Read Writ (2010) 23:607–626
DOI 10.1007/s11145-009-9174-x

Fostering alphabet knowledge development: a comparison of two instructional approaches

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Published online: 4 April 2009

Abstract Preschool-aged children ($n = 58$) were randomly assigned to receive small group instruction in letter names and/or sounds or numbers (treated control). Alphabet instruction followed one of two approaches currently utilized in early childhood classrooms: combined letter name and sound instruction or letter sound only instruction. Thirty-four 15 minute lessons were provided, with children pre- and post-tested on alphabet, phonological awareness, letter–word identification, emergent reading, and developmental spelling measures. Results suggest benefits of combined letter name and sound instruction in promoting children's letter sound acquisition. Benefits did not generalize to other emergent literacy skills.

Keywords Emergent literacy · Alphabet knowledge · Letter-sound correspondence · Preschool intervention

This study reports results from the dissertation of Shayne B, Piasta, submitted in partial fulfillment of the requirements for the Ph.D. at Florida State University. The research was supported by a Predoctoral Interdisciplinary Research Training Grant (R305B04074) from the Institute of Education Sciences. The opinions articulated are ours and do not represent views of the university or funding agency. Gratitude is expressed to Christopher J. Lonigan, Christopher Schatschneider, and Carol McDonald Connor for providing comments on early drafts of this manuscript, Avni Vyas for her daily work within the preschool centers, Caroline Phythian-Sense and Shari Watson for conducting assessments, Liz Wagner and Samyuktha Kashinath for fidelity coding, and the preschool directors, teachers, parents, and children for welcoming us into their classrooms.

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Introduction

The acquisition of alphabet knowledge, or knowledge of letter names and corresponding sounds, is an important accomplishment in children's early literacy development (Whitehurst & Lonigan, 1998) and recognized as the strongest predictor of later reading ability (Hammill, 2004; National Research Council, 1998; Scarborough, 1998; Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004; Share, Jorm, Maclean, & Matthews, 1984). Young children with high levels of letter name knowledge tend to develop better reading skills, and children who demonstrate extremely low letter name knowledge tend to experience difficulties in reading acquisition (National Research Council, 1998; O'Connor & Jenkins, 1999; Snowling, Gallagher, & Frith, 2003; Torppa, Poikkeus, Laakso, Eklund, & Lyytinen, 2006).

Letter sound knowledge is essential in learning to read alphabetic languages like English (Adams, 1990; Ehri, 1987, 1997, 1998). Consequently, alphabet knowledge is an important component of early literacy instruction (Justice, Pence, Bowles, & Wiggins, 2006), and its development is incorporated into a number of recent federal educational initiatives (e.g., Head Start, Administration for Children and Families, 2003; Reading First, U.S. Department of Education, 2002; Early Reading First, U.S. Department of Education, 2003) and state curriculum frameworks (e.g., Florida Department of Education, 2006; Massachusetts Department of Education, 2001).

Unfortunately, little is known regarding how alphabet knowledge is best imparted. Early studies have been criticized based on research design and ecological validity (see Ehri, 1983) and more recent studies have generally combined alphabet training with other types of instruction such as phonological awareness (e.g., Roberts, 2003). The National Early Literacy Panel (2008) identified only three studies that investigated the impact of alphabetic instruction by itself. Curricula designed to facilitate early literacy skills vary considerably in how alphabet knowledge is taught (Justice et al., 2006), especially with respect to whether instruction targets letter names and sounds, or only letter sounds.

Letter name and sound instruction

Although knowledge of letter sounds would seem to be more important for learning to read and write than knowledge of letter names, strong predictive relations with later literacy skills have been found for knowledge of letter names as well as letter sounds (e.g., Scarborough, 1998; Schatschneider et al., 2004). Letter naming abilities have been found to uniquely predict emergent and later reading skills once letter sound knowledge was controlled (e.g., Burgess & Lonigan, 1998; Lonigan, Burgess, Anthony, & Barker, 1998; Schatschneider et al., 2004). Many early childhood curricula, in fact, include a letter naming component (e.g., Open Court, Bereiter et al., 2003; Creative Curriculum, Heroman & Jones, 2004; Land of the Letter People, n.d.). Letter name knowledge also may help children acquire letter sound knowledge (Evans, Bell, Shaw, Moretti, & Page, 2006; Justice et al., 2006; McBride-Chang, 1999; Piasta, 2006; Share, 2004; Treiman, Berch, & Weatherston, 1993; Treiman, Tincoff, Rodriguez, Mouzaki, & Francis, 1998; Treiman, Weatherston, & Berch, 1994).

Support for the idea that letter name knowledge is used to acquire letter sound knowledge is provided by the letter name structure effect (e.g., Evans et al., 2006; Justice et al., 2006; McBride-Chang, 1999; Piasta, 2006; Treiman et al., 1998). Some letters like B and F include cues to letter sounds (i.e., /b/ and /f/) in their names. Other letters have names that do not provide cues to their sounds, like W and H. When children's patterns of alphabet acquisition are examined, a letter name structure effect is apparent: letter names and sounds are most likely to be known for letters that include cues to their sounds as opposed to letters with unrelated names and sounds (Justice et al., 2006; McBride-Chang, 1999; Piasta, 2006; Treiman et al., 1998). Additionally, in studies of acquiring knowledge of the Hebrew alphabet, Share (2004) found that children were more likely to learn the sounds of pseudoletters when they had been previously taught a pseudoletter name linked to its corresponding sound, and Levin, Shatil-Carmon, and Asif-Rave (2006) found that children who were taught letter names attempted to extrapolate letter sounds from this knowledge.

