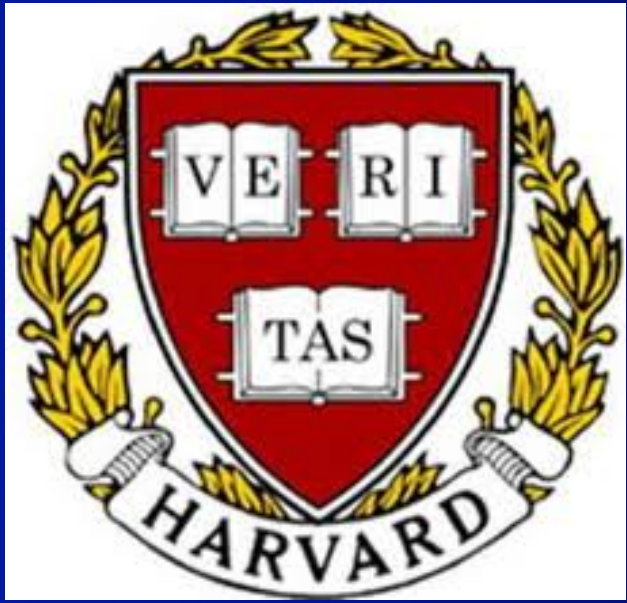




# Using Scaffolds to Measure Optimal Performance in Preschool Literacy

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## Abstract

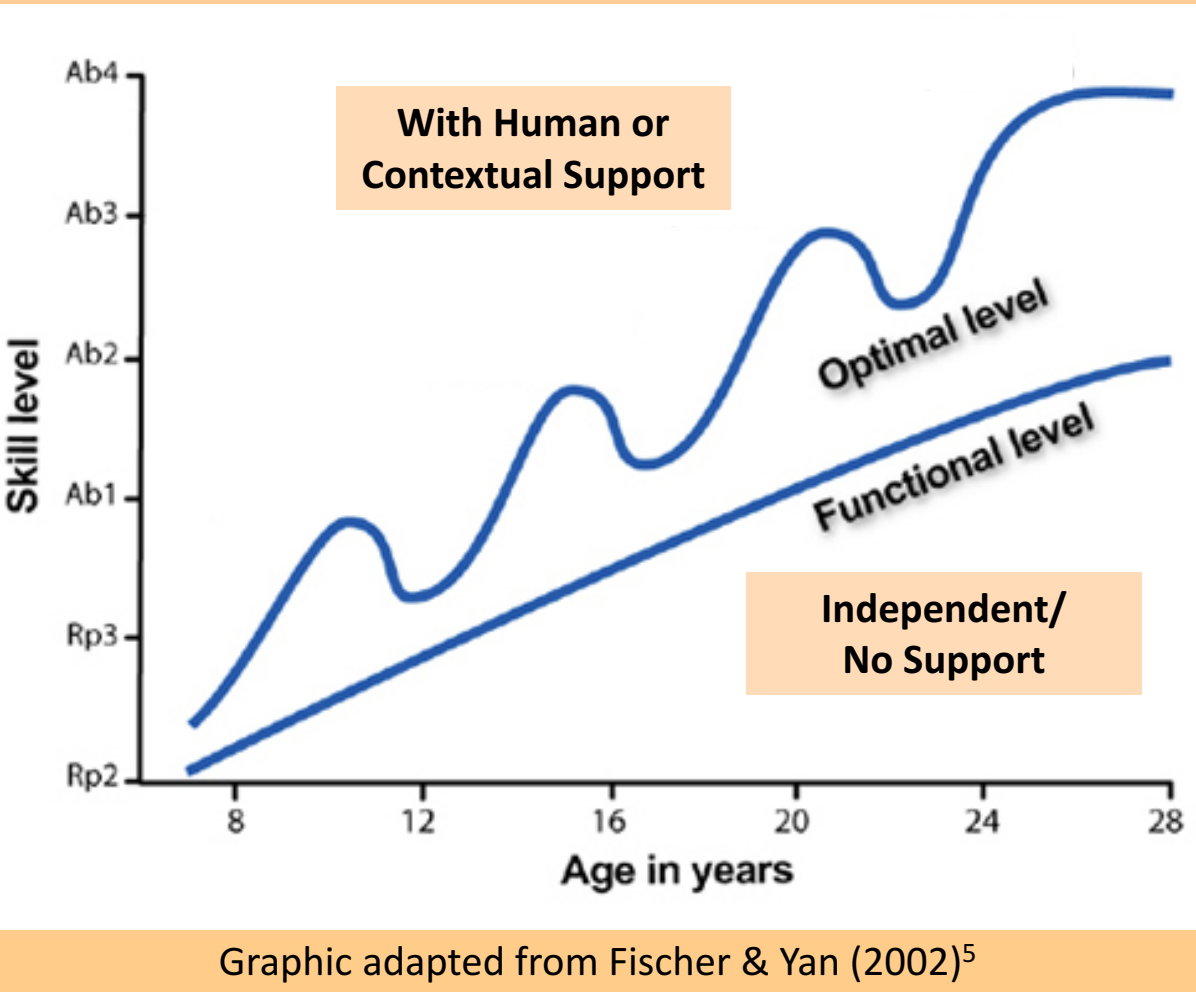
In typical spelling assessments, 3- to 4-year-olds get lower scores than 5-year-olds.<sup>1,2</sup> Are these lower scores a result of typical development or aspects of development unrelated to spelling (i.e., lack of motor ability to write letters and working memory limitations)?<sup>1-4</sup> This study compared two preschool spelling assessments: (1) a typical handwritten assessment that included a working memory scaffold, and (2) a movable alphabet assessment that included both a motor and working memory scaffold. Results indicate that:

