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Evaluating the components of an emergent literacy intervention for preschool children at risk for reading difficulties

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Abstract

Many preschool children are at risk for reading problems because of inadequate emergent literacy skills. Evidence supports the effectiveness of interventions to promote these skills, but questions remain about which intervention components work and whether combining intervention components will result in larger gains. In this study, 324 preschoolers (mean age = 54.32 months, *SD* = 5.88) from low-income backgrounds (46% girls and 54% boys; 82% African American, 14% White, and 4% other) were randomized to combinations of meaning-focused (dialogic reading or shared reading) and code-focused (phonological awareness, letter knowledge, or both) interventions or a control group. Interventions had statistically significant positive impacts only on measures of their respective skill domains. Combinations of interventions did not enhance outcomes across domains, indicating instructional needs in all areas of weakness for young children at risk for later reading difficulties. Less time for each intervention in the combined phonological awareness and letter knowledge intervention conditions, however, did not result in reduced effects relative to nearly twice as much time for each intervention when children received either only the phonological awareness intervention or only the letter knowledge intervention. This finding suggests that a relatively compact code-focused intervention can address the needs of children with weaknesses in both domains.

Keywords

Emergent literacy; Oral language; Phonological awareness; Letter knowledge; Intervention; Reading

Introduction

Acquiring reading skills is a significant developmental accomplishment for children. Reading skills form the core of academic achievement. Children who read well read more than their peers who are less skilled in reading and, as a consequence, they acquire even better reading skills, more vocabulary knowledge, and knowledge in other domains (e.g., Cunningham & Stanovich, 1997; Mol & Bus, 2011). Whereas well-developed reading skills are important for success in school, they have become increasingly important because employment opportunities have shifted toward technical and informational jobs from service and manufacturing jobs. Despite their significance for academic and occupational outcomes,

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large-scale national assessments of children's reading skills in the United States indicate that a substantial percentage of children are not acquiring or maintaining grade-level reading skills. In the most recent results of the National Assessment of Educational Progress (National Center for Education Statistics, 2010, 2011), 33% of fourth-grade students, 24% of eighth-grade students, and 26% of twelfth-grade students scored below the basic level in reading. Across grades, the likelihood of reading below the basic level was highest for children from nonmajority groups, children from low-income backgrounds, and children who were classified as English-language learners.

Research indicates substantial continuity between early reading skills and later reading skills (e.g.,Duncan et al., 2007; Wagner et al., 1997), suggesting that efforts to improve children's reading skills should be focused on children's early development. For example, Duncan et al. (2007) conducted longitudinal predictive analyses using data from six large-scale data sets that included achievement scores from between 700 and 10,000 children. These children's reading skills had been assessed when they were in preschool or kindergarten and again when they were in a later grade (e.g., third grade, fifth grade). The analyses identified significant continuity between children's preschool or kindergarten reading skills and their reading achievement at the later measurement periods, with an average zero-order correlation between early reading and later reading of .44. The predictive significance of early reading skills was maintained when measures of various child, family, and study variables were controlled in the analyses, and they extended to the broader academic outcome of grade retention.

Emergent literacy skills

Evidence indicates that skills children develop before school entry serve as the foundation for later success in developing reading skills (Whitehurst & Lonigan, 1998). The National Early Literacy Panel (Lonigan, Schatschneider, & Westberg, 2008a) conducted a meta-analysis to identify the early skills associated with later reading and writing skills. Each of the 300 studies that were used in the meta-analysis included an assessment of one or more potential early literacy skills measured when children were in preschool or kindergarten and an assessment of word decoding, reading comprehension, or spelling measured when children were in kindergarten or older. Skills related to print knowledge (e.g., alphabet knowledge, concepts about print, writing/name writing) were moderate to strong predictors of all conventional literacy skills. Two of three phonological processing abilities, phonological awareness and rapid automatized naming (but not phonological memory), were moderate predictors of all conventional literacy outcomes. Measures of oral language were also moderate predictors of conventional literacy outcomes. In the analyses, there were few differences suggesting that children's ages substantially influenced the predictive relations.

In general, results from longitudinal studies indicate that there is a moderate degree of modularity between these emergent literacy skills and later conventional literacy skills. Some emergent literacy skills are code related, and other emergent literacy skills are meaning related. Code-related skills are those skills that facilitate children's abilities to acquire the alphabetic principle successfully and become accurate and fluent decoders of text. Meaning-related skills are those skills, primarily associated with language, that allow children to comprehend text once it is decoded. Whereas skills in these two domains are correlated during development, they are differentially predictive of different aspects of later conventional literacy skills and they appear to be responsive to different types of instructional activities (e.g., Lonigan, 2006; Lonigan, Schatschneider, & Westberg, 2008b). For example, Storch and Whitehurst (2002) reported that oral language skills were directly related to reading comprehension outcomes but not to decoding outcomes in their longitudinal study. In the meta-analysis reported by Lonigan et al. (2008a), average correlations between measures of oral language (other than vocabulary) and reading

comprehension outcomes were higher than average correlations between oral language measures and word decoding outcomes.

Although these emergent literacy skills originate and develop throughout the preschool period for most children, some children arrive at kindergarten with low levels of these skills, making it less likely that they will be ready for the reading instruction they will receive during the early elementary grades. Children from families with lower socioeconomic status (SES) often have less well-developed emergent literacy skills than children from families with higher SES (e.g., Bowey, 1995; Lonigan, Burgess, Anthony, & Barker, 1998; Raz & Bryant, 1990), suggesting that the risk that these children face could be reduced by exposure to preschool programs designed to enhance emergent literacy skills. Most children from lower SES families in the United States, however, participate in programs that use traditional models of early childhood education that focus more on socioemotional development than on emergent literacy skills and that use implicit rather than explicit methods of instruction (Jackson et al., 2007; U.S. Department of Health and Human Services, 2005).

Interventions to promote development of emergent literacy skills

A host of reading intervention programs for young school-age readers have proven to be effective, particularly with respect to decoding skills (Ehri, Nunes, Stahl, & Willows, 2001; Ehri, Nunes, Willows, et al., 2001; Ouellette & Sénéchal, 2008; Suggate, 2010). Many of these studies, however, have been conducted with children who were of kindergarten age or older, and the interventions might not be appropriate for preschool children given both children's developmental levels and schools' academic expectations. Relative to the number of studies with school-age children that have evaluated programs to help struggling readers or children at risk for reading difficulties, there have been far fewer studies with preschool children at risk for later reading difficulties.

Interventions for meaning-related emergent literacy skills

Many studies of interventions designed to promote preschoolers' oral language skills have involved some form of shared book reading (Marulis & Neuman, 2010). Of these interventions, a form of interactive shared book reading known as dialogic reading has substantial evidence that it results in significant gains in children's oral language skills (e.g., Arnold, Lonigan, Whitehurst, & Epstein, 1994; Lonigan & Whitehurst, 1998; Whitehurst et al., 1988). In typical shared reading, the adult reads and the children listen; however, in dialogic reading, the roles of adults and children are reversed. The adult uses different scaffolding techniques (e.g., asking specific types of "wh-" and open-ended questions, modeling, using expansions and repetitions) derived from research on language development to encourage children to talk about the pictures in the book and learn to "tell the story". During dialogic reading, both within a book and across time, adults shift their scaffolding strategies from relatively simple questions about the things pictured in the book, to increasingly complex questions that require children to describe relations between things pictured in the book, and to those that require children to connect aspects of the book to other elements such as intentions, internal states, plot, and personal experiences.

Meta-analytic summaries provide some support for a positive effect of both standard shared reading (i.e., just reading to children) and dialogic reading (see Lonigan, Shanahan, & Cunningham, 2008); however, an important difference between studies of the two types of shared reading involves the comparison group. In studies of standard shared reading, the comparison group typically includes children who received no additional instructional activities (i.e., a no-treatment control). In contrast, in nearly every study of dialogic reading, the comparison group includes children who receive standard shared reading with the same

amount of exposure as for children who were exposed to dialogic reading. Consequently, the impacts of most dialogic reading studies represent the effect of dialogic reading above the effect of standard shared reading, suggesting that dialogic reading may be a particularly useful intervention for promoting preschoolers' oral language skills.

