time. In addition, future studies may evaluate the influence of assessment order on results to determine if there is a practice effect and/or fatigue effect by randomizing children to receive one or the other assessment first.

This scoring rubric may not have been sensitive to the added challenge of spelling longer words. A new study may evaluate the sensitivity of different scoring rubrics. Further, part of the challenge in scoring methods may be agreement on what constitutes a phonetically accurate sound. Is the sound for ‘p’ related to the sound for ‘b’? Is ‘g’ related to ‘k’? Having agreement on phonetically-accurate and phonetically-related sounds is relevant for sensitive scoring systems. Future research might create a chart to guide assessors in accurately scoring invented spellings. This chart would have to be regionalized to represent the different dialects in English (e.g., Boston, Louisiana, Melbourne, London).

This study is a quasi-experiment because it is not completely random in its selection and assignment of subjects. School selection was limited to public schools in Western Massachusetts who were willing to participate. This convenience-base creates a selection threat to the study's internal validity.

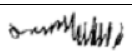
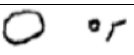
Appendix A

Scoring Scale used in Historical Handwritten Spelling Assessment

The following scoring system was not used in the present study. However, it is useful to notice the changes between this system (for handwritten assessments) and the present system.

Table A-1

Spelling Scoring System used in Historical Spelling Assessments (reproduced from Puranik & Lonigan, 2012 as modified from Tangel & Blachman, 1992)

Score	Stage	Rule	mat	bed
0		No response		
1	Graphic	A scribble produced by scratching.		
2		A single good form (e.g., a square, a circle-like form, a triangle-like form) not produced just by scratching, but in a more controlled manner.		
3	Literate	**Conventional symbol:** The writing contains at least one real letter not phonetically related to the letters in the word. A dot or a circle on its own is not considered a conventional symbol.	P,W	X,Y,C
4		**Random string of letters:** More than one random (not phonetically-related) letters.	Apn, cxo, cvh, lfk	nx, ops, npt, gan
5	Early Phonetic	**Early phonetic representation:** The writing contains at least a single letter that is phonetically-related to the word the child was asked to write in any position of the word.	tio, tte, sai, eht, agm	Dad, Deh, ced
6		**Correct first letter of the word:** Correct first letter in initial position and/or with phonetically related letters.	M, mnn	bptre, bpt, bht
7	Phonetic	**Multiple phonetic representation**: The writing contains 2/3 related phonemes but not a repetition of the same letter. The first letter of the word must be in the initial position.	mab, mht, map	bdc, bdd, bcd, bd, bzd
8		**Invented spelling:** The writing contains two or more phonetic letters that represent most of the word's phonemes, along with any attempt to represent the vowel.	matt, mta	bad, bde, bied
9	Correct	**Conventional spelling:** The word the child was asked to write is written in its conventional form.	mat	bed

**Note*: Letter reversals (e.g., b for d) are ignored as they are common and a sign of typical development at this age. Uppercase, lower case, or a mix of letters are scored as equally acceptable

Appendix B: Parental Opt-Out Form

Preschool Literacy Study: Information for Parents

Your child's preschool class has been chosen for inclusion in a study of preschool literacy being conducted by a graduate student (Julia Volkman; 413-695-4946; jvolkman@g.harvard.edu) at Harvard University. The study will evaluate a new way to assess what children know about sounds and letters. The assessment will take approximately 20-minutes during which your child will look at pictures and work with letters to build words. Your child's results will be given to your child's teacher who can then share them with you. (However, since we are just testing this new assessment, we don't yet know if your child's scores will be reliable indicators of their developing ability.) To protect your child's anonymity, only your child's first name and month/year of birth will be given to the researcher. The researcher will not keep any information that includes your child's name after the study ends. The de-identified data collected will be analyzed to see if the assessment methods studied are effective. The results will be included in Ms. Volkman's thesis and may be published in an academic journal so that other educators can learn about the study. Participation is voluntary.

If you would like to speak with the research team or have any questions, concerns, or complaints about the research or if you would like a copy of the school's permission to participate, please contact Ms. Volkman. You may also contact the faculty member supervising this work: Stephanie M. Jones, PhD., stephanie_m_jones@gse.harvard.edu, 617-496-2223. This research has been reviewed and approved by the Harvard University Committee on the Use of Human Subjects in Research. You may reach them at 617-495-5459, cuhs@fas.harvard.edu.

If you would like your child to be included in the study, you don't need to do anything. If you would prefer that your child not be included in the study, please sign this form and return it to your child's teacher.

