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Early Literacy Intervention for Preschoolers Who Need Tier 3 Support

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Abstract

Phonemic awareness has been consistently identified as an essential skill for as well as an important predictor of later reading achievement. Children who lack these early literacy skills at kindergarten entry are more likely to demonstrate both short- and long-term reading difficulties. Despite the importance of providing intervention early, there is a paucity of research on Tier 3 early literacy interventions in preschool. A single-case multiple baseline across subjects design was used to examine the effects of a Tier 3 phonemic awareness intervention with preschool children who were identified as needing Tier 3 support in early literacy skills. The intervention was conducted individually with children, 5 to 10 min a day over an 8-week period. The results show gains in phonemic awareness for all children; however, the intervention was clearly more effective for some students than others. Factors that may have affected children's learning are discussed.

Keywords

emergent literacy, literacy, intervention strategies, phonological awareness

A converging body of evidence over the past two decades demonstrates that many children entering kindergarten lack the language and early literacy skills foundational to school success (Bailet, Repper, Piasta, & Murphy, 2009). Of the critical emergent literacy skills necessary for reading, phonological awareness has consistently been identified as an important predictor of later reading achievement (National Early Literacy Panel, 2008). Phonological awareness refers to a child's explicit awareness of the sound structure of spoken words (Gillon, 2005) or to the ability to distinguish the sounds of spoken words separately from their meaning (Chard & Dickson, 1999). An abundance of research provides converging evidence that phonological awareness is both highly predictive of and causally related to the ease with which children learn to read and their later reading ability (Ehri et al., 2001; Lonigan, 2003; Snow, Burns, & Griffin, 1998). Furthermore, interventions to increase phonological awareness in preschool and kindergarten, prior to formal reading instruction, have been shown to positively affect reading readiness (Gillon, 2000, 2005; National Early Literacy Panel, 2008).

One of the challenges facing preschool educators is how to provide support in learning critical early literacy skills to children who need it. Response to intervention (RTI) is a service delivery model that is increasingly being implemented in elementary schools and is emerging in early childhood programs (Ball & Trammell, 2011; Greenwood et al., 2011). Within an RTI model, interventions of increasing intensity are provided based on the students' instructional response (Fletcher & Vaughn, 2009) and differentiated levels of instructional support are provided to students based on their demonstrated need. RTI models are commonly divided into three tiers: Tier 1, whole class instruction with a research-based curriculum; Tier 2, small-group interventions to overcome specific learning gaps; and Tier 3, more intensive intervention for those with significant learning needs. Movement between instructional tiers is flexible, dynamic, and based on demonstrated learning and progress toward goals (Division for Early Childhood of the Council for Exceptional Children [DEC], National Association for the Education of Young Children [NAEYC], & National Head Start Association [NHSA], 2013). While RTI is a promising model for meeting all children' needs, many barriers to RTI implementation exist in early childhood education, including, among others, a lack of effective interventions for children who need Tier 2 and Tier 3 levels of instructional support (Bailet et al., 2009; Greenwood et al., 2011).

Research on Phonological Awareness Interventions

Most published phonological awareness intervention studies have been conducted with children in the early elementary grades at the beginning stages of learning to

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read. Meta-analyses of phonological awareness training programs have generally found that training in phonological awareness not only improves children's phonological awareness but, to a lesser extent, reading skill as well (Bus & van IJzendoorn, 1999; Ehri et al., 2001; National Reading Panel, 2000). Although far fewer, increasing numbers of studies of phonological awareness interventions with preschool-age students show positive results.

Most studies of phonological awareness training with preschoolers at risk of reading failure have focused on two groups: children from low socioeconomic status (SES) backgrounds and children with speech-language impairment. Many interventions have focused broadly on emergent literacy skills, such as letter identification, in addition to a range of phonological awareness skills such as rhyming and syllable segmenting. In general, children made short-term improvements in phonological awareness skills, supporting the notion that preschool children at risk of reading failure can learn these skills. Across the interventions, preschool children learned to rhyme, identify letters, blend and segment syllables, identify onsets, and, in some cases, isolate initial phonemes (e.g., Bailet et al., 2009; Justice, Chow, Capellini, Flanigan, & Colton, 2003; Nancollis, Lawrie, & Dodd, 2005; Roth, Troia, Worthington, & Handy, 2006; Ziolkowski & Goldstein, 2008). The duration of the interventions ranged from 6 to 8 min a day, 3 times a week for 5 weeks (total of 1.75 hr), to 30 min a day, 2 times a week for 9 weeks (total of 9 hr).

Studies in which multiple phonological awareness skills were targeted generally indicated that children demonstrated significant improvement in the skill(s) on which training occurred, with little to no transfer to untrained skills. For example, Ziolkowski and Goldstein (2008) used a single-case design to investigate the efficacy of an explicit phonological awareness intervention embedded within repeated shared book reading. A multiple baseline across behaviors design was conducted with 13 preschool children from low-income backgrounds who had language delays. The intervention focused on rhyming and initial sounds. Across all subjects, the rhyme intervention enhanced children's rhyming skills, while the intervention on initial sounds increased children's alliteration and initial sound fluency skills. Similar results regarding specific effects and lack of transfer of skills were found by Roth and colleagues (Roth et al., 2006).