Letter sound only instruction

Despite the above evidence, others have postulated that letter name learning holds no benefit for letter sound acquisition (for discussion, see Adams, 1990, pp. 350–355; Groff, 1984; McGuinness, 2004). Proponents of this view have suggested that letter name knowledge is merely correlated with letter sound knowledge and literacy outcomes (Foulin, 2005; Groff, 1984). Studies that compare countries in which letter names are taught (e.g., Israel, United States) to countries that only teach letter sounds (e.g., United Kingdom) do not find differences in literacy outcomes by age 7 or 8 (Caravolas, Hulme, & Snowling, 2001; Ellefson, Treiman, & Kessler, 2009). Others have argued not only that letter name knowledge does not facilitate letter sound acquisition and early literacy, but that knowledge of letter names actually interferes with the development of these skills (Groff, 1984; McGuinness, 2004). Consequently, some early childhood curricula refer to letters only by sounds (e.g., Jolly Learning Ltd., n.d.; Montessori; Montessori & Gutek, 2004), and some educators within the deaf community object to letter name instruction for children with hearing impairments [e.g., the program Children's Early Intervention for Speech–Language–Hearing (CEI), Tade & Vitali, 1994; see also Easterbrooks & Estes, 2007; Steinberg & Harper, 1983].

The purpose of the present study was to compare directly the effectiveness of combined letter name and sound instruction with letter sound only instruction for teaching alphabet knowledge and other emergent literacy skills. Additionally, we compared both types of alphabet instruction to a treated control in which number instruction was provided. Based on the extant literature, we hypothesized that combined letter name and sound instruction would prove the most beneficial for children's learning. Benefits for both types of alphabet instruction over the treated control were also expected.

Method

Participants

English-speaking, preschool-aged children were recruited from classrooms serving 3- and 4-year olds at four private childcare centers in a mid-sized southeastern city. Children for whom parental consent was granted ($N = 113$) were screened to determine their uppercase letter naming abilities (task described in Measures section). Children producing fewer than eight letter names were considered eligible for study participation. The cutoff of eight letter names was determined through examination of a large database containing information on over 1,000 3- and 4-year old children living in the same mid-sized southeastern city. Knowledge of eight or fewer letter names represented below-average letter knowledge for children of this age (C. Lonigan, personal communication, June 13, 2007).

Sixty-three children met the screening criteria and were invited to further participate in the study. Five eligible children did not complete the study. Two children moved, two children refused to complete study assessments, and one child displayed serious behavior problems that disallowed participation in the small groups. Sample characteristics for the 58 children completing the intervention are presented in Table 1. About 48% of the sample was female. The majority of children in the sample were Caucasian (72.41%), with 13.79% African–American and 13.79% of other ethnicities (Indian, Hispanic, or Asian). Fifty percent of the children had parents who had graduated from college, and 8.62% of parents had additional post-graduate training. Parents of three children failed to provide their education information.

To better ensure equivalency of groups on initial alphabet knowledge at the start of the study, children were blocked within-classroom with respect to their letter knowledge before being randomly assigned to one of the three intervention conditions (Shadish, Cook, & Campbell, 2002): combined letter name and sound instruction (LNLS), letter sound only instruction (LS), or number instruction. Each condition thus included children of all ability levels and from each participating classroom. Within conditions, children were also randomly assigned to the small groups through which instruction was delivered. In this manner, neither condition nor small groups were confounded with initial alphabet knowledge levels, childcare centers, teachers, or classes.

Instruction

Curricula consisting of 34 individual lessons were delivered to participating children over a 9-week period (8 weeks of instruction plus a week of mid-testing). All instruction was implemented by the researcher and two graduate students as a pull-out program to small groups of 3–5 children. Each implementer provided instruction in all three conditions to avoid confounding intervention condition with implementer.

Lessons were scripted and fidelity of implementation was monitored throughout the course of the study. Audio recordings of 30% of all lessons were reviewed by

