Proposal for a Thesis

In the Field of Psychology

In Partial Fulfillment of Requirements for

The Master of Liberal Arts Degree

Harvard University

Extension School

Revised: August 11, 2016

Julia Volkman

xxxxxxxxxxx

xxxxxxx, MA #####

###-###-####

jvolkman@g.harvard.edu

## I. Tentative Title

Spelling and scaffolds in preschool: Does a movable alphabet improve spelling performance?

## II. Research Problem

Understanding young children's spelling abilities may provide both unique insight into their overall linguistic development and identify children at risk for reading difficulties in ways that typical reading assessments can not (Clemens, Oslund, Simmons, & Simmons, 2014; McBride-Chang, 1998). 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, and/or insensitive scoring systems (Clemens, et al., 2014; Diamond, 2013; Puranik & Apel, 2010). These latter possibilities raise the question of what would happen if we controlled for 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 preschool spelling abilities than a handwritten assessment?

The present study is a within-subjects quasi-experiment that assesses the spelling of 3- to 4-year-old children using a movable alphabet and handwriting. The study's hypotheses are that (1) preschoolers will score higher on a movable alphabet assessment than on a handwritten

assessment and (2) movable alphabet spelling scores will be a better predictor of phonemic awareness and letter knowledge than handwritten spelling scores.

To date, no other studies have specifically evaluated the influence of motor and working memory scaffolds on spelling scores in preschoolers. This study will build towards a more accurate understanding of the word-building capacities of 3-to 4-year-olds.

## III. 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 a significant 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).

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 information that one needs in a short amount of time (like memorizing a phone number) in a temporary storage buffer (Diamond, 2013).

## IV. Background of the Problem

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; Puranik, Lonigan, & Kim, 2011; Strattman & Hodson, 2005). Some researchers have suggested that spelling may in fact be a proxy for phonemic awareness (McBride-Chang, 1998). As such, having a way to measure preschool spelling abilities has implications for understanding developing literacy overall.

### Developing Handwriting Skills

One challenge of accurately measuring preschool spelling abilities is that spelling assessments often rely on handwriting. Letter writing ability correlates strongly ($r = 0.63$; $p < 0.001$) with spelling ability in 4- to 5-year-olds (Puranik, Lonigan, & Kim, 2011). 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 (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 of preschool cognitive versus motor abilities.

**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 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 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, second grade scores on working memory assessments may predict the variance on some measures of phonemic awareness (Oakhill & Kyle, 2000).

The demands put on working memory 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), using scaffolds will 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). Tests 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.

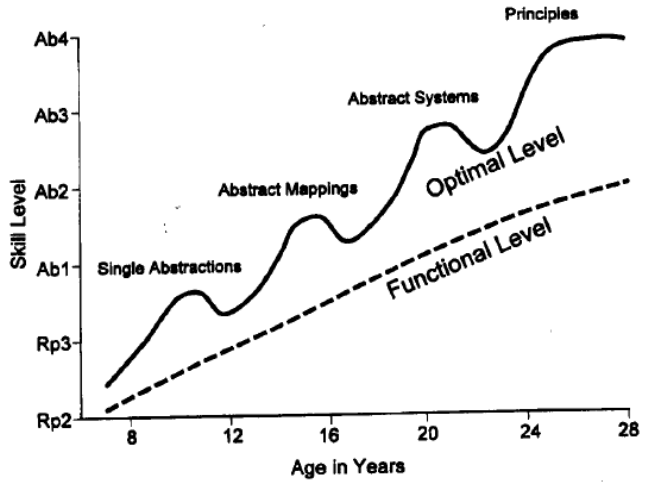



*Figure 1:* Acquisition of knowledge according to Dynamic Skill Theory (reproduced from Fischer & Yan, 2002)

A question the present study hopes to answer is if a movable alphabet serves as a working memory scaffold that allows preschoolers to demonstrate a higher spelling ability than possible in 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 to be used in the present study's spelling assessment

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 its influence 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 two 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.

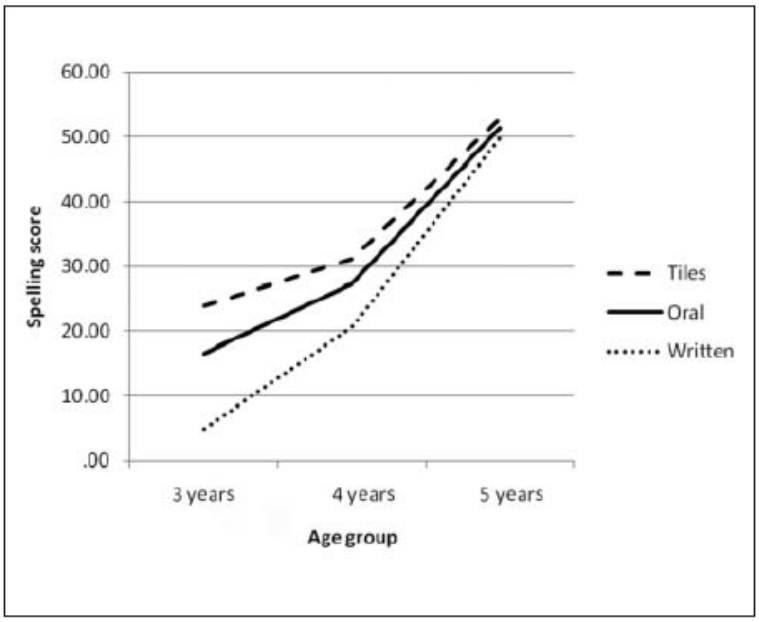



*Figure 3:* Mean spelling performance by age/assessment (reproduced from Puranik & Apel, 2010)

This study also found that the ability of the 3- to 4-year-old child to spell correlated 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 receive higher scores on the spelling tasks (handwriting $r = 0.73$; letter tiles $r = 0.60$; oral spelling $r = 0.61$; $p < .001$ for all). Once children could write 19 letters (around age 5), the mode of spelling assessment did not matter.