Interventions for code-related emergent literacy skills

A few studies of phonological awareness interventions have been conducted with preschoolers (e.g., Byrne & Fielding-Barnsley, 1991; O'Connor, Jenkins, Leicester, & Slocum, 1993; Roberts, 2003). In general, these interventions show positive effects on children's phonological awareness, letter knowledge, and later reading skills. Surprisingly, there are few studies on the effects of interventions to teach children just letter knowledge (Piasta & Wagner, 2010). Interventions designed to promote children's knowledge of print (e.g., Justice & Ezell, 2002; Justice, McGinty, Piasta, Kaderavek, & Fan, 2010) have proven to be effective; however, the largest effects of these interventions have not been on children's letter knowledge, which is the component of print knowledge most predictive of later reading and spelling (Lonigan et al., 2008a). One recent study that evaluated the impacts of two forms of letter knowledge intervention reported that teaching children about both letter names and letter sounds was more effective than teaching children about letter sounds only, and only the intervention that included both letter name and letter sound knowledge resulted in higher letter knowledge than a control intervention (Piasta, Purpura, & Wagner, 2010).

Specific versus synergistic effects of interventions

Despite evidence for the effectiveness of different interventions, questions remain concerning the necessary components of interventions to reduce the probability that preschoolers at risk for later reading problems will experience difficulties in learning to read. As noted above, different emergent literacy skills are differentially predictive of different components of reading. Several studies indicate that the effects of interventions are also specific to these domains. For instance, in their study of a print referencing intervention, Justice et al. (2010) reported that positive effects of the intervention did not extend to measures of children's language skills. Similarly, Bowyer-Crane et al. (2008) reported a study that contrasted the effects of a 20-week oral language intervention and a 20-week code-focused intervention that taught kindergarten children phonological awareness and rudimentary reading skills. Results at posttest and a 6-month follow-up assessment revealed that children who received the code-focused intervention outscored children who received the oral language intervention on measures of letter knowledge, phonological awareness, spelling, and reading. In contrast, children in the oral language intervention outscored children in the code-focused intervention on measures of vocabulary and grammar.

Children at risk for later reading difficulties are often at risk for problems in both code and meaning domains. Consequently, results indicating that effective interventions promote the development of skills in only one domain suggest that children will need exposure to multiple interventions to alleviate risk. There are, however, empirical and theoretical reasons to expect that interventions designed to promote development of only one skill may enhance the effects of interventions designed to promote the development of other skills. Specifically, combinations of different code-focused interventions and combinations of code-focused and meaning-focused interventions may yield effects that are broader than the effects expected from the interventions in isolation.

Combined phonological awareness and print knowledge intervention

Meta-analytic results summarizing studies of the effects of phonological awareness interventions with younger (e.g., preschool, kindergarten) and older children suggest that

phonological awareness interventions that include interventions involving print have larger effects than phonological awareness interventions alone (Bus & van Ijzendoorn, 1999; Ehri, Nunes, Willows, et al., 2001; Lonigan et al., 2008b). Such meta-analytic results, however, are comparisons of effect sizes across studies. Few studies have compared directly the effects of phonological awareness training alone with phonological awareness training combined with training about print (see Sénéchal, Ouellette, Pagan, & Lever, 2012, for a similar point). Of the few studies that have made this comparison directly, the results have been equivocal.

In their quasi-experimental study, Bradley and Bryant (1983) compared outcomes for 13 children who received phonological awareness training only, 13 children who received phonological awareness training and letter sound training, 26 children who received conceptual categorization training, and 13 children who received no training. Reading and spelling scores for children who received both phonological awareness and letter sound training were higher than those for children who received only phonological awareness training, but only the difference on the spelling measure was statistically significant. Similarly, Schneider, Roth, and Ennemoser (2000) randomized 138 kindergarten children who were at risk for later reading problems to groups that received letter sound training only, phonological awareness training only, or a combination of phonological awareness and letter sound training. With the exception of a significant finding for spelling tests administered at the end of first and second grades, there were no significant differences among the three groups on measures of phonological awareness or letter knowledge completed at posttest or on any reading measure administered at the end of first and second grades.

Combined oral language and phonological awareness intervention

Despite the clear importance of phonological awareness for acquiring reading skills, little is known about its developmental origins. One theory that attempts to explain the development of phonological awareness is the lexical restructuring model (LRM; Metsala & Walley, 1998). According to the LRM, as children's mental lexicons grow, their mental representations of words shift from a holistic form to a segmented form. This shift to an increasingly segmental representation allows children to access smaller segments of speech sounds to use in phonological awareness tasks. Consequently, the development of phonological awareness is limited by the developmental status of a child's mental lexicon (Walley, 1993; Walley, Metsala, & Garlock, 2003). Within the LRM, lexical restructuring is conceptualized as an individual difference variable that is dependent on vocabulary growth and is influenced by several lexical characteristics of words, including age of acquisition, word frequency, and phonological neighborhood density (i.e., the number of words differing by a single phoneme in the lexicon).

The LRM is consistent with the finding of a developmental continuum of phonological awareness from large and concrete units of sound (e.g., words, syllables) to small and abstract units of sound (e.g., phonemes) (Lonigan et al., 1998). In addition, young children's oral language skills, including vocabulary, are significantly correlated with their performance on phonological awareness tasks (Burgess & Lonigan, 1998; Lonigan, Burgess, & Anthony, 2000; Storch & Whitehurst, 2002). Based on the LRM, it is possible that interventions that promote children's vocabulary growth will have a positive effect on their phonological awareness skills or that an effective vocabulary intervention will enhance the effects of a phonological awareness intervention by facilitating greater segmentation of children's lexicons that can then be accessed more efficiently given the explicit requirement to do so that is embedded within a phonological awareness intervention.

Purpose of the current study

The purpose of this study was to evaluate the efficacy of interventions designed to promote the development of emergent literacy skills with a sample of preschool children who were at high risk for later problems in reading and to examine experimentally the specific and synergistic effects of the different interventions. We expected that each intervention would result in significant gains in the skill it was intended to affect (e.g., children exposed to a dialogic reading intervention would gain more vocabulary skills than children exposed to simple shared reading or no shared reading). In addition, we expected that combinations of interventions would result in gains beyond those resulting from the individual interventions. Specifically, based on the LRM, we anticipated that combining dialogic reading with a phonological awareness intervention would result in greater phonological awareness growth than a phonological awareness intervention alone (i.e., because of vocabulary growth), and based on meta-analytic findings, we anticipated that combining letter knowledge and phonological awareness interventions would result in greater growth in phonological awareness and letter knowledge than a phonological awareness or letter knowledge intervention alone.

Methods

Participants

Children were recruited for this study across 2 years from 13 Head Start centers and Title I preschools in a local school district in northern Florida. Parents or guardians provided informed consent for 365 3- to 5-year-olds (mean age = 54.07 months, *SD* = 5.91) who completed at least some initial assessments. Of this group, 324 (89%) completed at least some posttest assessments (completion within assigned groups ranged from 84 to 90%). Children who did not complete any posttests left their preschool during the school year. Consents were returned for an additional 9 children for whom no assessments were completed because they left their preschools before pretesting commenced. With the exception that children in the completer sample were significantly older than children who did not complete posttest (mean age = 52.40 months, *SD* = 5.86), $F(1,364) = 4.34$, $p = .04$, there were no significant differences between children in the completer sample and children who did not complete posttest on any variable at pretest (all *p*s > .11).