Table 1 Descriptive statistics

	Full sample (n = 58)				LNLS condition (n = 20)			LS condition (n = 20)			Number condition (n = 18)		
	α	*M*	SD	Range	*M*	SD	Range	*M*	SD	Range	*M*	SD	Range
Screening													
LN production[a]	.65	3.53	2.70	0–8	3.65	2.80	0–8	3.40	2.50	0–8	3.56	2.96	0–8
LN recognition[a]	.72	5.21	3.50	0–14	5.05	3.82	0–14	5.35	3.54	1–12	5.22	3.28	0–12
Pretest													
Parent education		5.53	1.12	1.00–7.00	5.73	.88	4.00–7.00	5.14	1.54	1.00–7.00	5.71	.71	4.50–7.00
Age (years)[b]		3.77	.62	2.77–5.00	3.70	.65	2.77–5.00	3.78	.56	2.79–4.86	3.83	.66	2.97–4.95
LS production[a]	.78	.95	1.88	0–9	.90	2.02	0–7	1.05	2.06	0–9	.89	1.57	0–5
LS recognition[a]	.79	2.17	2.85	0–15	2.30	3.73	0–15	2.05	2.67	0–12	2.17	1.95	0–8
LWid W score	.58	310.19	17.23	276–340	310.10	13.68	293–336	308.95	16.32	276–340	311.67	22.01	276–340
LWid SS		96.98	9.61	72–114	97.65	9.54	76–110	96.53	8.34	78–114	96.72	11.32	72–111
Voc W score		42.36	10.40	13–67	43.20	9.13	27–60	40.30	10.48	13–55	43.72	11.80	24–67
Voc SS		98.29	11.36	64–125	100.40	9.80	85–119	95.50	10.80	64–108	99.06	13.42	77–125
PA raw score	.86	10.95	5.34	0–23	11.20	5.15	1–22	10.60	5.88	0–23	11.06	5.20	2–21
PA SS		92.72	12.89	69–124	94.35	10.97	72–110	91.40	13.83	69–120	92.39	14.26	72–124
Number ID	.85	2.84	3.10	0–10	2.75	3.19	0–9	2.50	2.78	0–8	3.33	3.43	0–10
Posttest													
LN production[a]	.91	8.84	6.52	0–25	10.40	8.22	0–25	7.35	5.27	0–16	8.78	5.51	0–20
LN recognition[a]	.91	11.03	6.98	0–25	12.00	8.42	1–25	9.90	6.34	0–23	11.22	6.05	2–24
LS production[a]	.90	3.03	4.42	0–20	4.35	5.98	0–20	2.60	3.44	0–15	2.06	3.00	0–9
LS recognition[a]	.89	5.10	5.35	0–23	6.35	7.24	0–23	4.45	4.31	0–19	4.44	3.73	0–12
LWid W score	.71	321.10	18.49	264–359	321.60	21.36	276–359	319.80	13.43	293–336	322.00	20.79	264–345
LWid SS		99.88	10.34	73–115	100.70	12.95	73–115	99.20	7.12	88–113	99.72	10.63	75–115
PA raw score	.82	13.28	4.43	3–27	13.90	4.23	7–21	12.80	4.46	3–21	13.11	4.79	7–27

Table 1 continued

	Full sample (n = 58)				LNLS condition (n = 20)			LS condition (n = 20)			Number condition (n = 18)		
	α	*M*	SD	Range	*M*	SD	Range	*M*	SD	Range	*M*	SD	Range
PA SS		97.48	11.46	72–126	101.25	9.09	85–115	95.15	12.48	72–123	95.89	12.18	79–126
Emergent reading[c]	.00	6.26	1.94	2–10	6.50	1.79	3–10	6.00	1.75	2–9	6.28	2.35	2–10
DST[d]	.35	.33	.78	0–3	.45	1.00	0–3	.30	.80	0–3	.22	.43	0–1
Number ID	.88	5.19	4.11	0–16	4.85	3.54	1–11	3.75	3.40	0–11	7.17	4.81	0–16
Gain													
LN production[a]		5.31	4.98	−2 to 17	6.75	6.32	−2 to 17	3.95	4.35	−2 to 12	5.22	3.59	−1 to 12
LN recognition[a]		5.82	5.47	−3 to 17	6.95	6.19	−1 to 17	4.55	5.76	−3 to 16	6.00	4.12	−1 to 15
LS production[a]		2.09	4.01	−5 to 20	3.45	5.40	0 to 20	1.55	2.35	−3 to 6	1.17	3.43	−5 to 8
LS recognition[a]		2.93	4.21	−4 to 21	4.05	5.74	0 to 21	2.40	2.66	−2 to 7	2.28	3.92	−4 to 12
LWid W score		10.91	18.05	−41 to 54	11.50	19.55	−29 to 54	10.85	16.40	−12 to 44	10.33	19.03	−41 to 38
PA raw score		2.33	4.48	−9 to 12	2.70	4.65	−9 to 11	2.20	4.30	−6 to 11	2.06	4.72	−8 to 12
Number ID[e]		2.34	2.21	−1 to 10	2.10	1.37	−1 to 5	1.25	1.45	−1 to 4	3.83	2.85	−1 to 10

Notes: *LNLS* Letter name and letter sound, *LS* letter sound, *LN* letter name, *LWid* Woodcock–Johnson Letter–Word Identification subtest, *SS* standard score ($M = 100$, SD = 15), *Voc* Receptive One-Word Picture Vocabulary Test, *PA* Test of Preschool Emergent Literacy Phonological Awareness subtest, *Number ID* number identification subtest, *DST* Developmental Spelling Test

[a] Maximum score = 26

[b] Years of parent education scored according to the Hollingshead (1975) index

[c] Maximum score = 17

[d] Maximum score = 30

[e] Maximum score = 16

the researcher, with implementation issues discussed as they arose. Fidelity was assessed on 15% of all lessons by coding audio recordings for the presence or absence of key lesson components. Research assistants blind to the study's hypotheses individually coded audio recorded lessons. Double-coding of 20% of the fidelity recordings indicated high interrater reliability ($\kappa = .93$).