A study comparing typing, handwriting, and using letter tiles in first-grade also found no benefit of using letter tiles over handwriting (Cunningham & Stanovich, 1990). This suggests that movable alphabets may be of benefit only in preschool-aged children.

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 hopes to answer 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. 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. As expected, 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. Of note is that the study found that four-year-old spelling scores moderately correlated (0.581; $p < 0.001$) with letter name knowledge.

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 precedes 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 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 ealry spelling abilities.

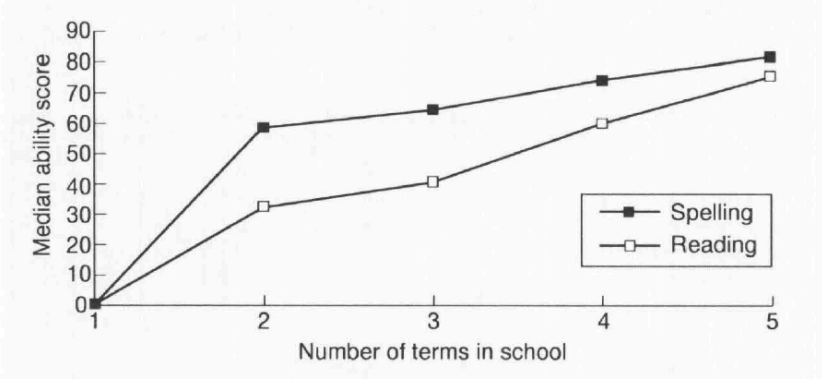



*Figure 4:* Scores of spelling and reading over time in 4- and 5-year-old children (reproduced from Wood & Terrell, 1998)

**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 study results. 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 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 cards 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 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) 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.

The present study will use an alphabet that matches the approach used in the children's preschool. The alphabet will be made of printed letter cards (10 of each) that are housed in a box that provides a clear location for each letter and organizes the letters alphabetically. Further, the scoring of the handwritten spelling assessment will give equal credit for uppercase and lowercase letters.

**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 (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 ($r = 0.98$ for correlation; 93% agreement) (Tangel & Blachman, 1992) and have internal consistency ($\alpha = 0.96$) (Puranik & Lonigan, 2012).

The present study will use 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, Duques, & 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 well with word reading and phonemic awareness scores (ranging from $r = 0.74$ to $r = 0.77$).

Table 1

*Spelling assessment scoring rubric (adapted from Byrne & Fielding-Barnsley, 1993; Clemens, et al., 2014; Hindson, et al., 2005; Liberman, Rubin, Duques, & 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 |

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

Of note is that 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 will be 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 will compare 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 is also expected the movable alphabet assessment scores will positively correlate with standardized tests of phonemic awareness and letter knowledge.

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. Thus, the present study is needed to validate the precise use of a movable alphabet in preschool spelling assessment.

## V. Research Method

### Participants

A minimum of 54 three- to four-year-old students from public preschool classrooms in western Massachusetts will be recruited for inclusion in the study upon approval from the Harvard Committee on the Use of Human Subjects. This number was determined using G*Power 3.1 assuming a two-tailed *t*-test (matched pairs) with an effect size of 0.5, an alpha of 0.05, and a power of 0.95. School districts in Western Massachusetts with at least 70 students enrolled in preschool are listed in Table 2. The minimum of 70 students enrolled will allow for absences on testing days and the possible exclusion of outliers from the data set.

Students with documented disabilities (e.g., communication, intellectual, motor) that would prevent them from following study procedures will be excluded. Parental consent will be gained using an opt-out form (see Appendix B).

Because the researcher previously worked at Zanetti School in the Springfield school district, the principal of Zanetti will be contacted first. If she is willing to participate, the school district's Director of Curriculum/Instruction or other school officials will be contacted as necessary to obtain the school district's consent. If Zanetti School is not willing, the list in Table 2 will be randomized using the list randomizer tool at http://www.random.org and schools and schools contacted in that random order until a school district that is willing to participate is identified.

Table 2

*Public schools with 70 or more preschoolers enrolled in western Massachusetts (Massachusetts Department of Elementary & Secondary Education, 2016)*

| District | PreK Enrollment | First Language Not English (%) | English Language Learner (%) | Students With Disabilities (%) | High Needs (%) | Economically Disadvantaged (%) | Accountability 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 |

## Materials and Measures

**Materials.** The primary investigative material is the movable alphabet (see Figure 2). The box contains 10 printed cards for each letter of the alphabet. The alphabet will contain either uppercase or lowercase letters based on the style of letters used at the children's school. Letters will be printed with black ink on 32# white paper, laminated with a 5 mil food-grade laminate, and cut so that each card is approximately 1.25" W x 2" H.