Some evidence suggests that phonological awareness skills at the phoneme level are the most critical to acquiring the alphabetic principle (Hulme et al., 2002; Martin & Byrne, 2002; Phillips, Clancy-Menchetti, & Lonigan, 2008). Given the need to accelerate development of early literacy skills to close the nascent achievement gap in preschool, a number of recent studies targeting preschool children at risk of later reading difficulties indicate that it is possible to develop phonological skills at the phoneme level (i.e., phonemic awareness; for example, Bernhardt & Major, 2005; Gillon, 2000, 2002, 2005; Hesketh, Dima, & Nelson, 2007; Koutsoftas, Harmon, & Gray, 2009; Major & Bernhardt, 1998; van Kleeck, Gillam, & McFadden, 1998). Phonemic awareness is a subset of phonological awareness that focuses specifically on recognizing and manipulating phonemes (i.e., individual speech sounds).

For example, Gillon (2005) conducted a phonemic awareness intervention study with preschool children with speech impairments. The intervention targeted identifying the initial sound in words. Children with speech impairment who received the phonemic awareness intervention showed greater growth in early phonemic awareness than a comparison group of typically developing children. When the children started formal literacy instruction at 5 years of age, there were no significant differences between children with or without speech impairment in phonemic awareness skills. Follow-up at 6 years of age showed the children in the experimental group reading at or above their expected reading level. Furthermore, their reading achievement was significantly greater than that of a comparison group of children with a similar history of speech impairment.

Hesketh et al. (2007) randomly assigned 42 preschool-aged children with speech impairment to either a phonological awareness or a language stimulation program. Children were assessed on four measures of phonological awareness (alliteration awareness, phoneme isolation, word segmentation, and phoneme addition/deletion). Significantly more children improved in the phonological awareness group than in the language stimulation group for three out of the four measures. A marked improvement in ability to isolate phonemes was made by most children. However, for the two most advanced tasks (segmentation and addition/deletion), only a small minority of children showed improvement. The authors cautioned that the group results mask a great deal of variability between individuals.

In summary, there is some evidence that early phonemic awareness can be developed in preschool children who are at risk of later reading difficulties. A number of studies targeting children with speech-language disorders and/or who are from low-income backgrounds found that explicit instruction of phonemic awareness resulted in increased skills for at least some of the children. Most of the interventions in these studies were conducted in small groups and were equivalent to a Tier 2 intervention. In general, there is a paucity of research on Tier 3 early literacy interventions in preschool. The NAEYC and the International Reading Association (IRA; 2009) have issued a joint statement endorsing appropriate literacy assessment and individualized intervention strategies, including intensive, focused instruction "to accelerate progress toward literacy" (p. 2). Clearly, a need exists for research-based individualized interventions that accelerate development and enhance the

Table 1. Tier 3 Early Literacy Study Participants.

Child	Gender	Age in months	IGDI SID	PELI AK	PELI PA	TOPEL PK	TOPEL PA
Casey	M	52	2	0	1	81	84
Angela	F	51	6	0	3	80	79
Sydney	F	53	3	2	3	85	71
Kaylie	F	53	3	1	0	77	93
Suzanne	F	53	3	2	0	96	90
James	M	55	2	1	2	85	63
M		5.83	3.17	1.00	1.5	84.00	80.00
SD		1.33	1.47	0.89	1.38	6.63	11.45
Range		51–55	2–6	0–2	0–3	77–96	71–93

Note. Maximum score on IGDI SID = 15; maximum score on PELI AK = 26; maximum score on PELI PA = 15; TOPEL normative group mean scores = 100 (*SD* = 15). IGDI SID = Individual Growth and Development Indicator Sound Identification; PELI = Preschool Early Literacy Indicators; AK = alphabet knowledge; PA = phonological awareness; TOPEL = Test of Preschool Early Literacy; PK = print knowledge.

likelihood of success for those young children who need the most intense level of support, that is, Tier 3 support in an RTI framework.

The purpose of our study was to evaluate the effectiveness of a focused individualized intervention on the development of phonemic awareness skills, specifically awareness of initial sounds, in preschool children eligible for Tier 3 support. A single-case multiple baseline across subjects design was used. The single-case design allowed for the inclusion of children with diverse learning and speech and language abilities, as is typical among children who need Tier 3 support. The single-case analysis also provided information about the characteristics of children who are most and least responsive to the intervention.

Method

Participants

When recruiting and selecting participants for this study, our goal was to identify children who might qualify for Tier 3 support within an RTI model. As such, we employed a multiple-gating process. All potential participants were preschool children age-eligible for kindergarten in the following school year. Local Head Start preschools were contacted regarding the study and willingness to participate. Seventy-one children in nine preschool classrooms completed the screening phase. This first gate included teacher rankings, the Alphabet Knowledge and Phonemic Awareness subtests of the Preschool Early Literacy Indicators (PELI; Kaminski, Abbott, Bravo Aguayo, Latimer, & Good, 2014), and the Sound Identification measure of the Individual Growth and Development Indicators (IGDIs; Bradfield, Wackerle-Hollman, & McConnell, 2011). Teachers ranked the children in their classroom who would be eligible for kindergarten in the following year from highest (or most skilled) to lowest (or least skilled) in the area of early literacy skills. Eight of the nine teachers provided rankings for all children in their classroom. The ninth teacher provided rankings for all children except those who were deemed typically developing based on her professional judgment. Twelve children who scored greater than one standard deviation below the mean on the PELI and/or IGDI measure and who ranked in the bottom third in early literacy skills based on teacher ranking were administered the Test of Preschool Early Literacy (TOPEL; Lonigan, Wagner, Torgesen, & Rashotte, 2007) and began baseline data collection. Our goal was to select children for intervention who had the lowest scores across all measures and who demonstrated low phonemic awareness skills on the dependent measure.