LNLS and LS conditions. Lessons followed a similar format in both alphabet instruction conditions. In the LNLS condition, the letter was consistently referred to by its name and linked to its corresponding sound (e.g., the letter C that makes the sound /k/). In the LS only condition, the letter was designated only through reference with its corresponding sound (e.g., the letter that makes the /k/ sound). In both conditions, the single most common sound associated with individual consonants and short vowel sounds were taught. Thirty-four alphabet lessons were developed: 26 individual letter lessons plus eight weekly review lessons. All lessons lasted ~10–15 minutes. The individual letter lessons focused on a single uppercase letter and sound. To avoid bias due to typical alphabet order (see, e.g., McBride-Chang, 1999), letters were taught following a fixed random sequence (T, J, S, N, M, G, A, V, H, W, P, Z, O, C, Q, E, B, Y, R, K, U, I, F, X, D, L). Sample lessons are available from the first author.

Review lessons were included at the end of each week. These lessons began with a brief review of the letters learned during the week, followed by a shared alphabet book reading. The alphabet book was read with children's attention specifically drawn to the printed letter forms and their corresponding names and/or sounds, depending on the instructional condition.

Control/Number condition. Children in the control condition received number identification instruction. Similar to the alphabet instruction conditions, a curriculum consisting of thirty-four 10–15 minute lessons was provided. Sixteen lessons were devoted to instruction on a particular number, 0–15, with one to three individual number lessons provided each week. To equate on number of lessons and total instructional time, children in the Number condition received 18 review lessons. Review lessons were conducted for every set of two (e.g., 0–1), four (e.g., 0–3), and eight (e.g., 0–7) numbers learned. The last four lessons in the instructional sequence were full reviews of all numbers taught (i.e., 0–15). Number lessons were designed to be as similar as possible to alphabet lessons in format, activities, intensity, and duration.

Measures

Background/demographics. Parent/guardian surveys were distributed with consent forms and used to collect demographic and background information on participating children.

Vocabulary. Vocabulary was measured at the beginning of the study using the Receptive One-Word Picture Vocabulary Test (ROWPVT; Brownell, 2000). Children were shown color pictures of a number of objects and asked to point to the object named by the assessor.

Alphabet knowledge. Letter name and sound production were assessed by asking children to give the name and sound of each uppercase letter as presented on randomly ordered flashcards (Cronbach's $\alpha = .97$ and .96 respectively; Wagner, Torgesen & Rashotte, 1994; reliabilities for all measures as administered to the present sample are presented in Table 1). Children were given a second opportunity to demonstrate knowledge of the letters they were unable to identify in a recognition task. A sheet containing all 26 uppercase letters in random order was placed in front of the child, and he or she was asked to point to the correct letter as the examiner gave its name or sound.[1] Responses for both tasks were scored as correct or incorrect, with only the sounds taught in the course of the study considered correct. While composite scores (summed number of correct responses, ranging from 0 to 26) for the production tasks simply represent the number of letters or sounds correctly produced by the child, composite scores for the recognition task represent a more general assessment of the number of letters or sounds produced or recognized by the child (i.e., letters or sounds produced or recognized on either of the two tasks).[2] Letters were presented in a different random order for each child, and the order in which the letter name and sound tasks were administered was counter-balanced across children at midtest and posttest. Four composite scores were used in analyses: letter name production, letter name recognition, letter sound production, and letter sound recognition.

Phonological processing skills. Children's phonological awareness/processing were assessed using the Phonological Awareness subtest from the Test of Preschool Emergent Literacy (TOPEL; Lonigan, Wagner, Torgesen, & Rashotte, 2007; $\alpha = .86$). The Phonological Awareness subtest involves two tasks, phonological elision and phonological blending.

Emergent reading and spelling abilities. Children's emergent reading and spelling abilities were assessed with two tasks. The first was adapted from the forced-choice word reading task used with preschoolers by Byrne and Fielding-Barnsley (1991, 1993, 1995; Hindson et al., 2005). This task involves presenting children with three printed words (e.g., mat, sat, hat) and asking the child to identify the printed form of a spoken word (e.g., Which one says sat?). Responses to each item were scored as correct (1) or incorrect (0) and summed to create the composite score used in analyses. The original measure correlated from .39 to .43 with later kindergarten and grade 1 reading abilities (B. Byrne, personal communication, April 11, 2007) and had an internal consistency of $\alpha = .57$ (Hindson et al., 2005). Analysis of internal consistency with the present sample indicated problems with reliability ($\alpha = 0$), due to an average inter-item covariance of zero. Explanations for the low reliability estimate include the forced-choice nature of the task and ability of children to guess correct answers, as well as potential violations of independence of items (Cronbach & Shavelson, 2004) such as fatigue effects anecdotally noted in this sample of young children. Caution is warranted when interpreting results using this measure.

[1] Alphabet production and recognition abilities are typically assumed to represent two separate constructs of letter knowledge, as discussed by Dodd and Carr (2003) and reflected in a number of studies of emergent literacy (e.g., Lafferty, Gray, & Wilcox, 2005; Solity, 1996; Stuart, 1999; Sumbler, 1999; Vandervelden & Siegel, 1997; Williams, 1980).

[2] Tasks were administered in this manner to minimize both assessment time and children's frustration.