Additionally, the spelling assessments will include a picture card for each of the 20 words on the spelling list. Each picture card will feature a color photo that isolates its subject (e.g., a cat on a white background, not a cat on grass) and is printed on 32# white paper, laminated with a 5 mil food-grade laminate, and cut so that each card is approximately 3.75" W x 3"H, .

**Assessments.** Students in all groups will be evaluated on four assessments as summarized in Table 3. Children will be taken to a separate testing area in convenience order as

determined by their preschool teacher (so as not to disturb children engaged in an activity). The assessments for each child should take approximately 20 minutes to complete.

Table 3
*Assessments Overview*

| | **Assessment** |
|---|---|
| **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) |

*Phonemic Awareness.* Phonemic awareness will be evaluated using the PALS-PreK Beginning Sound Awareness subtest. Assessors show children a picture, name the item featured (e.g., milk), and ask 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, et al., 2004).

*Letter Knowledge.* Letter knowledge will be evaluated using the Brief Letter Sound Knowledge Assessment (Piasta, et al., 2016). The assessor shows children a list of 8 upper and lowercase letters (see Appendix C) and asks children to name each letter's sound. One point is given for each correct answer and then normed via a scoring key (Piasta, et al., 2013). This assessment was studied in 968 children and results positively correlated 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, which will be used in this assessment, was shown to have a reliability of 0.93 (Piasta, et al., 2016).

*Spelling.* All scored spelling assessments will draw randomly from the same pool of 12 possible basic words (i.e., bat, bag, bed, cap, cat, dog, map, mat, mop, net, pot, rat) and four possible challenge words (i.e., basket, cactus, magnet, sunset) for a total of eight used in the

handwriting trials and eight used in the movable alphabet trials. Training trials will be chosen randomly from a pool of four words (i.e., pig, hat, web, gum). Words were chosen based on the likelihood that they would be known by very young children, 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'). The words also favor the letters most commonly learned first by preschoolers (i.e., C, A, B, P, T, S, D, F, K, O, J, M, E, G) (Piasta, et al., 2016). The chosen trial words also avoid the letters children generally learn last (i.e., H, I, W, X, U, Y) (Piasta, et al., 2016). Challenge words are used to help avoid a possible ceiling effect. Detailed instructions on administering the spelling assessments are included in Appendix D.

**Data collection.** All assessments will be administered and scored by the researcher or a trained assistant who has experience working with young children. Numerical student identification numbers and birth dates will be used to track assessment results; no student names will be used.

## Design

The present study is a quasi-experimental, within-subjects study of a movable alphabet spelling assessment in preschoolers.

**Procedure.** The researcher will individually escort students from their classroom to a designated, quiet testing area that is free from distractions. The researcher will say, "We're going to play a few games together." The assessments will then proceed in the following order: (1) phonemic awareness; (2) letter knowledge; (3) handwritten spelling; and (4) movable alphabet spelling. All scoring will be conducted post-assessment.

At the end of the assessment, the researcher will show the child his/her work and say, "Look at all of the words you have spelled! I'm going to keep these so I can use them for my research but I would like to give you something in exchange. You can choose any one of these stickers if you'd like."

**Analysis Plan**

After reviewing descriptive statistics, statistical analyses will be conducted on the assessment results. The question of whether children score better on the movable alphabet assessment versus the handwritten assessment will be answered via a paired samples *t*-test (two-tailed).

The concurrent validity of the movable alphabet assessment will be established by seeing how its results relate to those of existing measures (i.e., the PALS Prek, the Brief Letter Sound Knowledge Assessment, and the handwritten assessment) (Slentz, 2008). A concurrent validity test of the movable alphabet assessment will be conducted via Pearson's correlation between all assessment scores.

The researcher and a trained assistant will score each of the spelling assessment results separately. Inter-rater reliability will be established by averaging the scores for each word and then correlating them between both raters to determine the correlational level of agreement.

## VI. Research Limitations

Studies suggest a significant influence of SES and vocabulary knowledge on literacy and brain development (Boles, 2011; Hart & Risley, 1992). This study will consider socioeconomic status only on a school-wide basis. Massachusetts defines economically disadvantaged students as those living in low-income households (see Table 2) (Massachusetts Department of Elementary and Secondary Education, 2015). In the US, about 45% of children live in low-

income households (Addy, Engelhardt, & Skinner, 2013). To validate the results of this assessment, results should represent those expected in the larger population. Thus, depending upon which school district participates, the economic level of the students may or may not match those of the nation as a whole.

The study will not consider the results of individual children with respect to the presence or absence of individual educational plans (IEPs), English as a second language, or family history of reading disability. The presence of these factors in individual children may introduce possible threats to the study's validity.

This study will always administer the handwriting assessment immediately before the movable alphabet assessment. It is thus possible that movable alphabet scores will be higher than handwriting scores due to a practice effect. Puranik and Apel (2010) followed this same administration order and found that spelling scores were higher in younger children for the movable alphabet assessment than for the written or oral assessments. However, their data saw no practice effect in older children who scored similarly on all spelling assessments. Future studies should control for this factor by randomizing delivery of the assessments, thus requiring a larger study population than is included in the present proposal.