The completer group ranged in age from 38 to 74 months at pretest (mean age = 54.32 months, *SD* = 5.88) and included 147 girls (46%) and 171 boys (54%). The majority of children in the sample were African American (82%), 14% were White, and the remaining 4% were other ethnicities (e.g., Latino/Hispanic, Asian American). As a group, these children were at substantial risk for later academic difficulties. Mean scores for initial assessments on standardized measures of oral language and nonverbal cognitive abilities were in the below-average range (i.e., at or below the 13th percentile). For example, the average standard score at pretest on the Peabody Picture Vocabulary Test was 76.0 (*SD* = 15.96), the average standard score on the Expressive One-Word Picture Vocabulary Test was 82.6 (*SD* = 12.94), and the average scaled score on three subtests of the Stanford–Binet was 42.4 (*SD* = 4.33). The children knew, on average, approximately seven letter names and only one of the letter sounds assessed. However, 36% of children knew no letter names and 65% knew none of the letter sounds assessed. Nearly all of the children were nonreaders, as indicated by scores of zero on two word decoding/reading tasks. Only 5 children (2%) correctly identified one or more words on the Woodcock Reading Mastery, Word Identification subtest, and only 15 children (5%) correctly identified one or more words from among a list of high-frequency words.

Measures

Trained research assistants, who were blind to group assignments and study hypotheses, tested children individually in their preschools. Test administration for individual children was conducted over several 20- to 30-min sessions within a 2-week period to ensure optimal performance on all tasks. At pretest, children completed three measures of oral language, three measures of nonverbal cognitive abilities, eight measures of phonological awareness, two letter knowledge measures, and two text decoding measures. At midyear and posttest, children completed two measures of vocabulary, eight measures of phonological awareness, two letter knowledge measures, and two text decoding measures. The order of test administration varied across children.

Oral language and cognitive ability measures

Children's single-word receptive vocabulary was assessed at pretest only using the Peabody Picture Vocabulary Tests-Revised (PPVT-R; Dunn & Dunn, 1981). Single-word expressive vocabulary was assessed at pretest, midyear, and posttest using the Expressive One-Word Picture Vocabulary Test-Revised (EOWPVT-R; Gardner, 1990). Children also completed the Basic Concepts subtest of the Clinical Evaluation of Language Fundamentals–Preschool (CELF-P:BC; Wilig, Secord, & Semel, 1992), which assesses knowledge of modifiers and attributes, at pretest, midyear, and posttest. To assess nonlanguage cognitive abilities, children were administered the Bead Memory, Pattern Analysis, and Copying subtests of the Stanford–Binet (4th edition) (Thorndike, Hagen, & Sattler, 1986) at pretest only. The three subtests from the Stanford–Binet were combined to form a nonverbal cognitive abilities composite variable.

Phonological awareness measures

Eight measures were used to assess children's phonological awareness at all three assessment periods. Each of the measures included at least two practice trials that were followed by correction, explanation, and readministration if the child gave an incorrect answer or confirmation and explanation if the child gave the correct answer. Within each measure, all 10 or 11 test trials were administered to all children so that their phonological awareness across all levels of linguistic complexity was assessed. There was no feedback on any of the test trials. All correct responses were real words.

There were two measures of children's sensitivity to rhyme. The *rhyme oddity* task was patterned after the task developed by MacLean, Bryant, and Bradley (1987) using their word list. Children were presented with three pictures in a row that were named by the examiner. Children were asked to select the one that did not rhyme with (or that "did not sound the same as" or was "different than") the other two (all three instructions were used for all children). The task consisted of 2 practice trials and 11 test trials (αs = .45, .66, and .79 for pre-, mid-, and posttest, respectively). The position of the odd word across trials was randomly determined and was the same for all children. The rhyme matching task used the same word list and pictures as the rhyme oddity task (αs = .71, .75, and .85 for pre-, mid-, and posttest, respectively). On this task, children were presented with a picture on a small card and needed to indicate which of two additional pictured words it rhymed with. The examiner named all three pictures before and during a trial.

On three measures, children blended sounds to form a new word. The *blending words* task required children to combine single-syllable words to form a compound word. There were 2 practice items that were presented both verbally and with pictures. For example, the examiner showed the child two pictures and named them (e.g., "This is a cow and this is a boy") and then asked the child what word would be produced if he or she said them together (e.g., "What do you get when you say 'cow' … 'boy' together?"). During practice trials, the

examiner emphasized the nature of the task by putting the pictures together while presenting the trial. There were 11 test trials that were presented verbally only (αs = .93, .92, and .94 for pre-, mid-, and posttest, respectively). The *blending syllables and phonemes* task required children to combine word elements to form a word. The examiner spoke isolated word elements, and children were asked to say the word made by combining the word elements (e.g., "What do you get when you say 'sis'… 'ter' together?"). There were 2 practice trials and 10 test trials (αs = .83, .84, and .81 for pre-, mid-, and posttest, respectively). The *blending multiple choice* task also required children to combine word elements to form a word. On this task, however, children were shown three pictures that were labeled by the examiner before presentation of the auditory stimuli, and children either said or pointed to the picture of the blended word. There were 2 practice items and 10 test trials (αs = .63, .64, and .64 for pre-, mid-, and posttest, respectively).

On three measures, children deleted parts of a word to form a new word. The *elision words* task required children to delete a single-syllable word from a compound word. The 2 practice items were presented both verbally and with pictures. For example, the examiner showed the child two pictures and named them (e.g., "This is a bat and this is a man"); the examiner asked the child to say the compound (e.g., "Say, 'batman"') and then asked the child to say the word with part of it deleted (e.g., "Say 'batman' without saying 'man"'). During practice trials, the examiner emphasized the nature of the task by removing the picture of the word to be deleted. The 11 test trials were presented verbally only (αs = .93, .94, and .94 for pre-, mid-, and posttest, respectively). The *elision syllables and phonemes* task required children to say a word minus a specific sound. During the 3 practice trials and 10 test trials (αs = .86, .85, and .80 for pre-, mid-, and posttest, respectively), the examiner asked children to say a word (e.g., "Say, 'cookie"') and then to say the word with either a syllable or phoneme missing (e.g., "Now say 'cookie' without saying 'eee"'). The *elision multiple choice* task also required children to say a word minus a syllable or phoneme. On this task, children were shown three pictures that were labeled by the examiner, and children could say or point to the picture of the elided word. There were 2 practice trials and 10 test trials (αs = .52, .59, and .52 for pre-, mid-, and posttest, respectively).

Print knowledge measures

All print knowledge measures were administered at pretest, midyear, and posttest. On the *letter name knowledge* task, children named 25 uppercase letters that were presented individually on 3 by 5-inch index cards (due to a clerical error, "W" was not included in the stimulus materials used to test children's letter name knowledge). The letters were presented to all children in the same random order. Testing was discontinued after five consecutive errors. The 3-month test–retest correlation was .85. On the *letter sound knowledge* task, children provided the sounds made by eight letters (M, B, D, A, C, O, P, and S) when they appear in words. The eight letters were printed in uppercase on separate 3 by 5-inch index cards, which were presented to all children in the same order. If children responded with the letter name or a word that started with the letter (e.g., "dog" for D), then they were prompted to provide the letter sound. Any valid letter sound was scored as correct. Only eight letter sounds were assessed (a) to avoid the frustration caused by asking children about all letters when most children knew few letter sounds and (b) because these letters represent letters that are acquired early by children (see Phillips, Piasta, Anthony, Lonigan, & Francis, 2012). The 3-month test–retest correlation was .56. Children completed the Word Identification subtest of the Woodcock Reading Mastery Test-Revised (WRMT-R; Woodcock, 1987). In addition, children were asked to read 15 high-frequency words (e.g., "the," "he," "cat"). Administration of the Word Identification subtest of the WRMT-R followed standard procedures (i.e., discontinuation following six consecutive errors), whereas all 15 high-frequency words were presented to the children.