Emergent spelling was assessed through the Developmental Spelling Test (DST; Ball & Blachman, 1991; Blachman, 1994; Blachman, Tangel, Ball, Black, & McGraw, 1999; Tangel & Blachman, 1992). Children are asked to spell five dictated words (*lap, sick, train, elephant, pretty*). Each word is scored on a scale of zero (random letter string) to six (conventional spelling). Intermediary scores are given for inventive spellings capturing phonologically-relevant information (e.g., L for elephant). A 10-item version of the DST correlated .85 with a standardized spelling measure (Wide-Range Achievement Test-Revised Spelling subtest; Jastak & Wilkinson, 1984) when administered in first grade, and the 5-item DST as administered in kindergarten showed predictive validity with first grade reading skills ($r = .61–.63$; Tangel, 1991). The internal consistency for the DST as administered to the present sample was rather low ($\alpha = .35$), owing to the small number of items and generally poor performance of children on this measure (see descriptive statistics in Table 1). Scores for each of the five words were summed to create the single composite score used in analyses.

Letter–word identification. The Letter–Word Identification subtest of the Woodcock–Johnson Tests of Achievement-III (Woodcock, McGrew, & Mather, 2001) was used to measure of letter knowledge and word recognition ability.

Number identification. Children's cardinal number knowledge was assessed through a number identification task, as adapted from Malofeeva, Day, Saco, Young, and Ciancio (2004). Children were asked to name each number from 0 to 15, as presented on flashcards ($\alpha = .90$; Malofeeva et al., 2004).

Procedures

All assessments were administered by trained research assistants blind to the conditions to which the children were assigned. Assessment batteries were often administered in multiple sessions, depending on the needs of individual children. In August, all children were screened via a letter name production/recognition task. Children meeting screening criteria were pretested in late August/early September, at which time their verbal abilities, letter sound knowledge, phonological processing, and number identification were assessed, and a standardized letter and word identification task was also administered. For progress monitoring purposes, letter name and sound knowledge was reassessed at the mid-point of the instructional intervention; these results are not reported. Posttesting took place during the 3 weeks following the conclusion of the instructional intervention.

Results

Preliminary analyses

Descriptive statistics for children's pretest, posttest, and gain scores in each of the intervention conditions are reported in Table 1. Raw scores were used in all analyses. Preliminary analyses indicated that children in the three conditions did not differ on gender, χ^2 (2, $n = 58$) = 2.156, $p = .340$, ethnicity [comparing

Caucasian, African–American, and Other; χ^2 (4, $n = 58$) = 2.234, $p = .693$], age, $F(2, 55) = .217$, $p = .806$, or average parent education, Welch's test, $F(2, 32.64) = 1.092$, $p = .347$. Nor did the screening/pretest scores of children differ across the three conditions [letter name production, $F(2, 55) = .042$, $p = .959$; letter name recognition, $F(2, 55) = .036$, $p = .965$; letter sound production, $F(2, 55) = .043$, $p = .957$, letter sound recognition, $F(2, 55) = .037$, $p = .964$; number identification, $F(2, 55) = .349$, $p = .707$; letter–word identification, $F(2, 55) = .115$, $p = .892$; vocabulary, $F(2, 55) = .603$, $p = .551$; phonological awareness, $F(2, 55) = .066$, $p = .936$].

Correlations among measures are provided in Table 2. Scores from pretest to posttest were relatively stable. Alphabet knowledge, number identification, and letter–word identification scores were generally positively correlated within assessment points. Vocabulary, phonological awareness, emergent reading, and developmental spelling tended to be unrelated to alphabet measures and number identification, although vocabulary, phonological awareness, and developmental spelling appeared interrelated. Age also tended to correlate with assessment scores and was found to suppress unwanted variance in outcomes in initial analyses. Thus, participant age was centered and used as a covariate in all analyses.

Fidelity. On average, implementers delivered the instructional lessons with 97.71% fidelity (SD = 5.87). Letter names were erroneously given in less than 3% of all LS only lessons, with the letter name used once during three lessons and three times during one review lesson. Planned pairwise comparisons using Dunnett's T3 procedure (Maxwell & Delaney, 2004) indicated no significant differences in fidelity ratings among the intervention conditions [$t(40.237) = .516$, $p = .938$ for LNLS versus LS conditions, $t(40.237) = -1.684$, $p = .272$ for LNLS versus Number conditions, $t(40.237) = -2.506$, $p = .051$ for LS versus Number conditions]. Although fidelity ratings were high across all three implementers (100.00, 98.72, and 93.75%), the implementer with the lowest rating demonstrated significantly lower fidelity than the other two implementers, $t(24.267) = 3.678$, $p = .003$ and $t(24.267) = -2.676$, $p = .033$, who did not differ from one another, $t(24.267) = 1.709$, $p = .282$. The same implementer also erred more frequency in providing letter names during LS only lessons (4) than the other implementers (1 each). Given the differences in fidelity ratings, dummy codes representing implementer were used as fixed effect covariates in all analyses.

Nested nature of the data. Potential impacts of children's classrooms, teachers, and schools were not confounded with the three conditions in the study, through random assignment at the child level and the block randomization technique. Instruction, however, was delivered within the context of small groups. Hierarchical linear models (HLM; Raudenbush & Bryk, 2002), nesting children within groups, indicated minimal shared variance among groups for all outcomes except letter sound recognition ($p = .012$). Between-group variance ranged from <1 to 19.17%. Adding dummy codes representing instructional implementer reduced all shared group variance to non-significant levels [4.95% or less for all outcomes except emergent reading (10.65%)]. Given this finding and use of random assignment in forming the groups themselves, all analyses were conducted at the child level, with implementer treated as a fixed effect, to preserve power.