Of those children who began baseline data collection, two were discontinued due to (a) rising baseline scores (one child) and (b) high baseline scores (one child). Three children had scheduling and logistics issues preventing their participation. As such, seven children began the intervention, but one child dropped out due to chronic absenteeism. Ultimately, six children from six different Head Start classrooms met our criteria and participated fully in the study.

Descriptive data on participants who completed the study are reported in Table 1. All participants were between 51 and 55 months of age at the onset of the study and were age-eligible for kindergarten in the following school year. In addition, all participants were nominated by their teachers to receive the intervention. All children achieved scores greater than one standard deviation below the mean on multiple screening measures. Two children, Suzanne and Kaylie, achieved scores on the Phonological Awareness subtest of the TOPEL that were within one standard deviation of the mean; however, both children demonstrated scores of zero on the Phonological Awareness subtest of the PELI and scored greater than one standard deviation below the mean on the Sound Identification measure of the IGDIS. Despite their TOPEL scores, both Suzanne and Kaylie demonstrated consistent scores of zero on the dependent measure throughout baseline. Two children were on Individualized Education Plans (IEP) for special education

services, Angela for developmental delay and James for communication delay.

Independent Variable

The independent variable was the Reading Ready Early Literacy Intervention (RRELI), which included interventionist-led activities and games focused on building children's (a) phonemic awareness, specifically the ability to identify first sounds in spoken words; and (b) alphabet knowledge, specifically letter names and sounds with the goal of developing children's understanding of the alphabetic principle. The RRELI consisted of a series of lessons with associated games and activities to promote the development of phonemic awareness and alphabet knowledge.

The RRELI lessons were sequenced to effectively and efficiently teach phonemic awareness and alphabet knowledge with the end goal of promoting children's understanding of the alphabetic principle. The lessons were mastery based, and each lesson ended with a short check-out that determined whether a new skill would be taught the next lesson or if the current skill required further instruction and practice. The intervention used game formats, songs, and finger play to keep children engaged. For example, children practiced listening for the sound /m/. The children were taught to rub their tummies (or make some other gesture) when the teacher said the sound /m/. During guided practice, the children played a game in which they moved a game marker on a game board whenever they responded correctly to the sound. Intervention activities were designed to provide children with a high rate of opportunities to respond (i.e., six to 12 opportunities per minute). As such, even in a brief game of 5 min, a child could have between 30 and 60 opportunities to respond. Adaptations and game variations were provided. Specific procedures related to providing encouragement and guidance, what to do if children had difficulty with lesson components, and guidance on variations that could be employed were provided with each lesson. An in-depth description of the intervention may be found in Kaminski, Powell-Smith, Hommel, McMahon, and Aguayo (2014).

The intervention focused on three target sounds, /m/, /t/, and /f/. The specific sounds were selected because they are easy for preschool children to produce, are represented by the same letter in English and Spanish, and occur frequently in print and at the beginning of common words. The lesson sequence for each sound progressed from having the child discriminate the target sound in isolation to identifying the sound in the initial position in two-syllable words. The final lesson of the sequence introduced the letter that represents the sound (e.g., the letter "M" for the sound /m/). Each of the RRELI lessons followed the same systematic steps of effective instruction: (a) introduce the activity, (b) practice and review naming letters of the alphabet, (c) review the previous skill, (d) introduce and teach the new skill, (e) practice the new skill in a game, and (f) contextualize the skill. Twelve lessons were delineated for each sound, but the flexibility to cover more than one lesson in an intervention session was allowed. Conversely, repetition of a given lesson was allowed if mastery was not achieved. Across children, multiple lessons were covered in a single session 19% of the time (range = 0%–46%). Lessons were repeated 23% of the time (range = 13%–35%).

Dependent Variable

Dynamic Indicators of Basic Early Literacy Skills (DIBELS) Next First Sound Fluency (FSF; Good et al., 2011) was used to evaluate the effects of the intervention. FSF is a brief, direct measure of a child's fluency in identifying the initial sound in words. It is an indicator of a child's emerging phonemic awareness skills. Using standardized directions, the assessor says a series of words one at a time and the child says the first sound in the word. FSF takes approximately 1 min to administer. Reliability of FSF is strong, with interrater reliability ranging from .94 to .98 and alternate-form reliability ranging from .82 to .93. Criterion-related validity of FSF with the Group Reading Assessment and Diagnostic Evaluation (GRADE; Williams, 2001) is moderate, with correlations ranging from .40 to .52. FSF is typically administered in the beginning of the kindergarten year as a part of the DIBELS Next assessment. The kindergarten beginning-of-year benchmark goal for FSF is a score of 10 (Good et al., 2013).

Procedures

Training on intervention. Three research assistants served as interventionists and received training and ongoing feedback and support in implementation of the RRELI. One interventionist held a BS in psychology with a focus in early childhood development and had 9 years of experience in early childhood education and research at the start of the study. The second interventionist had 5 years of experience in early childhood education and educational research and at the time of the study was enrolled in a master's program in special education with an emphasis in early intervention. The third interventionist, who also served as project coordinator, held a master's degree and had 2 years of experience teaching preschool and 5 years of experience in educational research at the start of the study.