- Preschoolers scored higher on the movable alphabet spelling assessment
- Movable alphabet scores were a significantly stronger predictor of developing literacy than handwriting scores
- Children were more willing to attempt to spell words with the alphabet assessment
- Assessment scores were not closely tied to age or measures of behavior

## Background

According to Dynamic Skill Theory,<sup>5</sup> scaffolds help to reveal an individual’s growing knowledge rather than their baseline, unsupported knowledge.

Figure 1: Dynamic Skill Development— Higher capacity with scaffolds<sup>1</sup>



Individuals follow a predictable path of progressions and regressions as they master new knowledge/skills (top, curving line). Assessments that do not include scaffolds (bottom, straight line) reveal a lower, functional level of understanding rather than the actual, dynamic one. Scaffolded preschool spelling assessments may provide a more sensitive measure of optimal preschool spelling ability than assessments without scaffolds.

**Developing Motor Skills:** Spelling assessments often rely on handwriting. However, very young children may not yet be able to write letters.<sup>2,6</sup> An inability to form letters with the hand does not necessarily imply a lack of knowledge about the letters.<sup>6,7</sup>

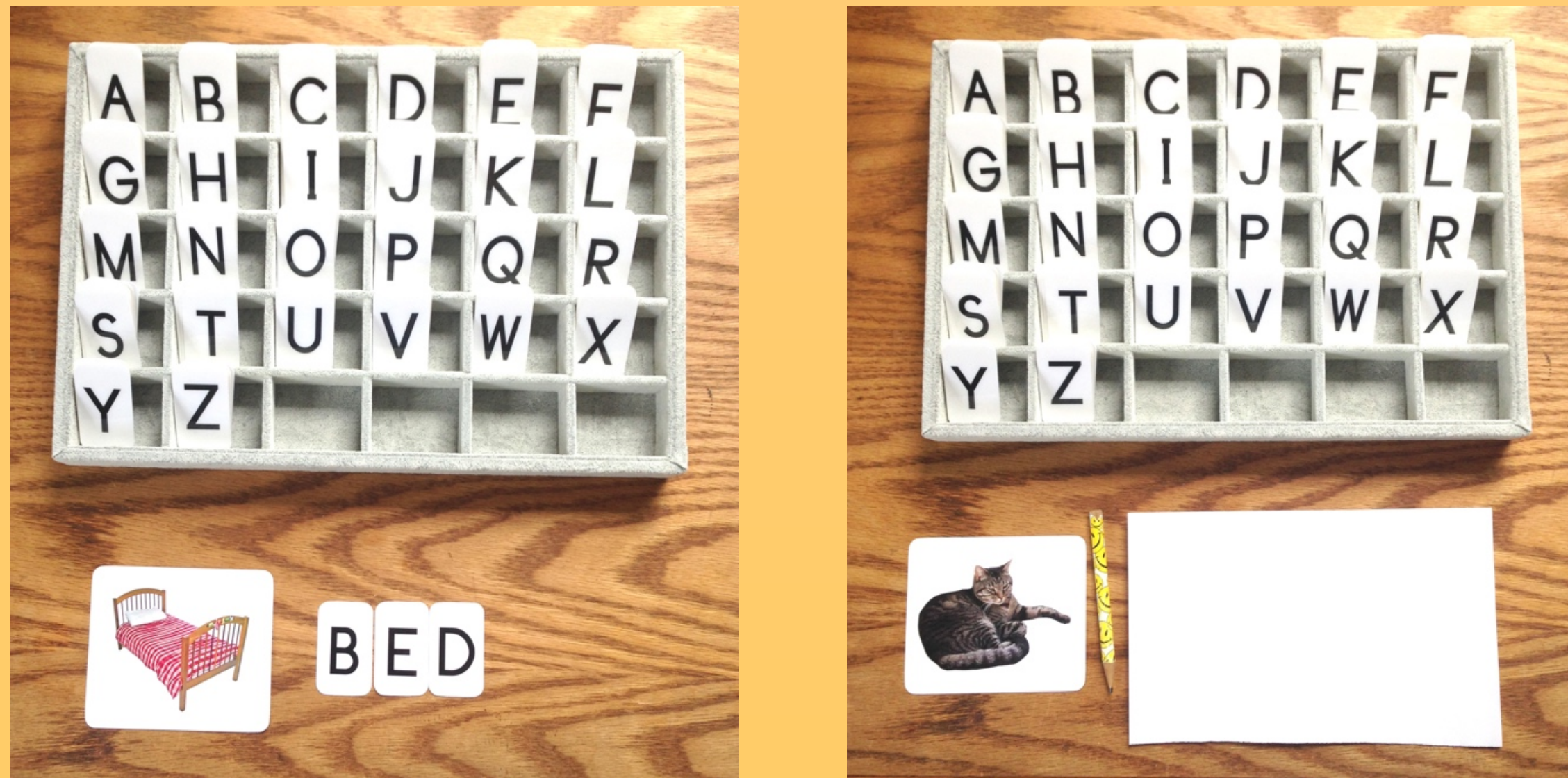
**Self-Efficacy:** Children’s individual beliefs about their own skills and capacities are related to their willingness to attempt and persist with a new task.<sup>8,9</sup> Young children with little handwriting experience may not believe that they are capable of writing letters properly. As such, they may be unwilling to begin or make ongoing effort to handwrite letters thus resulting in a lower handwritten spelling score.