Table 2 Correlations among screening, pretest, and posttest measures

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Age (years)	.360**	.310*	−.065	.126	.514***	.287*	.543***	.475***	.258**	.235**	.266*	.190	.245**	.416**	.283*	.412**	.436***
2. T1 LN production	–	.916***	.486***	.500***	.248**	.608***	.211	.588***	.707***	.704***	.511***	.485***	.573***	.289*	.083	.240**	.540***
3. T1 LN recognition		–	.575***	.626***	.192	.593***	.231**	.554***	.618***	.636***	.470***	.492***	.590***	.193	.103	.212	.479***
4. T1 LS production			–	.886***	.032	.240**	.140	.107	.346**	.455***	.417**	.479***	.338**	.084	−.169	−.072	.072
5. T1 LS recognition				–	.165	.319*	.216	.320*	.444***	.532***	.523**	.596***	.487***	.053	−.030	−.018	.289*
6. T1 Voc W score					–	.323*	.495***	.261*	.207	.196	.227**	.141	.205	.469***	.093	.277*	.289*
7. T1 LWid W score						–	.172	.491***	.501***	.528***	.433***	.363**	.492***	.255**	.159	.097	.420**
8. T1 PA raw score							–	.165	.063	.033	.220**	.111	.222**	.593***	.159	.210	.032
9. T1 Number ID								–	.583	.587***	.405**	.407**	.444***	.165	.167	.311*	.848***
10. T2 LN production									–	.939***	.616***	.611***	.712***	.100	.251**	.065	.544***
11. T2 LN recognition										–	.669***	.703***	.701***	.137	.171	.088	.580***
12. T2 LS production											–	.925***	.438***	.164	.030	.037	.327*
13. T2 LS recognition												–	.462***	.090	−.009	.034	.371**
14. T2 LWid W score													–	.126	.200	−.034	.414**
15. T2 PA raw score														–	.077	.272*	.145
16. T2 Emergent reading															–	.059	.136
17. T2 DST																–	.286*
18. T2 Number ID																	–

Notes: *T1* screening or pretest, *LN* letter name, *LS* letter sound, *Voc* Receptive One-Word Picture Vocabulary Test, *LWid* Woodcock–Johnson Letter–Word Identification subtest, *PA* Test of Preschool Emergent Literacy Phonological Awareness subtest, *Number ID* number identification subtest, *T2* posttest, *DST* Developmental Spelling Test

* $p < .05$, ** $p < .01$, *** $p < .001$

Impact of alphabet instruction

A series of 3 (condition) × 2 (time) repeated measures ANOVAs were used to compare pretest to posttest gains on alphabet knowledge, phonological processing, and letter–word identification outcomes (see Table 1 for gain scores).[3] Planned interaction contrasts were used to compare pretest to posttest gains among the three instructional conditions. Posttest emergent reading and spelling scores were compared using one-way ANOVAs. Again, planned contrasts were used for individual comparisons among conditions. Given the directional nature of hypotheses regarding the impact of instruction on literacy-related outcomes (i.e., LNLS > LS > Number), effects of condition were tested using one-tailed significance values (Knotternerus & Bouter, 2001; Pillemer, 1991). Furthermore, given recent attention to the value of effect sizes (Wilkinson & APA Task Force on Statistical Inference, 1999) together with the limited power of the small-scale study, we also examined effect size magnitude for all contrasts of interest.[4]

Alphabet knowledge. Main effects of time indicated that children made significant gains from pretest to posttest for all measures of alphabet knowledge, $F(1, 52) = 37.881$, 49.382, 20.717, 30.967 for letter name production, letter name recognition, letter sound production, and letter sound recognition, respectively, all $ps < .001$. Interaction contrasts indicated differential gains in letter name production between children in the LNLS condition and those in the LS condition, $F(1, 52) = 3.129$, $p = .041$, favoring the LNLS condition (Cohen's $d = .53$). No differences in letter name production gains emerged when the two alphabet instruction conditions were compared to the Number condition, [$F(1, 52) = .973$, $p = .164$, $d = .19$ for LNLS versus Number conditions, and $F(1, 52) = .489$, $p = .756$, $d = -.30$ for LS versus Number conditions], nor did any of the conditions differ in comparison of letter name recognition gains [$F(1, 52) = 1.696$, $p = .099$, $d = .41$ for LNLS versus LS conditions, $F(1, 52) = .462$, $p = .250$, $d = .11$ for LNLS versus Number conditions, and $F(1, 52) = .315$, $p = .711$, $d = -.029$ for LS versus Number conditions].

Significant differences among conditions were found for the measures of letter sound knowledge. Specifically, children in the LNLS condition learned more letter sounds than children in the Number condition [$F(1, 52) = 5.997$, $p = .009$, $d = .47$

[3] Significant positive skew was noted for the letter sound production, letter sound recognition, and developmental spelling tasks (skewness statistic ranging from 1.906 to 2.826). Transformations (Tabachnick & Fidell, 1996) with the DST variable did not significantly improve its distribution; reported analyses were conducted on the untransformed variable and ought to be interpreted cautiously. Given the relative robustness of ANOVA to violations of non-normality (Maxwell & Delaney, 2004), isolation of skew to the LNLS condition, and meaningful metric of these measures (i.e., number of letter sounds known), no further transformations were conducted on the letter sound outcomes, and analyses were conducted on both the original and outlier-adjusted variables. These analyses yielded similar results; thus, only the analyses for the unadjusted variables are reported. Additional assumptions for repeated measures and one-way ANOVAs were satisfied (Maxwell & Delaney, 2004).