____ Please do NOT include my child _____ in this study.

_____
Signature of parent

Disclosure: Ms. Volkman is the President and sole owner of Maitri Learning, a small business that prints and manufactures Montessori materials including the black and white movable alphabet used in this research study.

Figure B-1: Parental Opt-Out Form

PALS Beginning Sound Awareness Scoring Sheet

Word	Score (+ identified, - not identified)
PRACTICE ITEMS: 1. man 2. sock 3. bag 4. sink	
1. milk	
2. ball	
3. six	
4. bird	
5. map	
6. sick	
7. meat	
8. bear	
9. mop	
10. sad	
TOTAL SCORE:	

Student Identifier	

Letter Sound Short Form Assessment Score

Letter Sound Tally	
Letter Sound Score	**Number correct:**
	Scaled score:
	Sum score:

No. Correct	Scaled Score (*SE*)	Sum Score
0	17.89 (1.27)	.87
1	19.09 (.95)	2.76
2	19.87 (.76)	5.59
3	20.45 (.67)	8.84
4	20.94 (.64)	12.17
5	21.43 (.66)	15.47
6	21.96 (.73)	18.66
7	22.62 (.86)	21.58
8	23.52 (1.07)	23.90

Figure C-1: Phonemic Awareness & Letter Knowledge Data Collection Forms

Spelling Scoring Rubric

Score	Response	Example: cap*
6	Correct conventional spelling	cap
5	Includes all phonemes with phonetically accurate letters	kap
4	Includes all phonemes with phonetically related letters	cab
3	Includes at least 2 phonetically accurate but not all phonemes	cp or ka
2	Includes one phonetically accurate phoneme	k or p
1	Includes one related phoneme	g or b

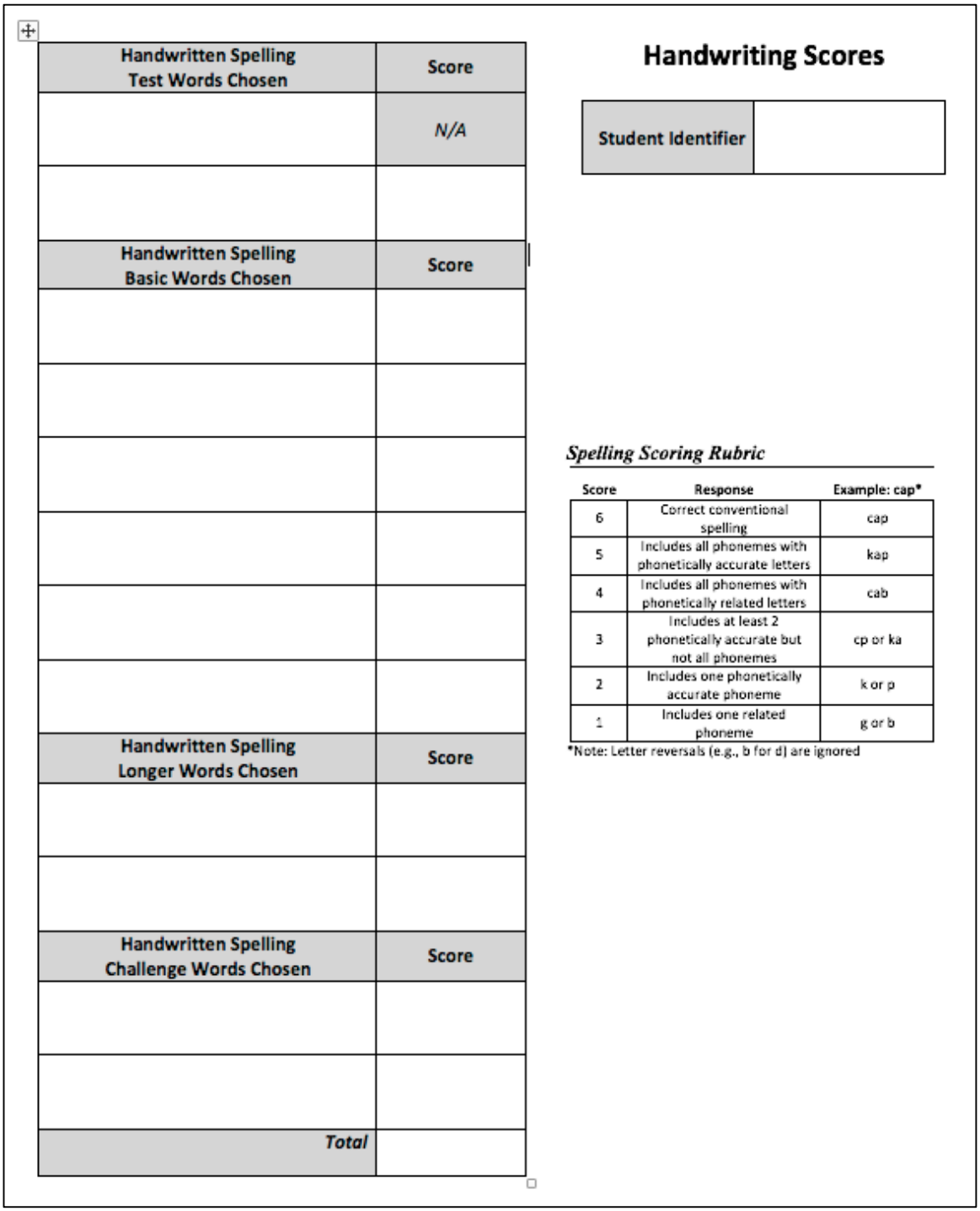
*Note: Letter reversals (e.g., b for d) are ignored