This study will not evaluate words that do not follow rules of basic phonetic spelling. If ceiling effects are found, a more complex word list should be used in future research.

This study is a quasi-experiment because it is not completely random in its selection and assignment of subjects. The school selection is convenience-based which creates a selection threat to the study's internal validity.

## VII. Tentative Schedule

| Event | Date(s) |
|---|---|
| Revised proposal submitted | August 11, 2016 |
| Proposal accepted by research advisor | August 31, 2016 |
| Thesis director assigned | September 16 , 2016 |
| First thesis draft completed | January 2, 2017 |
| Thesis director returns corrected 1st draft | January 15, 2017 |
| Revised thesis draft completed | February 1, 2017 |
| Thesis director returns revised draft | February 15, 2017 |
| Final text submitted | March 1, 2017 |
| Bound copy approved | April 15, 2017 |
| Graduation | May, 2017 |

## VIII. Working Bibliography

### Works Cited


Addy, S., Engelhardt, W., & Skinner, C. (Jan 2013). Basic facts about low-income children under 18 years. *National Center for Children in Poverty.* Retrieved from http://www.nccp.org/publications/pub_1074.html

Boles, D. B. (2011). Socioeconomic status, a forgotten variable in lateralization development. *Brain and Cognition,* 76(1), 52-57.

Bowles, R. P., Pentimonti, J. M., Gerde, H. K., & Montroy, J. J. (2013). Item response analysis of uppercase and lowercase letter name knowledge. *Journal of Psychoeducational Assessment,* 32(2), 146-156.

Bradley, L. & Bryant, P. E. (1983). Categorizing sounds and learning to read: A causal connection. *Nature*, 419-421.

Byrne, B. & Fielding-Barnsley, R. (1993). Evaluation of a program to teach phonemic awareness to young children: A 1-year follow-up. *Journal of Educational Psychology,* 85(1), 104.

Byrne, B. & Fielding-Barnsley, R. (1995). Evaluation of a program to teach phonemic awareness to young children: A 2-and 3-year follow-up and a new preschool trial. *Journal of Educational Psychology,* 87(3), 488.

Castles, A., Wilson, K., & Coltheart, M. (2011). Early orthographic influences on phonemic awareness tasks: Evidence from a preschool training study. *Journal of Experimental Child Psychology,* 108(1), 203-210.

Clemens, N. H., Oslund, E. L., Simmons, L. E., & Simmons, D. (2014). Assessing spelling in kindergarten: Further comparison of scoring metrics and their relation to reading skills. *Journal of School Psychology*, 52(1), 49-61.

Cummings, K.D., Kaminski, R.A., Good III, R.H., & O'Neil, M. (2011). Assessing phonemic awareness in preschool and kindergarten: Development and initial validation of First Sound Fluency. *Assessment for Effective Intervention,* 36(2), 94-106.

Cunningham, A. E., & Stanovich, K. E. (1990). Early spelling acquisition: Writing beats the computer. *Journal of Educational Psychology*, 82(1), 159.

Dehaene, S. (2009). Reading in the brain: The new science of how we read. New York, NY: Penguin Group.

Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64, 135.

Drouin, M., & Harmon, J. (2009). Name writing and letter knowledge in preschoolers: Incongruities in skills and the usefulness of name writing as a developmental indicator. *Early Childhood Research Quarterly*, 24(3), 263-270.

Ehri, L. C., Nunes, S. R., Willows, D. M., Schuster, B. V., Yaghoub-Zadeh, Z., & Shanahan, T. (2001). Phonemic awareness instruction helps children learn to read: Evidence from the National Reading Panel's meta-analysis. *Reading Research Quarterly,* 36(3), 250-287.

Farley, K., Piasta, S., & O'Connell, A. (2014). Validity of letter-sound short forms: Association with early literacy and classroom practices. *Society for the Scientific Study of Reading.* Twenty-third Annual Meeting. Retrieved from https://www.triplesr.org/validity-letter-sound-short-forms-associations-early-literacy-skills-and-classroom-practices-0

Fischer. K. & Yan, Z. (2002). The development of dynamic skill theory. In: Lewkowicz, D.J. & Lickliter, R., eds. Conceptions of Development: Lessons from the Laboratory. New York, NY: Psychology Press.

Foy, J. G. & Mann, V. (2006). Changes in letter sound knowledge are associated with development of phonological awareness in pre-school children. *Journal of Research in Reading,* 29(2), 143-161.

Gathercole, S. E., & Alloway, T. P. (2006). Practitioner review: Short-term and working memory impairments in neurodevelopmental disorders: Diagnosis and remedial support. *Journal of Child Psychology and Psychiatry*, 47(1), 4-15.

Hart, B., & Risley, T. R. (1992). American parenting of language-learning children: Persisting differences in family-child interactions observed in natural home environments. *Developmental Psychology,* 28(6), 1096-1105.

Hindson, B., Byrne, B., Fielding-Barnsley, R., Newman, C., Hine, D. W., & Shankweiler, D. (2005). Assessment and Early Instruction of Preschool Children at Risk for Reading Disability. *Journal of Educational Psychology*, 97(4), 687.

Hoover, W. A. & Gough, P. B. (1990). The simple view of reading. *Reading and Writing,* 2(2), 127-160.