[4] With the exception of the emergent reading and developmental spelling measures, on which only posttest data was available, effect sizes were computed to align with interaction contrast results. Thus, effect sizes reflect relative differences among conditions in learning gains as opposed to simple posttest comparisons.

for letter sound production; $F(1, 52) = 3.097$, $p = .042$, $d = .29$ for letter sound recognition]; a similar trend favoring the LNLS condition over the LS condition for letter sound production was also apparent, $F(1, 52) = 2.767$, $p = .051$, $d = .51$. Letter sound recognition gains of children in the LS condition did not significantly differ from those of children in either the LNLS or Number conditions [$F(1, 52) = 1.349$, $p = .125$, $d = .34$ for LNLS versus LS and $F(1, 52) = .421$, $p = .260$, $d = .04$ for LS versus Number], nor did letter sound production gains significantly differ from gains of children in the Number condition, $F(1, 52) = .736$, $p = .197$, $d = .14$. Note that only the letter sound production contrast between the LNLS and Number conditions remained significant after application of a linear step-up procedure to control the Type I error rate (Benjamini & Hochberg, 1995; Kesselman, Cribbie, & Holland, 1999).

Emergent literacy skills. Children demonstrated significant pretest to posttest gains on the Letter–Word Identification subtest, $F(1, 52) = 3.490$, $p = .034$, but their learning did not differ among instructional conditions, $F(1, 52) = .024$, $p = .439$, $d = .04$ for LNLS versus LS conditions, $F(1, 52) = .017$, $p = .448$, $d = .02$ for LNLS versus Number conditions, $F(1, 52) = .077$, $p = .391$, $d = .03$ for LS versus Number conditions. Children's phonological abilities increased from pretest to posttest, $F(1, 52) = 5.746$, $p = .010$, but, again, these gains were not differential across conditions, $F(1, 52) = .041$, $p = .420$, $d = .10$ for LNLS versus LS conditions, $F(1, 52) = .000$, $p = .500$, $d = .05$ for LNLS versus Number conditions, $F(1, 52) = .032$, $p = .429$, $d = .03$ for LS versus Number conditions. Contrasts on the emergent reading and developmental spelling tasks showed no significant differences among conditions [for emergent reading, $F(1, 52) = .961$, $p = .166$, $d = .28$ for LNLS versus LS conditions, $F(1, 52) = .072$, $p = .395$, $d = .11$ for LNLS versus Number conditions, and $F(1, 52) = .443$, $p = .254$, $d = -.14$ for LS versus Number conditions; for developmental spelling, $F(1, 52) = .728$, $p = .199$, $d = .17$ for LNLS versus LS conditions, $F(1, 52) = 1.065$, $p = .153$, $d = .29$ for LNLS versus Number conditions, and $F(1, 52) = .047$, $p = .291$, $d = .12$ for LS versus Number conditions].

Number identification. Children made significant pretest to posttest gains in number identification, $F(1, 52) = 49.157$, $p < .001$. Interaction contrasts indicated that children in the Number condition learned significantly more numbers than children in either the LNLS or LS conditions, $F(1, 52) = 7.682$, $p = .004$, $d = .22$ and $F(1, 52) = 16.123$, $p < .001$, $d = .71$, respectively, and these differences remained significant after application of the linear step up procedure to control the error rate. Number learning did not differ between the two alphabet instruction groups, $F(1, 52) = 1.740$, $p = .193$, $d = .26$ (two-tailed).

Discussion

In employing two methods of imparting alphabet knowledge to preschool-aged children, this small-scale training study examined the short-term impact of alphabet instruction on letter learning and emergent literacy skill development. The results, although largely exploratory in nature, provide preliminary evidence concerning benefits of combined letter name and sound instruction for alphabet knowledge acquisition.

Impact on alphabet outcomes

As supported by the extant literature, we hypothesized that children receiving letter name and sound instruction would show the greatest advantages in alphabet learning. Effect size estimates supported such an advantage over children in either of the other two study conditions. Statistical results showed that these children did, in fact, learn to produce more letter sounds than children in the treated control, along with a trend towards a similar benefit over those in the letter sound only condition. Letter name outcomes also favored the combined letter name and sound condition over the letter sound only condition. Children receiving letter sound instruction and those in the treated control generally did not differ on alphabet outcomes.

Children receiving letter name and sound instruction learned an average of two more letter sounds than those provided with letter sound or number instruction. Although a gain of two sounds may be somewhat modest, the effect sizes associated with these results were moderate in size and similar to those found in multi-componential studies of alphabet learning (see National Early Literacy Panel, 2008; Piasta & Wagner, 2008 for review). Such effects would most likely lead to greater gains in studies of greater duration or intensity (e.g., more than a single 15 minute lesson devoted to each letter).

Importantly, the advantage of combined letter name and sound instruction over letter sound only instruction cannot be attributed simply to greater print exposure, instructional time, or instructional intensity, given the design of the study. Rather, the advantage must be attributed to the fact that both letter names and sounds were taught.