Training was provided in person during two 3-hr small-group sessions in which components of the intervention were described and modeled. The training was conducted by the first author, who holds a doctorate in school psychology as well as degrees in speech-language pathology and early intervention. Participants practiced implementation of each intervention component in pairs and received guided feedback from the principal investigator. For example,

during the training's paired practice activities, the principal investigator observed whether the interventionist implemented the specific strategies for encouragement and guidance provided in the lesson plan for that particular lesson. If the strategies were not implemented or were not implemented as prescribed in the lesson, the principal investigator provided feedback to the interventionist, modeling the strategy if necessary, and the interventionists repeated the practice.

Fidelity. During the intervention phase, fidelity checks were conducted every other week, beginning with the first week, for each interventionist. Each interventionist was evaluated by trained observers who rated the fidelity of implementation of the intervention using the Reading Ready Intervention Fidelity Checklist (see Figure 1). The Reading Ready Intervention Fidelity Checklist was developed specifically for the RRELI. The checklist is comprised of four sections. The first is a list of eight key intervention components that are rated on a 3-point scale as to whether the component is implemented fully, partially, or not at all. Examples of items on the checklist include "Teacher introduces the lesson" and "Teacher introduces and teaches the new skills." The second section covers activity management (e.g., "Materials are ready and organized." "Teacher paces lesson to maintain child engagement."), contains five items, and is also scored on a 3-point scale. A checklist of child behavior is provided in the third section, in which the fidelity observer rates the child's accuracy of responses, level of engagement, and language abilities. The final section provides a description of the setting and a rating of the level of noise/distraction. The Fidelity Checklist was used along with the RRELI Lesson for that particular day, which listed the specific steps to be followed in that lesson as well as specific strategies to be used for providing encouragement and support.

Fidelity observers were two research assistants with more than 20 years combined experience in early childhood special education. One of the observers had a master's degree in special education and extensive experience providing coaching in intervention implementation to classroom teachers. The second observer had a PhD in school psychology with an emphasis in early childhood and a great deal of experience providing consultation to early childhood teachers. Both observers participated in the intervention training and received an additional half-day of training on conducting observations and scoring the Reading Ready Intervention Fidelity Checklist. During the training, which was led by the principal investigator, each item on the checklist was discussed with examples and nonexamples provided for each item. For example, for the item "Teacher introduces and teaches the new skills," the fidelity observers were taught that to receive full credit, the interventionist had to introduce the skill by explicitly telling the child what skill was going to be worked on that day (e.g., "We are going to learn about the first sound in words"). In addition, to receive full credit, the interventionist had to teach the skill following the steps outlined in the lesson plan for that day, such as demonstrating the skill ("I do") and then doing it together with the child ("We do") before moving to guided practice ("You do"). The interventionist received partial credit if he or she did one or more but not all of the steps. The interventionist received no credit if he or she did not introduce the skill at all but went directly to guided practice in a game.

Training on assessments. The same three research assistants who conducted the interventions received intensive training on administration and scoring of all measures used in the study, including the PELI, IGDI, and TOPEL. Training was provided in small-group sessions led by one of the authors and covered the following: (a) overview of the assessment, (b) directions for administration, (c) scoring rules with group practice scoring for each rule, and (d) paired practice in administering and scoring the measures with guided feedback. For each of the measures, assessors participated in a "check-out" in which they had to achieve 90% reliability in administration and scoring before they conducted any assessments.

Experimental Design and Conditions

A multiple baseline design across children was used to evaluate intervention effectiveness. The study consisted of two conditions: baseline and intervention. During baseline, children received "business as usual" early literacy instruction delivered by the classroom teacher. In addition, children were tested with FSF twice per week by one of the three trained interventionists.

During the intervention phase, children received the RRELI, which was conducted individually with children over 8 to 11 weeks. Intervention activities were conducted by the trained interventionists in a designated area of the classroom during center time. The activities took 5 to 10 min and were implemented 3 times a week. Each child participated in at least 24 intervention sessions. Details regarding the number of weeks of intervention, number of intervention sessions, average number of sessions per week, days absent, and attendance rate are found in Table 2. Two children participated in additional intervention sessions. Casey received three more sessions for a total of 27, and Sydney participated in one additional session for a total of 25 sessions. In addition, some students experienced school absences during the intervention phase. Attendance rates ranged from 65% to 97%. Kaylie had the lowest attendance rate (65%) and Casey had the next lowest attendance rate (80%).

Lesson repetitions occurred with all participating children and are noted in Table 2. The number of repeated lessons ranged from three to nine. In some instances, a

Reading Ready
Intervention Fidelity Checklist: Early Literacy

Score: _____
Possible: _____
% Fidelity: _____

Observer: _____ Date: _____ Time: _____ to _____

Interventionist: _____ Lesson: _____ Student ID: _____

Fidelity of Intervention	Y 1	P .5	N 0	Notes
1. Teacher leads the children in practicing the alphabet in a way that provides children practice in saying each letter name for specific letter form.				
2. Teacher introduces the lesson.				
3. Teacher reviews past skill/teaches new skill.				
4. Children practice the skill.				
5. Teacher uses explicit and consistent instructional language.				
6. Teacher provides 6-12 opportunities per minute for each child to respond during the activity.				
7. Teacher uses designated procedures for encouragement and guidance throughout the lesson.				
8. Teacher closes the activity by contextualizing the skill.				
Activity Management				
1. Materials are ready and organized.				
2. Teacher reminds children of Reading Ready rules.				
3. Teacher proactively provides positive attention to children for attention and appropriate behavior.				
4. Teacher paces lesson to maintain attention.				
5. Ratio of positive teacher attention for appropriate behavior to attention for misbehavior is at least 5/1.				