Movable Alphabet Scores

Student Identifier	

Test Words Chosen	**Child's Spelling**	**Score**
	spelled by researcher	*N/A*
Basic Words Chosen	**Child's Spelling**	**Score**
Longer Words Chosen	**Child's Spelling**	**Score**
Challenge Words Chosen	**Child's Spelling**	**Score**
	Total	

Figure C-2: Movable Alphabet Spelling Assessment Data Collection Form



Handwritten Spelling Test Words Chosen	Score
	N/A
Handwritten Spelling Basic Words Chosen	**Score**
Handwritten Spelling Longer Words Chosen	**Score**
Handwritten Spelling Challenge Words Chosen	**Score**
Total	

Handwriting Scores

Student Identifier	

Spelling Scoring Rubric

Score	Response	Example: cap*
6	Correct conventional spelling	cap
5	Includes all phonemes with phonetically accurate letters	kap
4	Includes all phonemes with phonetically related letters	cab
3	Includes at least 2 phonetically accurate but not all phonemes	cp or ka
2	Includes one phonetically accurate phoneme	k or p
1	Includes one related phoneme	g or b

*Note: Letter reversals (e.g., b for d) are ignored

Figure C-3: Handwriting Spelling Assessment Data Collection Form

TASK ORIENTATION Student ID: _____ Total score: _____

Rate each child on each of the following based on your observations during the ENTIRE assessment period. Circle the letter that corresponds to the statement that best describes the child's behavior.

1. Pays attention to instructions and demonstration
   a) Child spends most of time off-task, inattentive.
   b) Child's attention frequently drifts and requires frequent prompts.
   c) Child's attention occasionally drifts, particularly at the end of activities, but is responsive to prompts.
   d) Child looks closely at pictures to distinguish between them. Child attends to and complies with interviewer.

2. Careful, interested in accuracy
   a) Child is frequently haphazard and unfocused when answering items.
   b) Child is careless at times.
   c) Child is generally careful but interest flags, particularly at end of testing session
   d) Child takes the time to look and appears to make thoughtful choices, particularly on hard items.

3. Sustains concentration; willing to try repetitive tasks
   a) Child not able to concentrate or persist on much of the assessment.
   b) Child frequently distracted, requires multiple prompts from tester.
   c) Child occasionally distracted but generally persistent, but does not require prompt from tester.
   d) Child able to concentrate and persist with task, even toward end of tasks and with distractions.

4. Is careless or destructive with test materials
   a) Child gets too "rowdy" with materials and breaks or damages test materials.
   b) Child is **repeatedly** careless but does not damage materials, paper. Needs repeated reminders.
   c) Child is careless or slightly destructive **one time**. Can include kicking, dropping object on floor "by mistake."
   d) Child is not careless and is not destructive.

5. Can wait during and between tasks
   a) Child is impulsive throughout assessment, needs lots of boundary-setting; transitions between tasks made difficult because of child's activity level/impulsivity.
   b) Child is often impulsive across multiple tasks or highly impulsive during one activity; child needs multiple prompts to wait while tester gathers materials for new task.
   c) A few instances of impulsive behavior; child sometimes shows anticipation for interesting task materials but rarely needs a reminder.
   d) Child waits before pointing to materials, reaching for blocks, etc., and waits patiently for new tasks to begin; no ambiguous or impulsive behaviors.