**Working Memory:** Working memory, the ability to keep track of and manipulate information that must be used in some way,<sup>4</sup> may be an additional limitation of spelling assessments.<sup>6,10,11</sup> Working memory capacity begins to form in infancy but undergoes a prolonged and extended developmental period.<sup>4</sup> Working memory aids (i.e., scaffolds) are known to reduce working memory load and thus free up cognitive resources for other tasks.<sup>12</sup>

**Scaffolding via a Movable Alphabet:** A movable alphabet is a physical representation of alphabet letters. Using a movable alphabet to “write” words provides a motor and working memory scaffold for spelling activities.

Figure 2: Movable Alphabet and Handwritten Spelling Assessments

In both assessments, children were shown a photo of the target word and could see the movable alphabet. In the alphabet assessment (left), they were asked to use the alphabet letter cards to make the word. In the handwritten assessment (right), they were asked to use a pencil to write the word.



## Methods & Materials

**Participants:** Two public schools in Western Massachusetts agreed to participate in the study. Students who were English Language Learners, had a known family history of reading disability, and/or with documented disabilities that would prevent them from following study procedures were excluded. Of 80 eligible students, two children refused to begin. All other students (n=78) completed at least one of the four planned assessments and were evaluated using both child behavior assessment tools.

**Materials & Measures:** The primary investigative material was the movable alphabet (see Figure 2). The alphabet 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. Additionally, both spelling assessments included a picture card for each of the 16 spelling words assessed (8 words randomly chosen/assessment). Students were evaluated using the five assessments listed in Table 1.

Table 1: Students were evaluated using five assessments

Assessed Domain	Assessment
Phonemic Awareness*	PALS Pre-K Beginning Sound Awareness Subtest <sup>13</sup>
Letter Knowledge*	Brief Letter Sound Knowledge Assessment <sup>14</sup>
Handwritten Spelling	Eight words graded via the spelling rubric (see Figure 2 & Table 2)
Movable Alphabet Spelling	Eight words graded via the spelling rubric (see Figure 2 & Table 2)
Child Behavior	Preschool Readiness Assessment: Task Orientation Subtest (PSRA-13) <sup>15</sup> Preschool Behavior Assessment Rubric (PBAR) <sup>16</sup>

\*Considered a key predictor of future reading and spelling abilities (in pre-readers)<sup>1,17-19</sup>

Table 2: Spelling Rubric (adapted from multiple sources<sup>1,17,20-22</sup>)

Score	Response	Example
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

## Results

Table 3: Paired Samples T-Tests (All Attempts)

	Mean Difference			St. Deviation			Sig. (2-tailed)		
Pairs	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	0.000	0.000	0.021
Alphabet – Handwriting attempts	0.679	0.689	0.647	1.624	1.766	0.996	0.000	0.003	0.017
Alphabet – Handwriting score	4.524	4.980	2.769	8.004	8.594	5.019	0.000	0.000	0.070

Note: Because not all children attempted to spell all 16 test words (8/test), the analysis was also run on their percentage correct. If a child attempted 4 words (24 possible points) and received a score of 6, their percent correct was 25% (6 out of 24). Percent correct scores are reported in their decimal format (e.g., 0.118 represents 11.8%).