Child Behavior	Setting
Accuracy of responses (Check one) ☐ => 80% appropriate/accurate responses ☐ 40% - 80% appropriate/accurate responses ☐ =< 40% appropriate/accurate responses Level of engagement (Check one) ☐ Was highly engaged with activities ☐ Generally attentive and engaged, occasionally had difficulty ☐ Had difficulty attending/keeping engaged Language abilities (Check one) ☐ Typical language for a preschooler, e.g., simple sentences ☐ Communicated with brief utterances, phrases. ☐ Nonverbal or 1-2 word responses	Describe: _____ _____ Level of Noise/Distraction of Setting ☐ Quiet and nondistracting ☐ Generally quiet, occasional distractions ☐ Noisy and highly distracting

Note: Y = Yes. P = Partial. N = No.

Figure 1. Reading Ready Early Literacy Intervention Fidelity Checklist.

lesson was repeated more than once. For example, Casey repeated eight lessons, six of which were repeated twice. As another example, James had five lessons repeated. One lesson was repeated once, one was repeated twice, two lessons were repeated 3 times, and one lesson was repeated 5 times.

Table 2. Summary Data on Intervention Delivery and Engagement Ratings for Each Participant.

Student	Weeks	Intervention sessions	Mean sessions per week	Number of repeated lessons	Days absent	Attendance rate	Total engagement rating (no. of sessions rated)	Mean engagement rating
Casey	11	26	2.45	7	9	80%	54.5 (22)	2.48
Angela	9	24	2.67	5	5	86%	69 (24)	2.88
Sydney	8	25	3.13	3	2	97%	71.5 (22)	3.25
Kaylie	12	24	2.00	6	17	65%	80 (24)	3.33
Suzanne	8	24	3.00	3	1	94%	85.5 (23)	3.72
James	9	24	2.67	6	4	89%	63 (24)	2.63
Average	9.5	24.5	2.65	5	6.33	85.17%	70.6 (23)	3.05

Note. Engagement rated on a 4-point scale where 0 = "not engaged at all during intervention"; 1 = "engaged occasionally, but mostly unengaged"; 2 = "engaged some of the time, roughly 50%"; 3 = "engaged most of the time"; and 4 = "engaged all of the time during the intervention."

Interventionists rated child engagement at the conclusion of the intervention sessions. Child engagement was rated along the following scale: 0 = "not engaged at all during intervention"; 1 = "engaged occasionally, but mostly unengaged"; 2 = "engaged some of the time, roughly 50%"; 3 = "engaged most of the time"; and 4 = "engaged all of the time during the intervention." Engagement rating data are found in Table 2. Finally, throughout the intervention phase, each interventionist conducted FSF testing once per week or after every third intervention session when absenteeism was a factor.

Results

Figure 2 displays the results for all six children on FSF. Data were visually inspected for level (overall level and level of final four data points), trend, and variability as well as immediacy of effect and overlap. In addition, effect sizes for the group were calculated to supplement the visual analysis (Brossart, Vannest, Davis, & Patience, 2014; Parker, Vannest, & Brown, 2009).

Casey demonstrated a baseline mean of zero and a mean score of .63 during intervention, indicating a very small change (<1) in level from baseline to intervention. Trend of data was flat in baseline, with a low positive trend in the intervention phase. With the exception of a score of 2 in the third session, Casey scored zeros during intervention until the final 2 weeks when he achieved scores of 3 and 6, respectively. Thus, change was not immediate and occurred in the context of a high degree of overlapping data (63%). The mean of Casey's final four data points is 2.25 and the data display a strong positive trend for the final four data points.

Angela demonstrated a baseline mean of zero and a mean score of 1.13 in the intervention phase—a slight change in level. Overall intervention data indicate a low positive trend during intervention. Similar to Casey, change was not immediate for Angela with 50% overlap of the data in intervention with baseline. With the exception of a score of 2 in the second week, Angela scored zeros during intervention until the final 3 weeks when she achieved scores of 2, 3, and 2, respectively. The average of Angela's final four data points is 1.75 with a moderate positive trend and overlapping data reduced to 25%.

Sydney demonstrated a baseline mean score of zero and a mean score of 6.75 in the intervention phase. The data showed a flat trend in baseline and a strong positive trend during intervention. There was little overlap in the data from baseline to intervention (13%) with an effect demonstrated quickly (Week 2). The mean of Sydney's final four data points was 10.75.

Kaylie demonstrated a mean baseline score of 0 and a mean score of 2.75 across the intervention phase. Scores during intervention were highly variable and ranged from low scores of 0 in the first and fourth weeks to high scores of 6 and 8 in the second and sixth weeks, respectively. The trend of the data was flat during baseline and was also flat but with increased variability of scores during intervention. There was relatively little overlap of intervention data with baseline (25%). The mean of the final four data points was 4 for Kaylie with no overlapping data.