Procedure

After informed consent was obtained and pretesting was completed, children were randomly assigned within their school to one of five intervention groups with the restriction that approximately equal numbers of children were assigned to each group. The intervention groups consisted of (a) dialogic reading plus phonological awareness training (Group 1), (b) dialogic reading plus letter knowledge training (Group 2), (c) dialogic reading plus the combination of phonological awareness and letter knowledge training (Group 3), (d) standard shared reading plus the combination of phonological awareness training and letter knowledge training (Group 4), and (e) a control group that received only the ongoing classroom curriculum (Group 5). All children continued to participate in their regular preschool curricula as selected and delivered by their Head Start or preschool staff. Each preschool classroom was a full-day program, and each had a lead teacher and one or two aides who worked with the children throughout the school day. Across preschools, the nominal curriculum in use was either High Scope (Title I preschools) or Creative Curriculum (Head Start centers).

Interventions

All intervention activities for this project were provided by project staff as small group (i.e., 3–5 children), pull-out interventions that lasted for approximately 10 to 20 min a day, 5 days a week, throughout the school year. The shared reading groups commenced immediately following the completion of pretesting and assignment (September/October) and continued throughout the school year. During the fall, the shared reading small groups lasted 20 min. After midyear, shared reading small groups lasted 10 min. The phonological awareness and letter knowledge intervention groups commenced in late January and continued until the end of the school year. Within preschools, the composition of the small groups varied from day to day depending on the availability of specific children and the other activities occurring in the preschool at the time the intervention small group was being conducted. A daily rotation schedule was used to pull the children from classrooms to reduce the chance of children missing the same classroom activity every day.

Intervention staff had master's or bachelor's degrees in psychology, education, or speech–language pathology and had prior experience in teaching or working with young children. Before beginning intervention activities, intervention staff received specific training consisting of didactic presentations, modeling, and hands-on practicing for each of the intervention activities. Throughout the project, either a master's-level certified speech–language pathologist or a master's-level special education teacher supervised the intervention staff members. Supervision involved direct observation of the intervention staff in the preschools, feedback concerning intervention activities, and modeling of intervention activities.

Dialogic reading intervention

In this study, dialogic reading was conducted in small groups following the model evaluated by Lonigan and colleagues (Lonigan, Anthony, Bloomfield, Dyer, & Samwel, 1999; Lonigan & Whitehurst, 1998). In this model, there are three tiers that vary in the complexity of questions asked and the feedback provided. Level I includes simple "wh-" questions, modeling, and corrective feedback (e.g., praise, repetition, labeling). Level II includes primarily open-ended questions and expansions. Level III includes questions that extend conversations about the book to children's own experiences. Use of a particular level depended on children's familiarity with the book and their oral language skills. At the beginning of the year and as each new book was introduced, most dialogic reading involved Level I. As children acquired the vocabulary to talk about the book and as the year progressed, dialogic reading increasingly involved Level II and Level III.

Standard shared reading intervention

The standard shared reading intervention also was conducted in small groups; however, rather than using the books as props to ask children questions and provide feedback, children were simply read the books. The same books used for the dialogic reading intervention were used, and each small group reading session lasted the same amount of time as dialogic reading groups.

Phonological awareness intervention

Small group phonological awareness intervention occurred 5 days a week for 10 min for 12 weeks for a total of approximately 600 min (10 h) from late January through May. The goal of these activities was to help the children become aware of the sound structure of words by engaging them in a variety of word play games. The hierarchy of skills taught progressed from a whole word to smaller and smaller parts of a word. The first 2 weeks were spent on rhyming words. The children were asked to imitate and label rhyming words and eventually to discriminate between words that rhymed and those that did not. This was followed by 2 weeks of manipulating compound words. Besides imitating and labeling the words, the children were asked to break the compound words into their two independent words and blend the two words into the compound. The remaining 8 weeks progressed from learning how to manipulate two- and three-syllable words to breaking words down into their onset and rime units.

Letter knowledge intervention

The letter knowledge activities were implemented 5 days a week for 10 min a day for 12 weeks for a total of approximately 600 min (10 h). Manipulatives were used, including magnetic letters, picture cards, pocket charts, dry erase markers, and white boards. During the first 2 weeks, the children were taught what letters are used for and why they are important. Next, the children were taught the difference between letters and numbers and the difference between uppercase and lowercase letters. Once the children had a preliminary understanding of what a letter was, they learned how to identify their own name and the first letter in their name. During the third through sixth weeks, the children learned the names of 10 letters. The children learned to identify and label both the uppercase and lowercase examples of the 10 letters and to discriminate them when mixed with other letters. The next week, the children were introduced to two of the letter sounds. In addition, they categorized pictures by the two letter sounds (all taught letter sounds were from the 10 taught letter names). During the final 4 weeks, the children learned four new letter sounds and continued categorizing pictures by the initial sound in the word. Throughout the intervention, letter names and sounds that were presented previously were reviewed multiple times.

For children assigned to the combined phonological awareness and letter knowledge intervention, a 2-week schedule of alternating days was used to balance exposure to each intervention and to control for total intervention time. During the first week, children would participate in 10 min of their assigned reading small group (i.e., dialogic or standard), followed by 10 min of the phonological awareness small group on Monday, Wednesday, and Friday and 10 min of the letter knowledge small group on Tuesday and Thursday. During the second week, days for the phonological awareness and letter knowledge groups were reversed.

Results

By the end of the preschool year, children's skills had increased substantially. Average standard scores on the EOWPVT-R increased from the below-average range at pretest to the low-average range ($M = 88.35$, $SD = 14.93$) by posttest. At the end of the year, the children

knew, on average, approximately 13 letter names and three of the eight letter sounds assessed. Only 14% of the children still knew no letter names, and only 41% still knew none of the letter sounds assessed. Most children continued to be nonreaders, as indicated by a score of zero on the two decoding tasks; however, by the end of the preschool year, 27 children (8%) correctly identified one or more words on the WRMT-R Word Identification subtest, and 37 children (12%) correctly identified one or more words from the list of high-frequency words.

Initial scores on measures and analytic strategy

Because children were nested within preschool centers, analyses of child outcomes were conducted using multilevel modeling that treated preschool center as a random factor. Analyses of child outcomes were conducted using raw scores on the measures. Only raw scores were available for phonological awareness and letter knowledge measures, and raw scores on the EOWPVT-R and CELF-P:BC were used for consistency across analyses. To control for age effects in raw scores and to control for variation in scores due to general cognitive ability, both children's chronological ages and children's standard scores on the nonverbal cognitive ability composite variable were used as covariates in all analyses. For analyses of midyear and posttest scores, the pretest version of the same measure or composite also was used as a covariate. Preliminary analyses indicated that neither sex nor race/ethnicity produced a main effect or entered into any significant interactions with the intervention contrasts. Therefore, these variables were not included in the impact analyses.

To reduce the number of outcome measures used in the analyses, composite variables for each of the outcome domains were created. The two expressive vocabulary measures were combined to create a Vocabulary composite (rs = .56, .52, and .53 at pre-, mid-, and posttest, respectively). For the phonological awareness measures, the two rhyming measures were combined to create a Rhyme composite (rs = .27, .53, and .66 at pre-, mid-, and posttest, respectively), the three blending measures were combined to create a Blending composite (αs = .57, .69, and .69 at pre-, mid-, and posttest, respectively), and the three elision measures were combined to create an Elision composite (αs = .68, .71, and .70 at pre-, mid-, and posttest, respectively). These three composite phonological awareness measures were combined to create an overall Phonological Awareness composite (αs = .67, .74, and .81 at pre-, mid-, and posttest, respectively). Finally, the two letter knowledge measures were combined to create a Letter Knowledge composite (rs = .68, .69, and .67 at pre-, mid-, and posttest, respectively). Because of severe floor effects, the word reading measures were not used in the impact analyses.

Descriptive statistics for children's ages and scores on the primary outcome measures at pretest for each of the five intervention groups are shown in Table 1. There were no significant overall effects of intervention group for any of these measures at pretest (all ps > .35), and post hoc LSD contrasts revealed only one significant difference ($p < .05$) between any of the groups, with Group 3 scoring higher than Group 2 on the Elision composite.