Such results are consistent with letter name-to-sound facilitation, expanding the work of Share (2004) and Levin et al. (2006) using a more ecologically-valid paradigm. Nevertheless, we must note that the mechanism for the combined letter name and sound advantage is not entirely clear. First, we recognize that the majority of children across conditions were exposed to letter names at home as well as in their preschool classrooms. This fact does not negate our causal attribution regarding the advantage of combined letter name and sound instruction, given the true experimental design (Shadish et al., 2002). However, we cannot rule out alternative mechanisms for the effect including interactions between our supplemental alphabet instruction and the home and classroom literacy practices already in place.

Additionally, we acknowledge that referring to letters only by sounds may have been an “unnatural” form of labeling for these U.S. children. The fact that children receiving letter sound only instruction performed worse on letter name measures than children in the treated control may support this interpretation. Both groups of children presumably experienced equivalent amounts of incidental letter name exposure at home and school, suggesting that the “new” letter sound labels may have led to confusion or interference in alphabet learning. As argued by Groff

(1984) and McGuinness (2004), letter sound only instruction may yet represent the most effective means of instruction when working with children for whom letter sounds are a common, natural label.

Finally, the lack of advantage in letter name learning between children in the combined letter name and sound condition and treated control was unanticipated. As we expected that the supplemental letter name instruction would lead to greater letter name learning and thus provide the mechanism for letter name-to-sound facilitation, the fact that the additional instruction did not benefit children beyond the letter name experiences they were already encountering is somewhat perplexing. In sum, although combined letter name and sound instruction may be most beneficial for U.S. preschoolers alphabet learning, more research is necessary to fully understand the mechanisms.

Transfer to other emergent literacy skills

Despite correlational research suggesting causal relations among alphabetic and other emergent literacy skills (e.g., Lonigan, Burgess, & Anthony, 2000; Scarborough, 1998; Schatschneider et al., 2004; Wagner et al., 1994), the present study found no immediate evidence of transfer from alphabet instruction to measures of letter–word identification, phonological awareness, emergent reading, or developmental spelling. Difficulty in generalization to new tasks and measures has often been described in the literature on literacy development (e.g., Brady, Fowler, Stone, & Winbury, 1994; Byrne & Fielding-Barnsley, 1989; Fuchs, Fuchs, & Karns, 2001; Stahl & Fairbanks, 1986; Torgesen et al., 1999), particularly for children with reading difficulties (e.g., Al Otaiba & Fuchs, 2002; Gersten, Fuchs, Williams, & Baker, 2001; Torgesen & Hudson, 2006; Torgesen, Wagner, & Rashotte, 1997).

A number of factors may have contributed to the lack of transfer. The provided instruction was, by design, limited to the specific domain of letter name and sound knowledge and anticipated to causally impact phonological processing, reading, and spelling development through impacts on letter name and sound knowledge. Tests of causal relations were thus predicated on the success of the alphabet instruction provided. Despite trends favoring the alphabet training conditions, the current study did not produce large, robust gains for children relative to children in the control condition. Such small changes in alphabet knowledge may not be enough to affect changes in phonological processing, reading, or spelling development. Moreover, two of the emergent literacy measures (emergent reading and developmental spelling) proved rather difficult for the current sample of preschoolers, resulting in low reliabilities and warranting caution in their interpretation. Hence, although alphabet knowledge and reading/spelling development may be causally related, the current study and its emergent literacy measures may not have been powerful enough to detect these relations.

Limitations and future directions

Several limitations in the present study deserve attention and may be addressed in future work. First, the intensity and duration of the alphabet instruction provided in the current study may have been too modest to produce large gains in children's emergent literacy skills. Although similar "letter of the day" methods are common in early childhood classrooms (e.g., Dickson, 1998; McGill-Franzen, Lanford, & Adams, 1997; Pressley, Rankin, & Yokoi, 1996; Slavin, 1999; SRA/McGraw-Hill, 2003), the current approach may have been less intense than other early literacy interventions (e.g., Blachman, Ball, Black, & Tangel, 1994; Blachman et al., 1999; Brady et al., 1994; Brennan & Ireson, 1997; Iversen & Tunmer, 1993; Stuart, 1999; Torgesen et al., 1999) and perhaps could have been strengthened through incorporation of additional instructional techniques such as mnemonic devices (Ehri, Deffner, & Wilce, 1984) or letter writing (Aram & Biron, 2004). Future studies might also consider integrating supplemental and classroom instruction, with letter names and/or sounds taught in the explicit daily lesson reinforced throughout the day.

Issues of statistical power must also be noted and attended to in future studies. Although our sample size was based on a priori power analyses and effect sizes in the extant literature (e.g., Levin et al., 2006; McBride-Chang, 1999; Share, 2004), actual effects were smaller than anticipated. Correspondingly, observed power was substantially lower than the intended 80% (ranging from .085 to .671 for alphabet outcomes and from .050 to .173 for emergent literacy outcomes). Additional studies producing larger effects or including larger numbers of participants are necessary.

The lack of transfer to emergent literacy skills also deserves further attention. As the ultimate intention of providing effective early alphabet instruction is to impact reading and spelling abilities during the elementary years and beyond, demonstration of such transfer is largely desirable. Although the present study tested only the immediate effects of supplementary alphabet instruction, increased instructional and statistical power in future projects would allow effects beyond preschool to be studied. Continued assessment beyond the early preschool years would permit use of more valid and reliable measures of decoding and spelling, rather than the experimental measures currently utilized which proved problematic for participating children.

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