Hulme, C., Hatcher, P. J., Nation, K., Brown, A., Adams, J., & Stuart, G. (2002). Phoneme awareness is a better predictor of early reading skill than onset-rime awareness. *Journal of Experimental Child Psychology,* 82(1), 2-28.

Invernizzi, M., Sullivan, A., Meier, J., & Swank, L. (2004). Phonological Awareness Literacy Screen (PALS-PreK) Teacher's Manual. University of Virginia. Retrieved from https://www.palsmarketplace.com/v/vspfiles/files/learn-more/PALS-Pre-K/PreK_technical_chapter.pdf

Liberman, I. Y., Rubin, H., Duque`s, S., & Carlisle, J. (1985). Linguistic abilities and spelling proficiency in kindergarteners and adult poor spellers. In D. B. Gray & J. F. Kavanagh (Eds.), Biobehavioral measures of dyslexia. Parkton, MD: York Press.

Martins, M. A., & Silva, C. (2006). The impact of invented spelling on phonemic awareness. *Learning and Instruction,* 16(1), 41-56.

Martins, M. A., & Silva, A. C. (2009). Two spelling programmes that promote understanding of the alphabetic principle in preschool children. *Journal of Writing Research*, 225-240.

Massachusetts Department of Elementary and Secondary Education. (2016). School/District profiles. Retrieved from http://profiles.doe.mass.edu/state_report

Massachusetts Department of Elementary and Secondary Education. (2015). A changing metric: Low income vs. economically disadvantaged. Retrieved from http://www.doe.mass.edu/infoservices/data/ed.html

McBride-Chang, C. (1998). The development of invented spelling. *Early Education and Development*, 9(2), 147-160.

Melby-Lervåg, M., Lyster, S. A. H., & Hulme, C. (2012). Phonological skills and their role in learning to read: a meta-analytic review. *Psychological Bulletin,* 138(2), 322.

Oakhill, J., & Kyle, F. (2000). The relation between phonological awareness and working memory. *Journal of Experimental Child Psychology*, 75(2), 152-164.

Piasta, S.B., Phillips, B.M., Williams, J.M., Bowles, R.P., & Anthony, J.L. (2016). Measuring young children's alphabet knowledge: Development and validation of brief letter-sound knowledge assessments using item-response theory. *The Elementary School Journal,* 116(4).

Piasta, S.B., Phillips, B.M., Williams, J.M., Bowles, R.P., & Anthony, J.L. (2013). Measuring young children's alphabet knowledge: Development and validation of brief letter-sound knowledge assessments using item-response theory. Manuscript submitted for publication. Retrieved from https://earlychildhood.ehe.osu.edu/files/2016/04/Letter-Sound-Short-Form-Assessment1.pdf

Piquard-Kipffer, A., & Sprenger-Charolles, L. (2013). Early predictors of future reading skills: A follow-up of French-speaking children from the beginning of kindergarten to the end of the second grade (age 5 to 8). *L'Année Psychologique,* 113(04), 491-521.

Puranik, C. S., & Apel, K. (2010). Effect of assessment task and letter writing ability on preschool children's spelling performance. *Assessment for Effective Intervention,* 36(1), 46-56.

Puranik, C.S. & Lonigan, C.J. (2011). From scribbles to scrabble: preschool children's developing knowledge of written language. *Reading and Writing,* 24(5), 567-589.

Puranik, C. S., & Lonigan, C. J. (2012). Name-writing proficiency, not length of name, is associated with preschool children's emergent literacy skills. *Early Childhood Research Quarterly*, 27(2), 284-294.

Puranik, C. S., Lonigan, C. J., & Kim, Y. S. (2011). Contributions of emergent literacy skills to name writing, letter writing, and spelling in preschool children. *Early Childhood Research Quarterly*, 26(4), 465-474.

Richgels, D. J. (1986). An investigation of preschool and kindergarten children's spelling and reading abilities. *Journal of Research and Development in Education*, 19(4), 41-47.

Roman, A. S., Pisoni, D. B., & Kronenberger, W. G. (2014). Assessment of working memory capacity in preschool children using the Missing Scan task. *Infant and Child Development*, 23(6), 575-587.

Shanahan, T. & Lonigan, C. J. (2010). The National Early Literacy Panel: A summary of the process and the report. *Educational Researcher,* 39(4), 279-285.

Share, D., Jorm, A., Maclean, R., & Matthews, R. (1984). Sources of individual differences in reading acquisition. *Journal of Educational Psychology,* 76, 1309–1324.

Shaywitz, S.E. & Shaywitz, B.A. (2001). The neurobiology of reading and dyslexia. *Focus on Basics.* 5, 11-15.

Slentz, K. L. (2008). A guide to assessment in early childhood: Infancy to age eight. *Washington State Office of Superintendent of Public Instruction.* Retrieved from http://www.k12.wa.us/EarlyLearning/pubdocs/assessment_print.pdf

Strattman, K., & Hodson, B. W. (2005). Variables that influence decoding and spelling in beginning readers. *Child Language Teaching and Therapy*, 21(2), 165-190.

Tangel, D. M., & Blachman, B. A. (1992). Effect of phoneme awareness instruction on kindergarten children's invented spelling. *Journal of Literacy Research*, 24(2), 233-261.