Suzanne demonstrated a mean baseline of 0 and a mean score of 14.63 during the intervention phase indicating a large change in level. Likewise, trend was flat during baseline followed by a strong positive trend during intervention. Suzanne demonstrated relatively quick effects, beginning in Week 2, with little overlap of data from baseline (13%). Suzanne's mean score for the final four data points was 18.5 with no overlapping data.

James demonstrated a mean baseline of 0 and a mean score of 1.25 across the intervention phase, indicating a small change in level. Trend of the data was flat in baseline and positive but low during intervention. Similar to Casey and Angela, other than a score of 2 in Week 2, James achieved zeros until the final 3 weeks of intervention when he evidenced a gradual upward trend with scores of 2, 2, and 4. During the intervention phase, 50% of the data overlapped with baseline. The mean score of James's final four

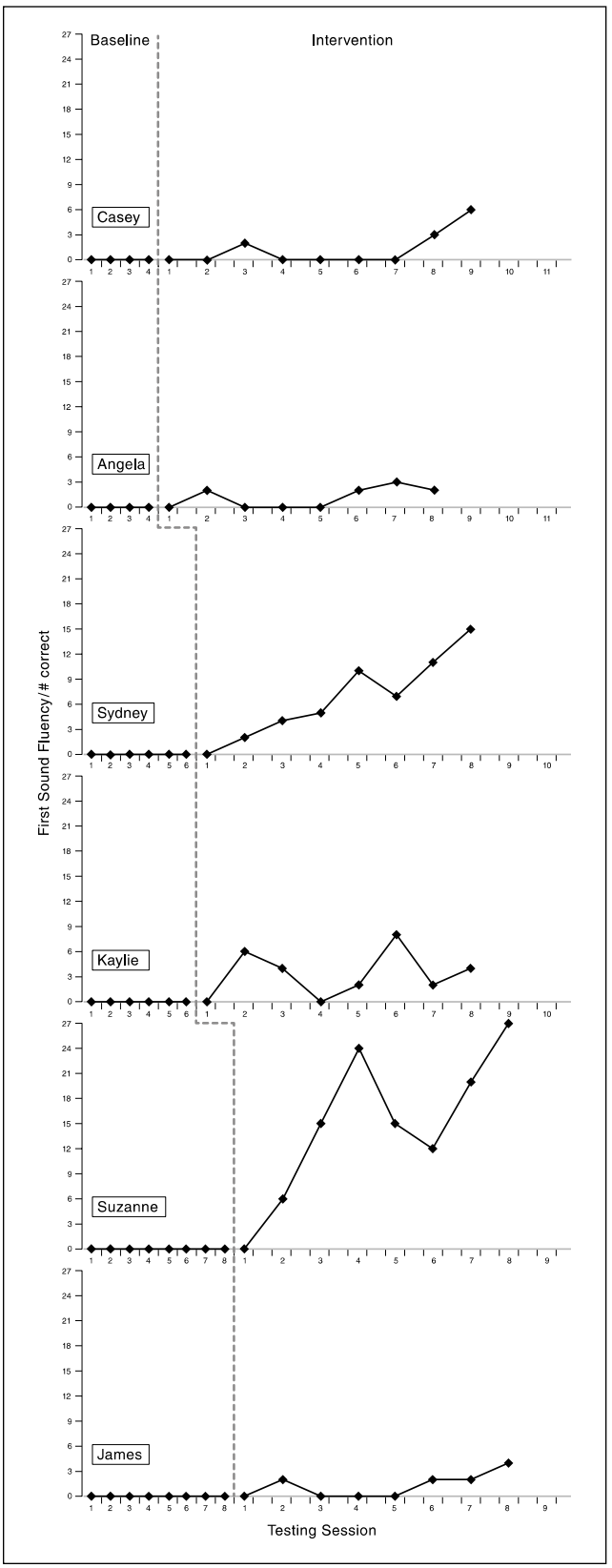

Figure 2. First sound fluency scores across baseline and intervention phases.
Note. The numbers on the *x* axis represent testing session.

Table 3. Effect Sizes for FSF Results in Tier 3 EL Intervention Study.

Effect size index	Calculated effect size for FSF	Interpretation
PAND	0.82	Medium
Phi	0.62	Medium
Cohen's *d*	1.57	Strong
NAP	0.83	Medium

Note. FSF = First Sound Fluency; EL = early literacy; PAND = percentage of all nonoverlapping data; NAP = nonoverlap of all pairs. PAND criteria: weak = .5–.83, medium = .84–.91, and strong = .92–1.0. Phi criteria: weak = 0–.52, medium = .55–79, and strong = .80–1.0. Cohen's *d* criteria: weak = 0–.49, medium = .50–.79, strong = .80–3.00. NAP criteria: weak = 0–.65, medium = .66–.92, and strong = .93–1.0.

data points was 2 with 25% overlapping data with baseline.

Effect Sizes

Four different effect sizes were calculated based on children's performance on FSF. First, we calculated the percentage of all nonoverlapping data (PAND; Parker, Hagan-Burke, & Vannest, 2007). Parker, Vannest, and Davis (2011) defined PAND as the percentage of all data remaining after removing the minimum number of data points which would eliminate all data overlap between Phases A and B. Second, we calculated Phi (Schneider, Goldstein, & Parker, 2008). Phi is a Pearson's R for a 2 × 2 contingency table. Thus, Phi^2 is the same as R^2 and is interpreted similarly as "proportion of variance accounted for. Like R, Phi can range from +1 to −1" (Schneider et al., 2008, p. 157). Third, we calculated Cohen's d, one of the most widely used measures of effect size. Fourth, and finally, we calculated nonoverlap of all pairs (NAP; Parker & Vannest, 2009). NAP summarizes data overlap between each Phase A (baseline) data point and each Phase B (intervention) data point in turn. Effect size results are reported in Table 3.