The questions of primary interest concerned the unique and additive effects of each of the three types of interventions. To address the question of the overall impacts of the three types of interventions, three specific contrasts were conducted. For the oral language intervention, children who received the dialogic reading intervention (Groups 1, 2, and 3) were contrasted with children who did not receive the dialogic reading intervention (Groups 4 and 5). For the phonological awareness intervention, children who received the phonological awareness intervention (Groups 1, 3, and 4) were compared with children who did not receive the phonological awareness intervention (Groups 2 and 5). For the letter knowledge intervention, children who received the letter knowledge intervention (Groups 2, 3, and 4)

were compared with children who did not receive the letter knowledge intervention (Groups 1 and 5). For all contrasts, student-level effect size (*ES*) was computed using Hedges' *g*, which represents the standardized mean difference between groups and was computed as the difference between adjusted means over the pooled within-group standard deviation. For the planned combined group contrasts, the Benjamini–Hochberg procedure (Benjamini & Hochberg, 1995), applied to all outcomes within a domain (i.e., vocabulary, phonological awareness, and letter knowledge) within a contrast, was used to protect against increases in Type I error.

To explore the impacts of the specific combinations of interventions, all pairwise comparisons were examined. Because of the reduced statistical power for these comparisons, predicted differences were evaluated as one-tailed tests in the direction of the predicted differences (e.g., higher scores on oral language outcomes for groups that received dialogic reading compared with scores for the group that received standard shared reading or no shared reading); however, comparisons in which there were no hypothesized differences were evaluated as two-tailed tests.

Scores at midyear

Children were assigned to groups during the fall; however, the phonological awareness and letter knowledge interventions did not commence until the middle of the school year. Children received dialogic reading, standard shared reading, or no reading beginning immediately after completion of pretests and continuing throughout the school year. Analyses of scores on midyear assessments were conducted to examine the intermediate effects of these interventions and to determine whether the different code-related intervention groups maintained their equivalence by examining each pairwise comparison. Descriptive statistics for scores on the primary outcome measures at the midyear assessment for each of the five intervention groups are shown in Table 2. The only predicted differences were on the vocabulary measures for groups that had received the dialogic reading intervention (i.e., Groups 1, 2, and 3 vs. Groups 4 and 5). Scores on the Vocabulary composite were significantly higher for Group 1 than for Group 4 ($p < .03$, $ES = .20$) and Group 5 ($p < .01$, $ES = .23$), and scores on the Vocabulary composite were significantly higher for Group 2 than for Group 4 ($p < .04$, $ES = .19$) and Group 5 ($p < .02$, $ES = .23$). Scores for Group 3 were not significantly higher than those for either Group 4 ($p = .36$, $ES = .03$) or Group 5 ($p = .22$, $ES = .07$). Scores on the individual vocabulary measures followed this same pattern, with the exceptions that the effects did not achieve significance for the Group 1–Group 4 ($p = .10$, $ES = .14$) or Group 2–Group 4 ($p = .11$, $ES = .16$) comparisons on the EOWPVT-R or for the Group 2–Group 4 comparison ($p = .15$, $ES = .11$) on the CELF-P:BC. No pairwise comparison was significant for any of the phonological awareness outcomes, and only two of the pairwise comparisons were significant for the letter knowledge outcomes. Both Group 1 ($p = .03$, $ES = .21$) and Group 3 ($p < .02$, $ES = .22$) scored higher than Group 2 on the letter name outcome.

Impacts of interventions at posttest

Results at posttest for the planned combined groups contrasts are shown in Table 3. Descriptive statistics for children's scores on the primary outcome measures at posttest (adjusted for age, nonverbal cognitive ability, and scores at pretest) for each of the five intervention groups are shown in Table 4, and effect sizes for each pairwise comparison between intervention groups on each of the outcome measures are shown in Table 5. Table 5 also includes information on whether a specific contrast involved a predicted effect for dialogic reading, phonological awareness intervention, and letter knowledge intervention as well as the direction of the predicted effect. Effect sizes shown in boldface type are for the outcomes on which a predicted effect was expected.

Dialogic reading intervention

Children who were in one of the groups that received the dialogic reading intervention scored significantly higher than children in the groups that did not receive the dialogic reading intervention on the Vocabulary composite, the EOWPVT-R, and the Basic Concepts subtest of the CELF-P. In addition, children in the dialogic reading group scored significantly higher than children in the contrast comparison group on the Blending composite. Effect sizes for the statistically significant effects of the dialogic reading intervention ranged from .17 to .21 (see Table 3). When the Benjamini–Hochberg procedure was applied, all of the effects on the vocabulary outcomes remained significant; however, the effect for the Blending composite was no longer statistically significant.

Effect sizes for the specific pairwise group contrasts involving dialogic reading (see Table 5) revealed that children in Group 1 significantly outscored children in Groups 4 and 5 on all vocabulary outcomes. Children in Group 2 significantly outscored children in Groups 4 and 5 on the Vocabulary composite but not on the individual vocabulary measures. Although children in Group 3 had higher scores on the vocabulary outcomes than children in Groups 4 and 5, these differences were not statistically significant. As expected, there were no significant differences between children who received standard shared reading and children who received no shared reading (i.e., Group 4 vs. Group 5).

Phonological awareness intervention

Children who were in one of the groups that received the small group phonological awareness intervention scored significantly higher than children in the groups that did not receive the small group phonological awareness intervention on the Phonological Awareness composite, the Blending composite, and the Elision composite. Children who received the phonological awareness intervention also scored marginally higher on the Rhyme composite. Effect sizes for these statistically significant effects ranged from .20 to .25 (see Table 3). When the Benjamini–Hochberg procedure was applied, all of the significant effects on the phonological awareness outcomes remained significant.

Effect sizes for the specific pairwise group contrasts involving the small group phonological awareness intervention (see Table 5) revealed that the most consistent effect was on the Blending composite, with five of the six predicted effects being statistically significant. Four of the six predicted effects were significant for the Phonological Awareness composite. Predicted effects on the Rhyme composite and the Elision composite were less robust, with two of the six predicted effects being statistically significant for each outcome but for different pairwise group contrasts.

We had hypothesized that providing an intervention that increased children's vocabulary skills would enhance the impact of the phonological awareness intervention. A test of this prediction was conducted by contrasting Group 1 (dialogic reading intervention plus phonological awareness intervention) combined with Group 3 (dialogic reading intervention plus phonological awareness and letter knowledge interventions) with Group 4 (shared reading control plus phonological awareness and letter knowledge interventions). This contrast was not significant for the Phonological Awareness composite ($p = .88$, $ES = .02$), the Rhyme composite ($p = .15$, $ES = .19$), the Blending composite ($p = .39$, $ES = .11$), or the Elision composite ($p = .22$, $ES = -.15$). The outcomes for the individual pairwise comparisons (i.e., Group 1 vs. Group 4 and Group 3 vs. Group 4) also did not support the hypothesized effect (see Table 5).

We also had hypothesized that adding a letter knowledge intervention to a phonological awareness intervention would enhance the impact of the phonological awareness intervention. A test of this prediction was conducted by contrasting Group 3 (dialogic

reading intervention plus phonological awareness and letter knowledge interventions) combined with Group 4 (shared reading control plus phonological awareness and letter knowledge interventions) with Group 1 (dialogic reading intervention plus phonological awareness intervention). This contrast was not significant for the Phonological Awareness composite ($p = .90$, $ES = .01$), the Rhyme composite ($p = .92$, $ES = .02$), the Blending composite ($p = .65$, $ES = -.06$), or the Elision composite ($p = .61$, $ES = .06$). The outcomes for the individual pairwise comparisons (i.e., Group 1 vs. Group 3 and Group 1 vs. Group 4) also did not support the hypothesized effect (see Table 5).

Letter knowledge intervention

Children who were in the groups that received the small group letter knowledge intervention scored significantly higher than children who were in the groups that did not receive the small group letter knowledge intervention on the letter sound knowledge measure but not on the letter name knowledge measure or the overall Letter Knowledge composite. The effect size for this statistically significant effect was .26 (see Table 3). When the Benjamini–Hochberg procedure was applied, the effect for the letter sound knowledge outcome remained statistically significant. This predicted impact of the letter knowledge intervention on children's letter sound knowledge replicated across all of the relevant pairwise comparisons (see Table 5).