Wood, C., & Terrell, C. (1998). Preschool phonological awareness and subsequent literacy development. *Educational Psychology*, 18(3), 253-274.

Worden, P. E., & Boettcher, W. (1990). Young children's acquisition of alphabet knowledge. *Journal of Literacy Research*, 22(3), 277-295.

**Works Consulted**

Anthony, J. L., & Lonigan, C. J. (2004). The Nature of Phonological Awareness: Converging Evidence From Four Studies of Preschool and Early Grade School Children. *Journal of Educational Psychology,* 96(1), 43.

Apel, K. (2009). The acquisition of mental orthographic representations for reading and spelling development. *Communication Disorders Quarterly*, 31(1), 42-52.

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

Bara, F. & Morin, M. F. (2013). Does the handwriting style learned in first grade determine the style used in the fourth and fifth grades and influence handwriting speed and quality? A comparison between French and Quebec children. *Psychology in the Schools,* 50(6), 601-617.

Bara, F., Fredembach, B., & Gentaz, É. (2010). Rôle des procédures exploratoires manuelles dans la perception haptique et visuelle de formes chez des enfants scolarisés en cycle 2. *Année Psychologique*, 110(2), 197.

Beech, J. R., Pedley, H., & Barlow, R. (1994). Training letter-to-sound connections: The efficacy of tracing. *Current Psychology,* 13(2), 153-164.

Blair C, Razza RP. Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Dev.* 2007; 78(2):647– 663

Brem, S., Bach, S., Kujala, J. V., Maurer, U., Lyytinen, H., Richardson, U., & Brandeis, D. (2013). An Electrophysiological Study of Print Processing in Kindergarten: The Contribution of the Visual N1 as a Predictor of Reading Outcome. *Developmental Neuropsychology*, 38(8), 567-594.

Burgess, S. R., & Lonigan, C. J. (1998). Bidirectional relations of phonological sensitivity and prereading abilities: Evidence from a preschool sample. *Journal of Experimental Child Psychology,* 70(2), 117-141.

Burgess, S. R., & Lonigan, C. J. (1998). Bidirectional relations of phonological sensitivity and prereading abilities: Evidence from a preschool sample. *Journal of Experimental Child Psychology*, 70(2), 117-141.

Bus, A. & Van Ijzendoorn, M. (1999). Phonological awareness and early reading: A meta-analysis of experimental training studies. *Journal of Educational Psychology*, 91, 403–414.

Byrne, B. & Fielding-Barnsley, R. (1989). Phonemic awareness and letter knowledge in the child's acquisition of the alphabetic principle. *Journal of Educational Psychology,* 81(3), 313.

Byrne, B., Olson, R. K., Samuelsson, S., Wadsworth, S., Corley, R., DeFries, J. C., & Willcutt, E. (2006). Genetic and environmental influences on early literacy. *Journal of Research in Reading,* 29(1), 33-49.

Caramazza, A., Chialant, D., Capasso, R., & Miceli, G. (2000). Separable processing of consonants and vowels. *Nature*, 403(6768), 428-430.

Carver, R. P. (2003). The highly lawful relationships among pseudoword decoding, word identification, spelling, listening, and reading. *Scientific Studies of Reading,* 7(2), 127-154.

Center on the Developing Child at Harvard University (2011). Building the Brain's "Air Traffic Control" System: How Early Experiences Shape the Development of Executive Function: Working Paper No.11. Available at http://www.developingchild.harvard.edu

DeBaryshe, B. D., & Gorecki, D. M. (2007). An experimental validation of a preschool emergent literacy curriculum. *Early Education and Development,* 18(1), 93-110.

Diamond, A., Kirkham, N., & Amso, D. (2002). Conditions under which young children can hold two rules in mind and inhibit a prepotent response. *Developmental Psychology,* 38(3), 352.

Ehri, L.C. (2014) Orthographic mapping in the acquisition of sight word reading, spelling memory, and vocabulary learning. *Scientific Studies of Reading.* 18, 5-21.

Fabes RA, Martin CL, Hanish LD, Anders MC, Madden-Derdich DA. Early school competence: the roles of sex-segregated play and effortful control. *Developmental Psychology.* 2003; 39(5):848–858.

Garcia, R. B., Mammarella, I. C., Tripodi, D., & Cornoldi, C. (2014). Visuospatial working memory for locations, colours, and binding in typically developing children and in children with dyslexia and non-verbal learning disability. British *Journal of Developmental Psychology,* 32(1), 17-33.

Gathercole, S. E., & Adams, A. M. (1993). Phonological working memory in very young children. *Developmental Psychology*, 29(4), 770.

Gazzaniga, M.S., Ivry, R.B., & Mangun, G.R. (2009). Cognitive neuroscience: The biology of the mind. New York, NY: W.W. Norton & Co., Inc.

Geva, E., Wade-Woolley, L., & Shany, M. (1993). The concurrent development of spelling and decoding in two different orthographies. *Journal of Literacy Research,* 25(4), 383-406.