**Scoring Reliability:** After all assessments were administered, the researcher and a trained assistant scored each of the spelling assessment results separately using the rubric shown in Table 2. The trained assistant’s scores correlated very strongly ( $r = 0.914, p < 0.001$ ) with the researcher’s scores.

**Measure of Developing Literacy/Concurrent Validity:** 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 ( $z = 3.164; p < 0.01$ ). 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 ( $r = 0.507, p < 0.01$ ) (see Table 5).

**Self-Efficacy:** Children were more willing to try and spell words with the movable alphabet (338 words attempted;  $M = 4.33$ ) than with handwriting (285 words attempted;  $M = 3.65$ ). 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). 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 ( $r = 0.606, p < 0.01$ ) (see Table 5).

**Behavior:** There were moderate correlations between behavior and number of spelling attempts (see Table 5). Correlations between spelling scores and behavior were weak. There was a very strong correlation ( $r = 0.966, p < 0.01$ ) between the PSRA-13 and PBAR behavioral assessments.

Table 4: Mean Results

	Mean			N		
Variable	All	Age 4	Age 3	All	Age 4	Age 3
Age	4.330	4.483	3.779	78	61	17
Alphabet attempts <sup>a</sup>	4.330	4.610	3.350	78	61	17
Handwriting attempts <sup>a</sup>	3.650	3.920	2.710	78	61	17
Alphabet total score <sup>b</sup>	14.360	15.960	8.470	70	55	15
Handwriting total score <sup>b</sup>	11.050	12.120	6.920	63	50	13
Alphabet % correct	0.401	0.440	0.259	70	55	15
Writing % correct	0.296	0.326	0.179	63	50	13
Phonemic Awareness <sup>c</sup>	7.930	8.360	6.470	76	59	17
Letter Knowledge <sup>d</sup>	2.460	2.610	1.940	78	61	17
PSRA-13 <sup>d</sup>	41.470	42.300	38.530	78	61	17
PBAR <sup>e</sup>	29.010	29.530	27.180	77	60	17

<sup>a</sup>8 maximum. <sup>b</sup>48 maximum. <sup>c</sup>10 maximum. <sup>d</sup>52 maximum. <sup>e</sup>36 maximum.

Table 5: 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
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	.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	.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	.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	.000	.013
	N	62	63	63	62	63	63	63	63	63	63	63
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	.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	.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. PSRA-13 = Preschool Readiness Assessment. PBAR = Preschool Behavior Assessment Rubric. \* = Correlation is significant at the 0.05 level (2-tailed). \*\* = Correlation is significant at the 0.01 level (2-tailed).

## Discussion

**Scaffolded Assessment Demonstrates that Preschoolers Can Spell:** The study results show that a movable alphabet spelling assessment is a more reliable, valid, and sensitive measure of preschool spelling abilities than a handwritten assessment. As such, the lower scores historically reported on handwritten preschool spelling assessments may reflect aspects of development unrelated to spelling such as a lack of motor ability to write letters or working memory limitations. Future studies should assess typical, scaffolded preschool spelling abilities in a larger study population.

**Alphabet Better Predicts 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.<sup>1,17-19</sup> Because spelling may be a proxy for phonemic awareness,<sup>23</sup> a movable alphabet might be useful as a stand-alone early literacy assessment (in lieu of tests of phonemic awareness and letter-sound knowledge). As such, it might also prove helpful in identifying preschoolers at risk for reading difficulty. Future studies should evaluate these possibilities.

**Scaffolds Influence Self-Efficacy:** The children displayed a clear desire for their handwritten letters to be accurate as illustrated in the following comments:

- "What’s the ‘t’ look like? I can’t do it. How do you do it?"
- “I can’t write.” Then refused to begin.
- "I don't know how to write an m. I don't know how to write much."
- "Is it a line down? Is it a circle? I don't know what the letter is."

These and other comments (reported in Volkman, 2017) raise the question of whether assessments without scaffolds may contribute to the self-efficacy decline noted as children progress through school.<sup>24</sup> 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. Future research should consider the relationship between assessments without scaffolds and self-efficacy.

**Behavior:** The study’s findings suggest 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 (see Volkman, 2017). Further studies on the validity of the PBAR are recommended.

**Future Directions:** The children included in this study received standard, public preschool literacy instruction. They did not receive explicit instruction in phonemic awareness segmenting (hearing *all* the phonemes in a word) or letter-sound knowledge (e.g., via tracing letter shapes while saying their sounds as is done in Montessori preschools). With this in mind, 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 (e.g., via brief games)? What results might then be seen in preschoolers allowed to “play” with a movable alphabet to build words? Children’s successful use of the movable alphabet in this study suggests that traditional education may be missing a key developmental window for offering children the phonemic keys of English.

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