As with the phonological awareness outcomes, we had hypothesized that the addition of a phonological awareness intervention to a letter knowledge intervention would enhance the impact of the letter knowledge intervention. A test of this prediction was conducted by contrasting Group 3 (dialogic reading intervention plus phonological awareness and letter knowledge interventions) combined with Group 4 (shared reading control plus phonological awareness and letter knowledge interventions) with Group 2 (dialogic reading intervention plus letter knowledge intervention). This contrast was not significant for the Letter Knowledge composite ($p = .81$, $ES = -.02$), the letter name knowledge measure ($p = .83$, $ES = -.02$), or the letter sound knowledge measure ($p = .89$, $ES = .02$). The outcomes for the individual pairwise comparisons (i.e., Group 2 vs. Group 3 and Group 2 vs. Group 4) also did not support the hypothesized effect (see Table 5).

Discussion

Overall, these results indicate that the three small group emergent literacy interventions had positive and specific effects in the targeted domains. Whereas all children experienced growth in their emergent literacy skills during the preschool year, children who received the small group dialogic reading, phonological awareness, or letter knowledge interventions experienced more growth than the children who received only their classroom curriculum. Consequently, the effects of the small group interventions were beyond those produced by traditional early childhood education curricula. The effects of the interventions were specific. Impacts were observed only in the skill domain that was the focus of an intervention. Moreover, results of this study did not support a synergistic effect of combining interventions in terms of larger effects, contrary to our predictions. Regardless, the effects on the three key emergent literacy skill domains highlight the benefits of focused intervention activities for preschool children at risk for later reading difficulties.

The results of this study indicate a clear advantage of academic skills-focused and explicit instructional activities relative to traditional early childhood curricula for increasing the early literacy skills of children who are at risk for later reading difficulties. With one exception, all of the predicted effects for the three interventions were replicated across the pairwise group comparisons on one or more of the relevant outcomes. Although the effects on vocabulary were in the predicted direction for Group 3, none of them achieved statistical

significance. The reason for this group's smaller effect at posttest is not clear; however, the smaller group effect was also evident at the midyear assessment. Although this was the only group that received three active interventions, this cannot explain the lower scores at midyear, and the impacts of the phonological awareness and letter knowledge intervention were not diminished for this group.

Of note is the fact that the obtained effects were the result of children's exposure to no more than 20 min of teacher-directed focused instructional activities a day for each intervention. For each of the code-focused interventions (as well as the combination of phonological awareness and letter knowledge interventions), the maximum intervention time for each child was 10 h. For the dialogic reading intervention, the maximum intervention time for each child was 30 h over the entire preschool year. The impacts of the interventions were restricted to the outcome measures for the constructs targeted by the intervention activities (e.g., dialogic reading positively impacted only oral language skills). Such findings are consistent with those of other studies (e.g., Bianco et al., 2011; Bowyer-Crane et al., 2008; Justice et al., 2010; Sénéchal et al., 2012) and support the view that emergent literacy skills are modular (i.e., domain specific). The practical implication of modularity of emergent literacy skills is that children at risk are likely to require instructional interventions in multiple domains to alleviate risk due to insufficiently developed emergent literacy skills.

The measures on which these impacts were obtained were broad measures of the skill. That is, although the outcome measures were aligned with the constructs that the interventions were designed to impact, the specific items in the measures were not aligned with the specific content that was the focus of the instructional activities (e.g., the vocabulary measures did not specifically sample the vocabulary that was taught in dialogic reading; the letter knowledge measures did not assess only the letter names and letter sounds taught). Consequently, the obtained impacts reveal a generalized increase in children's emergent literacy skills. Particularly with respect to outcomes for the language intervention, these results demonstrate the potential of these interventions for promoting development of broad skills within a domain. Many other studies of interventions have used language measures that were aligned with the specific content of the interventions (e.g., Bowyer-Crane et al., 2008; Coyne, Simmons, Kame'enui, & Stoolmiller, 2004; Whitehurst et al., 1994). In some cases, positive effects are obtained on the aligned measures but not on broader measures (e.g., see Bowyer-Crane et al., 2008; Marulis & Neuman, 2010).

Contrary to our expectations, there did not appear to be synergistic effects of combining interventions. That is, combining phonological awareness and letter knowledge interventions did not result in larger effects on either phonological awareness or letter knowledge outcomes than those produced by interventions specifically designed to promote these skills, and combining oral language and phonological awareness interventions did not result in larger effects on phonological awareness outcomes than those produced by the phonological awareness intervention alone. As noted above, the majority of evidence suggesting larger effects for combined phonological awareness and print knowledge interventions comes from meta-analyses that compare effect sizes across studies. This is one of only a few studies that have directly compared the combined intervention with its components. Prior studies comparing individual versus combined interventions have reported larger effects for combined interventions on spelling outcomes, which were not measured in this study. However, it may be that combined interventions yield larger effects for only those outcomes, such as spelling and word decoding, that represent the combination of phonological awareness and letter knowledge skills. Alternatively, it may be that print knowledge has an effect on phonemic awareness tasks (i.e., tasks requiring manipulation of phonemes) but not on subphoneme tasks; however, most of the items on the phonological awareness measures used in this study were subphoneme (e.g., words, syllables) because phoneme-level items

are beyond the capacity of most preschoolers, particularly those at risk for later reading difficulties (Lonigan et al., 1998). In a recent study, Castles, Wilson, and Coltheart (2011) reported that training children in letter sound correspondence enhanced the effects of a phonological awareness intervention on phonemic awareness tasks. Therefore, it is possible that there was a synergistic effect of combined phonological awareness and letter knowledge training that could not be detected because of the developmental level of the children in this study but that might become apparent later when children are more able to complete phoneme-level items and reading or spelling tasks.

Whereas there was apparently no synergistic effect of combining the code-focused interventions in terms of higher phonological awareness scores or higher letter knowledge scores, it is notable that the obtained effects for the groups that received both interventions (i.e., Groups 3 and 4) were neither statistically nor appreciably smaller than the effects for the groups that received only one of the interventions (i.e., Groups 1 and 2) despite the fact that children exposed to both interventions received half as much exposure to either phonological awareness or letter knowledge training than children exposed to only one of the interventions. Consequently, it is possible that the synergistic effect was that the same impact was obtained for half as much exposure. Comparisons of one versus two interventions require a trade-off between equating overall intervention time and equating exposure to the specific interventions. In this study, we chose to equate overall intervention time for both methodological and practical reasons. A future study might explore this possible synergy by equating on exposure both to the specific interventions and to overall intervention time by using an intervention activity unrelated to letter knowledge or phonological awareness for groups of children that receive only one of the code-focused interventions. An alternative explanation for this finding may be that there is an asymptotic limit of code-based interventions within a specified time period. In their meta-analyses of the effects of phonological awareness training with older children, Ehri, Nunes, Willows, et al. (2001) reported that the effect of between 5 and 10 h of instruction was not smaller than the effect of 10 to 20 h of instruction. The practical implication of this finding, however, is that a relatively compact code-focused intervention can address the needs of children who have both low phonological awareness skills and low letter knowledge skills.