The PAND data indicate a medium effect size for FSF. The PAND effect size is at about the 50th percentile when compared with 200 typical single-case design studies (see Parker et al., 2011). The Phi results also indicated a medium effect size. Based on Cohen's guidelines (Cohen, 1988), the effect size was strong for Cohen's d. Finally, like the PAND results, the NAP data indicate a medium effect size. For two children (Sydney and Suzanne), strong effects were found based on the NAP analysis.

Fidelity of Intervention and Child Engagement

Twelve fidelity checks were conducted during the intervention phase. Mean ratings for the fidelity of intervention and activity management components from the fidelity checklist

Table 4. Mean Ratings of Fidelity and Activity Management.

Interventionist	Mean fidelity of intervention	Mean activity management
Interventionist 1	6.60	3.90
Interventionist 2	7.75	4.63
Interventionist 3	7.67	5.00
Average	7.25	4.42

Note. Fidelity of intervention has a maximum of 8; activity management has a maximum of 5.

are reported in Table 4. Interventionists' mean ratings for fidelity of intervention ranged from 6.60 to 7.75 out of 8 ($M = 7.25$), while mean activity management ratings ranged from 3.90 to 5.00 ($M = 4.42$). These data reveal that the intervention components and activity management were conducted on average with 90% fidelity (11.67 of 13 possible points).

Data collected during the fidelity checks showed that average accuracy of student responses was >80% during two thirds of the observations. During the remaining one third of the observations, accuracy of student responses was between 40% and 79%. In addition, children were rated by the fidelity observers as being highly engaged with the activities during 33% of the observations, generally engaged during 42% of the observations, and having difficulty attending during 25% of the observations.

The interventionist ratings of child engagement are reported in Table 2 for each participating child along with an average across all children. The number of intervention sessions rated, the total engagement rating for all sessions, and the mean engagement rating are displayed. These data indicate that Casey had the lowest average engagement rating and Sydney had the highest average engagement rating. Overall, however, the children were rated as "engaged most of the time" by the interventionists.

Discussion

Overall, the effects of the Tier 3 early literacy intervention are positive albeit modest. Although all children showed skill gains in the intervention phase, the intervention was more effective for some children than others. The beginning-of-year kindergarten benchmark goal for FSF is a score of 10; the cut point for risk is 5 (Good et al., 2013). At the final administration of FSF for this study, three of the children scored above the cut point for risk and two surpassed the goal. Overall effect size indices for the sample indicate medium to strong effects (see Table 3).

The finding of considerable variability in RTI among the children who received Tier 3 support is not surprising given the diversity of skills and abilities among the group of children. These findings also are consistent with the literature on effectiveness of Tier 3 interventions for young primary grade students (Denton, Fletcher, Anthony, & Francis, 2006; Denton et al., 2013; Gillon, 2000; Vaughn et al., 2009).

Our findings indicate that it is difficult to know based on pretest scores alone which children would benefit the most from intervention. For example, the child who made the greatest gains (Suzanne) had the highest standard scores on both subtests of the TOPEL at pretest, indicating a potentially higher level of early literacy skills at the outset of intervention. However, the child who made the next greatest gains (Sydney) scored more than one standard deviation below the mean on both TOPEL subtests at pretest. Kaylie's score on the PA subtest of the TOPEL was within one standard deviation of the mean; however, Kaylie's overall gains were small.

A variety of factors may have affected children's performance. Special education status, challenging behaviors, and attendance were among the factors we examined. Among our group of six children, two children were on IEPs: James for communication impairment and Angela for developmental delay. In general, children who were on IEPs made smaller gains than children not receiving special education. This finding is consistent with the literature and expected given that these children have identified disabilities that warrant educational services beyond those provided in general education. Casey, while not on an IEP, demonstrated severe challenging behavior and had the lowest mean engagement rating. In fact, all three children with low RTI (Casey, Angela, and James) displayed relatively low levels of engagement during the sessions as rated by interventionists in daily intervention logs (see Table 2). The children were rated on a scale of 0 to 4, with a score of 0 being *not engaged at all during the session* and a score of 4 *being engaged all of the time during the session*. A rating of 2 indicates being engaged about 50% of the time and a rating of 3 indicates being engaged "most of the time." Casey, Angela, and James received mean engagement ratings of 2.54, 2.88, and 2.63, respectively. The ratings indicate that the three children who made the least gains were engaged, on average, a little more than 50% of the time during the intervention sessions. This level of engagement is in contrast to the mean engagement ratings for the remaining three children (Sydney, Kaylie, and Suzanne) of 3.26, 3.33, and 3.73, respectively, indicating that these children were engaged most to all of the time during the intervention sessions.

Intervention logs for the three children with low engagement revealed that more time was spent on behavior management, resulting in fewer opportunities for the children to respond and receive skill-focused feedback. It is possible that children with behavioral challenges, as a group, may demonstrate a delayed increase in skills. As the children learn to attend and play the games, opportunities to respond

will increase and eventually lead to increased skills. Two of the three children, Casey and James, did in fact show an increasing trend in the final few weeks of intervention. Angela's modest gains in scores also occurred during the final 3 weeks of intervention.