6. Remains in seat appropriately during test
   a) Out of seat frequently or difficult to manage (e.g. runs around room, climbs on furniture).
   b) Needs multiple reminders to return to seat, sit up but listens and responds to prompts.
   c) Gets out of seat 1x (including sliding off chair), returns to seat when prompted.
   d) Does not climb, open closets, grab objects. (Occasional adjustment in body position is appropriate)

Figure C-4: PSRA-13 Behavioral Assessment, Page 1 (Smith-Donald et al., 2007)

7. Alert and interactive; is not withdrawn
   a) Child seems "shut down" and difficult to engage in starting task.
   b) Child repeatedly withdraws from testing situation and needs encouragement to finish task.
   c) Child generally interacts, but at times turns away, lowers head, takes "break" from interaction.
   d) Child participates in interaction; body posture suggests relaxed engagement with the interviewer

8. Cooperates; complies with tester's requests
   a) Child does not cooperate even when tasks are easy.
   b) Child shows significant resistance, noncompliance and needs multiple prompts to get through assessment.
   c) Child shows minor indications of resistance, boredom (e.g. frowns, sighs) but completes tasks.
   d) Child attempts to do task as instructed even if task is difficult.

9. Shows pleasure in accomplishment and active task mastery
   a) Child makes negative comment or negative expression when completing task.
   b) Child is neutral when getting task right.
   c) Child appears slightly pleased in completing tasks.
   d) Child appears happy after completing task. May show excited body movements (e.g., "alright!" clapping)

10. Confident
   a) Child shows hesitation or reluctance on easy items, gives up easily (e.g., "I can't do this.").
   b) Less confident child shows repeated hesitation or asks questions that indicate a lack of confidence.
   c) Child is diligent, straightforward in answering tester's questions.
   d) Child shows confidence by comments such as "I know this one." Child is eager, energetic.

11. Defiant
   a) Child actively, directly refuses to comply with tester's request or direction.
   b) Child tests limits but responds to tester's prompt or restatement or request.
   c) Child says "no," but then follows tester's initial request. Tester does not have to "say it again."
   d) Child never exhibits active defiance.

12. Passively noncompliant
   a) Child appears not to hear instruction, even when tester repeats request.
   b) Child ignores tester but responds to prompt when tester repeats request/directive.
   c) Child seems slow to comply. Tester does not restate request, but wonders if child heard.
   d) Child hears requests and responds appropriately.

13. Modulates and regulates arousal level in self.
   a) Child becomes over-aroused and has difficulty regaining self-control.
   b) Child becomes over-aroused (sad, frustrated, silly) and needs prompt from tester but is able to calm down.
   c) Child becomes briefly over-aroused (sad, frustrated, silly) but quickly calms without help from adult tester.
   d) Child highly regulated. Never becomes sad, frustrated, or silly.

Figure C-5: PSRA-13 Behavioral Assessment, Page 2 (Smith-Donald et al., 2007)

Preschool Behavior Assessment Rubric (PBAR) Student ID: _____

Soon after administering the assessment, circle the appropriate box for each domain.

Domain	Score			
	1	2	3	4
Attention	Mostly off-task, inattentive	Attention *frequently* drifts; requires frequent prompts	Attention *occasionally* drifts; responsive to prompts	Attends closely without prompting
Engagement	Will not engage; seems 'shut down'	Repeatedly withdraws and needs encouragement to complete tasks	Generally interacts but occasionally lowers head, turns away, or takes a 'break'	Participatory; relaxed body posture
Cooperation	Defiantly refuses to comply or completely withdraws	Complies after repeated prompts; may test limits or ignore adult	Says no but then complies or may be slow in complying	Responds as requested; no prompting or delay
Positivity	Makes many negative comments	Neutral when doing something correctly	Slightly pleased in completing tasks	Happy or excited about completing tasks
Precision	Rowdy; Haphazard; Breaks/damages materials	Rowdy and careless at times; may slightly damage materials	Generally careful but may slightly damage materials; Interested in accuracy	Takes great care; precise
Control of Movement	Impulsive movements require *constant* boundary setting	Impulsive movements require *regular* boundary setting	A few impulsive movements; may or may not need boundary setting	No impulsive movements
Arousal	Overwhelming emotions (sad, silly, frustrated); difficulty regaining self-control	Very emotional but able to calm/stabilize with support	Briefly emotional but calms/stabilizes quickly	Calm and steady
Persistence/ Confidence	Not able to continue past difficulty; Won't begin	Continues past difficulty with *a lot of* encouragement; seeks validation	Continues past difficulty with *some* encouragement	Continues past difficulty independently or has no difficulty
Flexibility	Refuses to switch to a new task	Resists switching; argues or uses stall tactics	Mild complaint or delay when asked to switch tasks	Switches easily to new task

Score Total: _____

Figure C-6: PBAR Behavioral Assessment

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