To our knowledge, no prior study has evaluated the possible synergistic effects of combining a vocabulary intervention with a phonological awareness intervention. Although the results seem to contradict predictions from the LRM, there are at least three possible reasons why the predicted effects might not have been obtained. First, it may be that the effect of vocabulary growth on phonological awareness is narrower in scope than that tested in this study. That is, lexical restructuring does not occur uniformly throughout a child's lexicon but rather occurs at a local level (e.g., Walley et al., 2003); therefore, the extent of lexical restructuring depends both on vocabulary learned and on vocabulary already known. The specific vocabulary taught to children via dialogic reading was not selected. It may be the case that vocabulary representing specific lexical contrasts (e.g., words in the same phonological neighborhood) would need to be taught to obtain outcomes on specific phonological awareness items. Second, all children's vocabularies, regardless of intervention condition, grew substantially over the course of the study. Based on standardized vocabulary tests, children's rate of vocabulary growth exceeded that needed to maintain the starting level relative to age norms (e.g., EOWPVT-R scores increased by an average of nearly 6 standard score units from the beginning to the end of preschool). It may be that the advantage in terms of vocabulary growth of participating in dialogic reading, relative to the overall rate of vocabulary growth, was not sufficiently large to result in large differences in lexical restructuring. Finally, the phonological awareness measures used in this study contained only a limited number of phoneme-level items. It may be that lexical restructuring affects phonemic awareness more than it affects subphonemic awareness.

Vocabulary growth may result in lexical restructuring primarily at the phoneme level. Consequently, phonological awareness tasks that do not assess phonemic awareness (e.g., phoneme segmentation, phoneme blending) might not allow children to take advantage of this more fine-grained lexical representation.

Limitations

Unlike for the planned combined group contrasts, the significance levels for the pairwise comparisons were not adjusted for the multiple comparisons; therefore, any specific pairwise effect should be interpreted with caution. Given that the majority of pairwise comparisons replicated the effects for the planned combined group contrasts, however, concerns about inflated Type I error are reduced, and the larger threat for many of the pairwise comparisons was a failure to detect differences between groups. A second limitation of this study is that we did not follow children beyond the end of their preschool year. Therefore, this study cannot address the longer term effects of the gains children made as a result of the interventions. An expectation that a relatively short-term intervention will have long-lasting effects, however, treats early education as an inoculation against later educational challenges. In fact, some studies of longer term effects of early education suggest that positive benefits are reduced or lost over a relatively short period of time (e.g., DeCicca, 2007; U.S. Department of Health & Human Services, 2010; Whitehurst et al., 1999). Despite the positive effects of early intervention, children may lose such gains quickly if their educational experiences do not match their current academic skills. A positive effect of early intervention helps to raise children's skills to where they can take advantage of more advanced instruction but does not guarantee that they will receive such instruction.

Summary and conclusions

A substantial number of children fail to develop reading skills that are sufficiently adequate to support their academic needs. Significant continuity between early reading-related skills and later reading skills suggests that efforts to reduce children's risk of later reading problems might be focused most profitably on children's early development. The results of this study highlight the potential for optimizing preschool instructional activities for children at risk for reading problems by providing focused activities to promote the development of skills in the three key emergent literacy domains: oral language, phonological awareness, and print knowledge. Consistent with longitudinal prediction studies, results of this study and other intervention studies support the idea that emergent literacy skills are modular. Consequently, many children are likely to need interventions targeting each of the specific domains in which they have relatively weak development. Future research should evaluate the longer term effects of these interventions. It will be important in such research, however, to measure the kindergarten and first-grade instructional context of children who have received these preschool emergent literacy interventions to determine the conditions, if any, under which the gains observed in preschool enhance children's acquisition of conventional reading and writing skills.

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Table 1

Descriptive statistics for pretest scores on oral language, phonological awareness, and letter knowledge variables for five intervention groups.

	Intervention group				
	1	**2**	**3**	**4**	**5**
Shared reading group:	**Dialogic**	**Dialogic**	**Dialogic**	**Standard**	**None**
Code emphasis group:	**PA only**	**LK only**	**PA plus LK**	**PA plus LK**	**None**
Variable	**[Mean (*SD*)]**	**[Mean (*SD*)]**	**[Mean (*SD*)]**	**[Mean (*SD*)]**	**[Mean (*SD*)]**
n in group	57	64	67	64	72
Chronological age (months)	53.79 (5.72)	53.33 (6.01)	54.97 (6.20)	53.75 (5.74)	55.24 (5.71)
Vocabulary composite	33.27 (10.92)	31.41 (12.12)	34.66 (13.09)	34.85 (13.42)	33.30 (12.69)
EOWPVT-R (raw score)	21.93 (8.31)	20.34 (8.78)	22.67 (10.50)	22.52 (10.74)	21.79 (10.28)
CELF-P:BC (raw score)	11.53 (4.16)	11.02 (4.54)	11.99 (3.88)	12.37 (4.22)	11.51 (3.37)
PA composite	28.64 (12.15)	26.89 (11.23)	31.16 (14.22)	28.82 (12.96)	29.00 (13.08)
Rhyme composite	7.09 (3.35)	7.65 (4.11)	7.72 (3.63)	7.81 (3.56)	7.00 (3.48)
Blending composite	13.79 (6.04)	13.00 (6.23)	14.33 (7.12)	12.94 (6.08)	14.07 (6.91)
Elision composite	7.77 (5.91)	6.25 (4.42)	9.12 (6.57)	8.08 (6.09)	7.93 (6.13)
LK composite	6.88 (8.89)	5.92 (9.27)	9.30 (10.67)	8.90 (11.49)	7.03 (9.22)
Letter name	5.80 (7.75)	5.00 (7.75)	8.04 (9.05)	7.74 (9.75)	6.32 (8.18)
Letter sound	1.07 (1.81)	0.92 (1.94)	1.25 (2.18)	1.16 (2.13)	0.70 (1.62)

Note: Dialogic, dialogic reading; Standard, standard shared reading; PA, phonological awareness; LK, letter knowledge; EOWPVT-R, Expressive One-Word Picture Vocabulary Test-Revised; CELF-P:BC, Clinical Evaluation of Language Fundamentals–Preschool, Basic Concepts subtest.

Table 2

Descriptive statistics for adjusted midyear scores on vocabulary, phonological awareness, and letter knowledge variables for five intervention groups.

Intervention group:	**1**		**2**		**3**		**4**		**5**	
Shared reading group:	**Dialogic**		**Dialogic**		**Dialogic**		**Standard**		**None**	
Code emphasis group:	**PA only**		**LK only**		**PA plus LK**		**PA plus**		**LK None**	
Variable	**Adjusted *M***	**(*SD*)**	**Adjusted *M***	**(*SD*)**	**Adjusted *M***	**(*SD*)**	**Adjusted *M***	**(*SD*)**	**Adjusted *M***	**(*SD*)**
Vocabulary composite	41.49	(14.64)	41.14	(11.75)	39.17	(13.13)	38.72	(13.49)	38.17	(14.00)
EOWPVT-R	27.42	(12.93)	27.34	(9.07)	25.98	(11.19)	25.72	(11.05)	25.18	(11.50)
CELF-P:BC	13.97	(3.19)	13.69	(3.57)	13.25	(3.46)	13.27	(3.81)	13.03	(3.96)
PA composite	37.76	(15.35)	37.67	(14.62)	35.86	(16.90)	38.90	(15.82)	37.11	(15.17)
Rhyme composite	9.18	(4.70)	8.65	(4.45)	8.78	(4.89)	9.34	(4.94)	8.83	(4.28)
Blending composite	18.12	(6.73)	17.95	(6.90)	17.30	(7.39)	18.78	(7.24)	17.43	(6.89)
Elision composite	10.49	(7.06)	11.08	(7.52)	10.20	(7.08)	10.71	(7.27)	10.64	(7.13)
LK composite	11.83	(10.75)	10.54	(10.56)	12.29	(11.66)	10.74	(12.03)	11.31	(11.27)
Letter name	10.21	(9.25)	8.33	(8.51)	10.38	(9.99)	8.79	(10.29)	9.17	(9.27)
Letter sound	1.67	(2.40)	2.18	(2.67)	1.95	(2.89)	2.00	(2.85)	2.07	(2.57)

Note: Dialogic, dialogic reading; Standard, standard shared reading; PA, phonological awareness; LK, letter knowledge; EOWPVT-R, Expressive One-Word Picture Vocabulary Test-Revised; CELF-P BC, Clinical Evaluation of Language Fundamentals–Preschool, Basic Concepts subtest.