Gimenez, P., Bugescu, N., Black, J. M., Hancock, R., Pugh, K., Nagamine, M., et al., (2014). Neuroimaging correlates of handwriting quality as children learn to read and write. *Frontiers in Human Neuroscience*, 8. Retrieved from http://doi.dox.org/10.3389/fnhum.2014.00155

Good III, R.H., Kaminski, R.A., Dewey, E.N. Wallin, J., Powell-Smith, K.A., & Latimer, R.J. (2011). DIBELS Next technical manual: Draft. Dynamic Measurement Group, Inc. Available at http://dibels.org/

Graham, S. & Hebert, M. (2011). Writing to read: A meta-analysis of the impact of writing and writing instruction on reading. *Harvard Educational Review*, 81(4), 710-744.

Hatcher, P. J., Hulme, C., & Snowling, M. J. (2004). Explicit phoneme training combined with phonic reading instruction helps young children at risk of reading failure. *Journal of Child Psychology and Psychiatry*, 45(2), 338-358.

Hesketh, A., Dima, E., & Nelson, V. (2007). Teaching phoneme awareness to pre-literate children with speech disorder: A randomized controlled trial. *International Journal of Language & Communication Disorders*, 42(3), 251-271.

Hill, J.D. & Bjork, C. (2008). Chapter 2: The stages of language acquisition. In: Classroom Instruction That Works with English Language Learners Participant's Workbook. *Association for Supervision and Curriculum Development*. Retrieved from http://www.ascd.org/publications/books/108053/chapters/The-Stages-of-Second-Language-Acquisition.aspx

Lackaff, J. (2013). II. Language and Literacy. Retrieved from http://images.pearsonclinical.com/images/assets/wss_5/research_summary_language_and_literacy_fnl.pdf

LaForte, E.., McGrew, K.S., & Schrank, F.A. (2015). Woodcock-Johnson IV tests of early cognitive and academic development: Overview and technical abstract (Woodcock-Johnson IV Assessment and Service Bulletin Number 4). Riverside Publishing: Rolling Meadows, IL.

Lee, R., Zhai, F., Brooks-Gunn, J., Han, W. J., & Waldfogel, J. (2014). Head start participation and school readiness: Evidence from the early childhood longitudinal study–birth cohort. *Developmental Psychology*, 50(1), 202.

Lonigan, C. J., Allan, N. P., & Lerner, M. D. (2011). Assessment of preschool early literacy skills: Linking children's educational needs with empirically supported instructional activities. *Psychology in the Schools,* 48(5), 488-501.

McClelland M.M., Cameron C.E., Connor C.M., Farris C.L., Jewkes A.M., & Morrison F.J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology,* 43(4), 947–959

Mol, S. E. & Bus, A. G. (2011). To read or not to read: a meta-analysis of print exposure from infancy to early adulthood. *Psychological Bulletin*, 137(2), 267.

Montessori, M. (1912). The Montessori method; Scientific pedagogy as applied to child education in children's house. New York: Fredrick A. Stokes Company.

National Scientific Council on the Developing Child (2010). Early Experiences Can Alter Gene Expression and Affect Long-Term Development: Working Paper No. 10. Retrieved from http://www.developingchild.net

Newman, S. D., Malaia, E., Seo, R., & Cheng, H. (2013). The effect of individual differences in working memory capacity on sentence comprehension: an fMRI study. *Brain Topography,* 26(3), 458-467.

Piasta, S. B., & Wagner, R. K. (2010). Developing Early Literacy Skills: A Meta-Analysis of Alphabet Learning and Instruction. *Reading Research Quarterly,* 45(1), 8-38.

Pool, J. L., & Johnson, E. S. (2009). Screening for reading problems in preschool and kindergarten: an overview of select measures. *RTI Network.* Retrieved from http://www.rtinetwork.org/essential/assessment/screening/screening-for-reading-problems-in-preschool-and-kindergarten

Puolakanaho, A., Poikkeus, A. M., Ahonen, T., Tolvanen, A., & Lyytinen, H. (2003). Assessment of three-and-a-half-year-old children's emerging phonological awareness in a computer animation context. *Journal of Learning Disabilities,* 36(5), 416-423.

Royer, J. M., & Sinatra, G. M. (1994). A cognitive theoretical approach to reading diagnostics. *Educational Psychology Review,* 6(2), 81-113.

Shonkoff, J. P., & Phillips, D. A. (2000). *From neurons to neighborhoods: The science of early childhood development*. Washington, D.C.: National Academy Press.

Simos, P. G., Fletcher, J. M., Sarkari, S., Billingsley, R. L., Denton, C., & Papanicolaou, A. C. (2007). Altering the brain circuits for reading through intervention: a magnetic source imaging study. *Neuropsychology*, 21(4), 485.

Stuart, M., Masterson, J., & Dixon, M. (2000). Spongelike acquisition of sight vocabulary in beginning readers? *Journal of Research in Reading,* 23(1), 12-27.

Suggate, S. P. (2010). Why what we teach depends on when: Grade and reading intervention modality moderate effect size. *Developmental Psychology,* 46(6), 1556.

Torgesen, J., Schirm, A., Castner, L., Vartivarian, S., Mansfield, W., Myers, D., et al. (2007). National Assessment of Title I. Final Report. Volume II: Closing the Reading Gap--Findings from a Randomized Trial of Four Reading Interventions for Striving Readers. NCEE 2008-4013. *National Center for Education Evaluation and Regional Assistance.*

Treiman, R., Cohen, J., Mulqueeny, K., Kessler, B., & Schechtman, S. (2007). Young children's knowledge about printed names. *Child Development,* 78(5), 1458-1471.