Attendance also was variable. The study was designed so that children would complete 24 sessions of intervention in 8 weeks. Children were in school 4 days a week. They were to receive intervention 3 days a week, with the fourth day used for data collection. The two children who demonstrated the greatest effects, Suzanne and Sydney, also had the highest attendance and completed 24 and 25 sessions of intervention, respectively, in 8 weeks. Kaylie had the highest number of absences and took 12 weeks to complete 24 intervention sessions. Kaylie also demonstrated the greatest variability in scores throughout the intervention phase. The child who demonstrated the lowest gains in the dependent variable, Casey, took 10 weeks to complete 24 intervention sessions due to absences. Angela and James, the two children with IEPs, both had a few absences, completing 24 intervention sessions in 9 weeks.

An analysis of lesson repetitions indicates that Kaylie, James, and Casey demonstrated the most repetitions of lessons. In general, most repetitions involved the first sound learned (/m/) and were for Kaylie and James. Casey and James had the most total repetitions, but James had the highest number of lessons repeated more than 2 times. The lesson types that were repeated the most involved the more difficult discriminations (e.g., asking the child to select the word beginning with target sound from words that contain the target sound in medial or final position or from a variety of words with different sounds).

Supporting the variable responsiveness to intervention in our results is the emerging research base examining the learner characteristics of students who do not respond adequately to intervention. In their review of the literature of children from preschool to third grade who were unresponsive to early literacy interventions, Al Otaiba and Fuchs (2002) found that a majority of students who did not respond had phonological awareness deficits. Additional learner characteristics of these students included slow letter-naming speed, low verbal abilities, and developmental delays. Children who displayed problem behaviors were a particularly challenging group. These children were unresponsive to early literacy interventions even when the interventions were provided in a one-to-one format. In a summary of studies that included preliterate children with and without disabilities, Al Otaiba and Fuchs found that as many as 50% of students with disabilities were unresponsive to treatment. Similarly, in a study of phonological awareness instruction with kindergarten children with and without disabilities, O'Connor, Notari-Syverson, and Vadasy (1996) found that children with disabilities made less than half the average gain compared with nondisabled peers.

It seems possible that 5 to 10 min a day across 8 to 12 weeks is enough time to accelerate growth for some preschool children who need Tier 3 support, but it is likely not enough time for all children who need intensive support to gain the skills. Indeed, the majority of Tier 2 or Tier 3 interventions reported in the literature for primary grade students provide a longer amount of time daily (e.g., 30 min-2 hr) and/or extend the duration of the intervention (e.g., 20–30 weeks, 50–100 sessions) beyond what we provided in our Tier 3 interventions (e.g., Denton et al., 2006; Mathes et al., 2005). A study by Vaughn, Linan-Thompson, and Hickman (2003), with low readers in second grade, examined intervention responsiveness in relation to time in the intervention. Their results indicated some students met their exit criteria by 10 weeks, some after 20 weeks, and others after 30 weeks. However, nearly one fourth of the students did not meet their exit criteria after 30 weeks. Their results suggest that some students clearly need more opportunities to receive intervention even with an intensive, research-based intervention. The degree to which similar results might be seen with preschoolers is unknown but worth exploring via future research.

Limitations of the Study and Future Research

While we believe the results of this study are promising with respect to the efficacy of the RRELI, several limitations to the design and implementation should be considered. First, generalization of the findings to other preschool children who may qualify for Tier 3 support in the area of early literacy should be made with caution. Children who need this level of support are a heterogeneous group with diverse learning needs. Systematic replications are needed with additional children with varied learning needs in different contexts to increase our understanding of this intervention's effectiveness. The limited duration of the intervention may have prevented some children from demonstrating effects. Extending the intervention in future replications would be useful, especially given that in the 8- to 11-week duration of the intervention, only one child had the opportunity to complete the sequence of lessons for two different sounds.

In addition, the RRELI intervention evaluated in this study was designed to incorporate elements of effective instruction (e.g., Archer & Hughes, 2011; Brophy & Good, 1986; Gersten, Schiller, & Vaughn, 2000). Explicit steps for each lesson were clearly delineated with the intent of making the intervention consistent and relatively easy to implement. Within this structure, flexibility was allowed for the interventionist to pace the lessons and/or use variations that provided scaffolding to meet an individual child's learning needs. The interventionists met weekly with the project coordinator and the fidelity observers to discuss progress of individual children. The principle investigator participated in the meetings monthly, or more frequently as requested. Decisions about instructional modifications were generally

made in the context of these meetings. Even with this level of support for the interventionists, child outcomes were variable. In practice, the RRELI intervention would be implemented by classroom teaching staff, who may have less skill and/or support in making instructional adjustments based on an individual child's response to the intervention. Indeed, Gersten et al. (2008) recommended that Tier 3 interventions be provided by highly trained teachers, given the challenges posed by children who need this level of intensive support. Issues regarding the level of training and skill required to effectively implement the intervention and how this may be accomplished in practice need to be addressed.

Future work should (a) replicate current research, (b) examine the impact of increasing the length of the intervention period, and (c) demonstrate implementation by preschool personnel. The RRELI is well-developed and implementable. Results of this early literacy intervention study are promising and provide further direction for the ongoing development of Tier 3 early literacy interventions.

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Authors' Note

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