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Table 3

Descriptive and inferential statistics for planned multigroup contrasts of posttest scores.

	Intervention contrast								
	Dialogic reading			**Phonological awareness**			**Letter knowledge**		
Groups in contrast:	**1, 2, 3**	**4, 5**		**1, 3, 4**	**2, 5**		**2, 3, 4**	**1, 5**	
***n* in contrast group[a]:**	**185**	**132**		**184**	**133**		**191**	**126**	
Outcome variable	**Mean (*SD*)**	**Mean (*SD*)**	**ES**	**Mean (*SD*)**	**Mean (*SD*)**	**ES**	**Mean (*SD*)**	**Mean (*SD*)**	**ES**
Vocabulary composite	46.27 (13.75)	43.45 (13.59)	.21**	45.38 (13.69)	44.65 (13.67)	.05	44.89 (14.13)	45.35 (12.98)	−.03
EOWPVT-R	31.46 (11.74)	29.39 (11.44)	.18*	30.90 (11.69)	30.14 (11.51)	.07	30.57 (12.15)	30.62 (10.77)	.00
CELF-P:BC	14.69 (3.22)	14.12 (3.45)	.17*	14.52 (3.28)	14.35 (3.38)	.05	14.37 (3.41)	14.57 (3.19)	−.06
PA composite	45.23 (16.71)	43.32 (16.98)	.11	46.21 (17.28)	41.99 (16.17)	.25**	45.24 (17.27)	43.21 (16.13)	.12
Rhyme composite	11.13 (5.84)	10.34 (5.71)	.14	11.25 (6.12)	10.17 (5.30)	.19+	10.91 (6.00)	10.63 (5.44)	.05
Blending composite	20.16 (6.69)	18.90 (6.65)	.19*	20.46 (6.75)	18.49 (6.57)	.29***	19.94 (6.85)	19.18 (6.41)	.11
Elision composite	13.96 (7.19)	13.93 (7.33)	.00	14.55 (7.40)	13.12 (7.03)	.20*	14.31 (7.40)	13.40 (7.02)	.13
LK composite	15.54 (11.46)	14.40 (11.90)	.10	15.15 (11.78)	14.96 (11.45)	.02	15.64 (11.96)	14.21 (11.15)	.12
Letter name	13.10 (9.47)	12.10 (9.95)	.10	12.73 (9.70)	12.62 (9.64)	.01	13.00 (9.73)	12.20 (9.58)	.08
Letter sound	2.44 (2.68)	2.27 (2.71)	.06	2.44 (2.74)	2.26 (2.62)	.07	2.65 (2.81)	1.94 (2.50)	.26**

Note: EOWPVT-R, Expressive One-Word Picture Vocabulary Test-Revised; CELF-P:BC, Clinical Evaluation of Language Fundamentals–Preschool, Basic Concepts subtest; PA, phonological awareness; LK, letter knowledge.

+ $p < .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

[a] Maximum *n* in contrast; *n*s for individual outcome variables differ by up to 7 due to children with missing data on a measure.

Table 4

Descriptive statistics for adjusted posttest scores on vocabulary, phonological awareness, and letter knowledge variables for five intervention groups.

Intervention group:	**1**		**2**		**3**		**4**		**5**	
Shared reading group:	**Dialogic**		**Dialogic**		**Dialogic**		**Standard**		**None**	
Code emphasis group:	**PA only**		**LK only**		**PA plus LK**		**PA plus**		**LK None**	
Variable	**Adjusted *M***	**(*SD*)**	**Adjusted *M***	**(*SD*)**	**Adjusted *M***	**(*SD*)**	**Adjusted *M***	**(*SD*)**	**Adjusted *M***	**(*SD*)**
Vocabulary composite	47.84	(12.72)	46.16	(14.39)	45.15	(13.94)	43.45	(14.07)	43.44	(13.02)
EOWPVT-R	32.51	(10.69)	31.36	(12.28)	30.72	(12.09)	29.66	(12.01)	29.16	(10.77)
CELF-P:BC	15.12	(3.03)	14.59	(3.49)	14.43	(3.09)	14.08	(3.64)	14.15	(3.28)
PA composite	46.04	(16.00)	43.13	(16.11)	46.54	(17.80)	46.00	(17.80)	41.02	(16.23)
Rhyme composite	11.20	(5.81)	10.11	(5.48)	12.03	(6.17)	10.48	(6.32)	10.23	(5.13)
Blending composite	20.72	(6.21)	19.13	(6.59)	20.68	(7.16)	19.99	(6.76)	17.96	(6.56)
Elision composite	14.24	(7.04)	13.54	(7.06)	14.13	(7.42)	15.27	(7.69)	12.78	(7.01)
LK composite	14.23	(10.93)	15.81	(11.58)	16.40	(11.77)	14.63	(12.53)	14.23	(11.33)
Letter name	12.27	(9.33)	13.13	(9.47)	13.78	(9.58)	12.03	(10.14)	12.19	(9.78)
Letter sound	1.94	(2.40)	2.62	(2.67)	2.67	(2.86)	2.66	(2.86)	1.95	(2.57)

Note: Dialogic, dialogic reading; Standard, standard shared reading; PA, phonological awareness; LK, letter knowledge; EOWPVT-R, Expressive One-Word Picture Vocabulary Test-Revised; CELF-P BC, Clinical Evaluation of Language Fundamentals–Preschool, Basic Concepts subtest.

Table 5

Predicted effects and effect sizes for pairwise contrasts at posttest.

	Pairwise contrast									
	G1–G2	**G1–G3**	**G1–G4**	**G1–G5**	**G2–G3**	**G2–G4**	**G2–G5**	**G3–G4**	**G3–G5**	**G4–G5**
Predicted DR effect:	0	0	1	1	0	1	1	1	1	0
Predicted PA effect:	1	0	0	1	−1	−1	0	0	1	1
Predicted LK effect:	−1	−1	−1	0	0	0	1	0	1	1
Outcome variable										
Vocabulary composite	.12	.20 $^{+}$	**.33** **	**.34** **	.07	**.19** *	**.20** *	**.12**	**.13**	.00
EOWPVT-R	.10	.16	**.25** *	**.31** **	.05	**.14**	**.19**	**.09**	**.14**	.04
CELF-P:BC	.16	.22 $^{+}$	**.31** **	**.31** **	.05	**.14**	**.13**	**.10**	**.08**	−.02
PA composite	**.18** $^{+}$	−.03	.00	**.31** **	**− .20** *	**− .17** $^{+}$	.13	.03	**.33** **	**.29** *
Rhyme composite	**.19**	−.14	.12	**.18**	**− .33** *	**− .06**	−.02	.25 $^{+}$	**.32** *	**.04**
Blending composite	**.25** *	.01	.11	**.43** **	**− .23** *	**− .13**	.18	.10	**.41** ***	**.30** *
Elision composite	**.10**	.02	−.14	**.21** $^{+}$	**− .08**	**− .23** *	.11	−.15	**.19** $^{+}$	**.34** **
LK composite	**− .14**	**− .19**	**− .03**	.00	−.05	.10	**.14**	.15	**.18**	**.03**
Letter name	**− .09**	**− .16**	**.02**	.01	−.07	.11	**.10**	.18	**.16**	**− .02**
Letter sound	**− .27** *	**− .28** *	**− .27** *	.00	−.02	−.02	**.26** *	.00	**.27** *	**.26** *

Note: G, group. For predicted effects: 0 = *no effect*, 1 = *expected positive effect for contrast*, −1 = *expected negative effect for contrast*. Effect sizes shown in boldface type are for outcomes on which predicted effects for contrasts were expected. Marked significance levels are one-tailed for predicted effects and two-tailed for all other effects. DR, dialogic reading; PA, phonological awareness; LK, letter knowledge; EOWPVT-R, Expressive One-Word Picture Vocabulary Test-Revised; CELF-P:BC, Clinical Evaluation of Language Fundamentals–Preschool, Basic Concepts subtest.

$^{+}$ $p < .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.