Ukrainetz, T. A., Nuspl, J. J., Wilkerson, K., & Beddes, S. R. (2011). The effects of syllable instruction on phonemic awareness in preschoolers. *Early Childhood Research Quarterly,* 26(1), 50-60.

Vinter, A. & Chartrel, E. (2008). Visual and proprioceptive recognition of cursive letters in young children. *Acta Psychologica,* 129(1), 147-156.

Vinter, A. & Chartrel, E. (2010). Effects of different types of learning on handwriting movements in young children. *Learning and Instruction,* 20(6), 476-486.

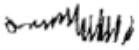
Wilson, S. J., Dickinson, D. K., & Rowe, D. W. (2013). Impact of an early reading first program on the language and literacy achievement of children from diverse language backgrounds. *Early Childhood Research Quarterly,* 28(3), 578-592.

Yeh, S. S. (2003). An evaluation of two approaches for teaching phonemic awareness to children in Head Start. *Early Childhood Research Quarterly,* 18(4), 513-529.

## Appendix A: 9-Point scoring scale used in historical handwritten spelling

The following scoring system will not be 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 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 of 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 other phonetically related letters. | M, mnn | bptre, bpt, bht |
| 7 | Phonetic | **Multiple phonetic representation**: The writing contains 2/3 related phonemes but not a repetitions 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 |

## Appendix B: Parental Consent Form

Opt-Out form

---

**Preschool Literacy Study**

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@fas.harvard.edu) at Harvard University's Extension School. The study will assess all students on their understanding of sounds and letters. Each assessment will take approximately 20-minutes. To protect your child's anonymity, your child's name will not be recorded on any study materials. The anonymous data collected will be analyzed to see if the assessment methods studied are effective than traditional ones. 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 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 teacher.

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

## Appendix C: Letter Sound Short Form Assessment (Piasta, et al., 2016)

**Instructions**: Say, *"I'm going to show you some letters, and I want you to tell me the sounds that they make when they are in words."* Show the child each of the letters on the list, one pair of uppercase and lowercase letters at a time (use two blank pieces of paper to hide the rest of the letters on the page). Ask the child, "*What sound does this letter make?"* If the child responds with a letter name, prompt *"That's a letter name, but what is the sound that the letter makes?"* If the child responds with a word, prompt *"That's a word that has that letter, but what is the sound that the letter makes?"* Tally the number of letters for which a correct letter sound is given and use the scoring key below to convert to scaled or sum scores.

| | |
|---|---|
| **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 |

A a

P p

Z z

M m

E e

L l

W w

X x

## Appendix D: Spelling Assessments

Table D-1
*Scoring of spelling assessment (Byrne & Fielding-Barnsley, 1993; Hindson, et al., 2005; Liberman, Rubin, Duques, & 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 | 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 as they are common and a sign of typical development at this age

### Handwritten Spelling Assessment

The movable alphabet will be placed in plain view of the child without obstructing the child's writing space. Three color-coded baskets of face-down cards will be placed by the researcher (plain for training trials, green for basic words, and blue for challenge words). Children will be told, "We are going to play a spelling game. I'll show you a picture of something and then you'll write down what it's called. I'll have a turn and then you can have a turn." The researcher will then take a blank piece of paper (approx. 5.5" x 4.25") and a pencil and place them on the work area. Next, she will randomly choose one of the training trial photo cards, show it to the child, say it's name aloud, and place it face up on the work area. The researcher will then model articulating all of the sounds in the word (e.g., d-o-g) and printing (in the same manner as the movable alphabet is printed) each letter to spell the word. The researcher will position herself so that the child can clearly see her paper and handwriting as it happens from the correct perspective. The researcher will then say, "Now you can have a turn. Let me get it ready for you." The researcher will give the child a new blank paper and the pencil and repeat

the process for one training trial offering assistance in understanding the procedure if necessary. The eight assessment trials (six basic words and two challenge words) will then begin with the researcher collecting each spelling paper as it is completed and placing it out of the child's sight. Spellings will be coded with the student's identification number and scored using the rubric in Table D-1 after the assessment is complete, apart from the children.

**Movable Alphabet Spelling Assessment**

The movable alphabet will be placed in plain view of the child and within the child's reach. Several inches of space will be left open in front of the child for placing the spelling word. Children will be told, "We are going to play another spelling game. I'll show you a picture of something and then you can write down what it's called but this time we'll write it down using these letter cards. I'll have a turn and then you can have a turn." The researcher will then randomly choose one of the photo cards from the training trial basket, show it to the child, say it's name aloud, and place it face up to the left of the work space beneath the alphabet. The researcher will then model articulating all of the sounds in the word (e.g., d-o-g), finding the appropriate letter in the alphabet box, taking a letter card, and placing it appropriately on the work area. The researcher will then say, "Now you can have a turn. Let me get it ready for you." The researcher will then write down her alphabet spelling on the recording sheet, return each letter to the box and move the photo card to a face-down discard pile. The researcher will then repeat the process but give the child a turn for one training trial offering assistance in understanding the procedure if necessary. The eight assessment trials (six basic words and two challenge words) will then begin.

The researcher will write down each of the child's spellings on the spelling sheet. Spellings will be scored using the rubric in Table D-1 after the assessment is complete, apart from the children.