

# Studies in MTSS Problem Solving: Improving Response to a Pre-Kindergarten Supplemental Vocabulary Intervention

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## Abstract

A tenet of the Multi-Tiered System of Supports (MTSS) is that even evidence-based interventions will not be effective with all children. We examined preschool children's response to a supplemental literacy intervention (*Story Friends*) in two classrooms. Children with weak vocabulary skills were identified and received the intervention. The extremes in children's response to *Story Friends* ranged from highly effective to very ineffective. In one classroom, three children who were not responsive to *Story Friends* received additional intervention components. Two of these children acquired new vocabulary words at rates comparable to highly responsive peers receiving *Story Friends* only, and greater than peers in both classrooms not receiving additional support. The third child was dropped due to refusal to attend sessions. Children's lack of learning the control words demonstrated that their progress on the taught words was not due simply to listening to the words read in the stories.

## Keywords

supplemental vocabulary intervention, prekindergarten, multitiered systems of support, problem-solving interventions, repeated acquisition single-case design

Children's early vocabulary development plays a critical role in their later reading achievement. Preschool children who demonstrate delays in vocabulary are at risk for delays in comprehension skills and reading disabilities in later school years (Biemiller, 2012; Catts, Hogan, & Adolf, 2005; Juel, 2006). Although children typically increase their vocabulary rapidly in the early years, research indicates that children from low socioeconomic status (SES) families face greater challenges in gaining vocabulary knowledge than more advantaged children (Hoff, 2003). This SES-related disparity acquiring vocabulary knowledge begins at birth and expands throughout the preschool years, kindergarten (Farkas & Beron, 2004; Hart & Risley, 1995), and the elementary grades (Biemiller & Slonim, 2001; Walker, Greenwood, Hart, & Carta, 1994).

Research also shows that early intervention using differentiated, supplemental vocabulary instruction may reduce the risk for delays in language and literacy development (Goldstein et al., 2016; Greenwood et al., 2016; Kelley, Goldstein, Spencer, & Sherman, 2015). The Multi-Tiered System of Supports (MTSS) is a framework for differentiating instruction based on each child's assessed needs (Carta & Miller Young, 2019). Basic tenets of MTSS include the use of evidence-based practices and individualized instruction knowing that effective interventions will

not be successful for all children. In MTSS, when children fail to demonstrate adequate growth in response to the core instruction provided to all children (Tier 1), they are provided additional support of greater intensity, frequency, or individualization (Stoiber & Gettinger, 2016).

Universal screening in MTSS is used to identify children showing early signs of learning difficulties who might benefit from supplemental or individualized instruction (Tier 2 or 3) (Greenwood et al., 2015). Ongoing progress monitoring assessments are used to assess the success of intervention and to make instructional decisions. When children's performance falls below benchmarks in the context of Tier 1, they are provided additional supplemental instruction (Tier 2). Children who meet established benchmarks with supplemental instruction are provided with less intensive instruction (i.e., a Tier 2 to Tier 1 intervention transition). Children who demonstrate inadequate

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progress with supplemental instruction may transition to a more intensive level of support (e.g., Tier 3) (Kaminski & Powell-Smith, 2016).

Approaches to intervention procedures in MTSS typically use either standard treatment or individual problem-solving intervention protocols (Fuchs, Mock, Morgan, & Young, 2003). Standard intervention protocols are evidence-based practices that target specific skills through lessons that are scripted or that use explicit instruction. Standard protocols are used with all children who need them in an early childhood program. Examples include *Paths to Literacy* (Goldstein & Olszewski, 2015), *Read It Again-PreK* (Justice & McGinty, 2009), and *Reading Ready* (Kaminski & Powell-Smith, 2016).

The problem-solving intervention protocol is used to develop interventions based on treatment hypotheses that summarize individual child progress data (Tilly, 2008). Said differently, intervention selection involves matching a child's assessed need with evidence-based practices likely to address this need (Embry & Biglan, 2008; Greenwood et al., 2018). The problem-solving protocol is an iterative cycle and includes (a) documenting evidence of the problem, (b) consideration of causal factors, (c) developing a solution, (d) monitoring implementation fidelity, and (e) monitoring child progress. The cycle is repeated as often as necessary to ensure adequate child progress.

In recent years, experimental studies have examined the efficacy of supplemental oral language interventions for young children with limited language skills (Kelley et al., 2015; Spencer et al., 2013; Tuckwiller, Pullen, & Coyne, 2010; Zucker, Solari, Landry, & Swank, 2013). Findings have indicated that kindergarteners at risk for later reading difficulties made greater gains in learning target words when they received a supplemental intervention (Loftus, Coyne, McCoach, Zipoli, & Pullen, 2010; Tuckwiller et al., 2010). Studies with preschoolers also have indicated that children who received a supplemental intervention significantly gained receptive (Zucker et al., 2013) or expressive word knowledge (Goldstein et al., 2016).

## Story Friends

*Story Friends* (Goldstein & Kelley, 2018; Kelley et al., 2015) is a small-group, technology-assisted, storybook vocabulary intervention that incorporates the explicit teaching of academic vocabulary (e.g., “enormous” and “ruin”); basic concept words (e.g., “empty/full”); and comprehension skills embedded within 10-min prerecorded, interactive storybooks for preschoolers. The intervention is a standard supplemental intervention protocol for use in MTSS for children whose vocabulary proficiency is below benchmark (Griffiths, VanDerHeyden, Parson, & Burns, 2006).

Reports indicate that *Story Friends* improves the outcomes of the majority of children who are lower performing in vocabulary (Goldstein et al., 2016; Greenwood et al., 2016; Kelley et al., 2015). *Story Friends*, instructional design takes advantage of the evidence behind children's learning from storybooks and explicit instruction. For example, research has documented that explicit teaching within shared reading (Beck & McKeown, 2007; Marulis & Neuman, 2010) is more effective than incidental teaching for promoting growth in children's vocabulary knowledge (Coyne, McCoach, & Kapp, 2007). Research also supports repeated exposures to words taught across various contexts have been shown to facilitate the memory processes of encoding, storage, and retrieval, and enhance the learning of new vocabulary words (Pullen, Tuckwiller, Konold, Maynard, & Coyne, 2010). Reports have indicated that increasing children's active participation in instructional activities and storybook listening (Braham & Lynch-Brown, 2002) are more effective in children's learning of target words compared with passive reading interventions (Walsh & Blewitt, 2006).

Technology supports makes it easy to implement at fidelity when facilitated by a staff assistant in the preschool classroom. During a session, small groups of children wearing headphones listen to a narrator read and instruct while viewing and interacting with the storybook content. These combined features ensure fidelity of implementation of an evidence-based practice at reduced teacher burden (Spencer et al., 2013).

Studies developing *Story Friends* reported that children who received *Story Friends* made significant improvement in learning new vocabulary words in the intervention compared with children in a *business as usual* comparison condition (Greenwood et al., 2016; Kelley et al., 2015; Spencer et al., 2013). All reported significant effects on mean vocabulary growth but also individual child variability observed in the vocabulary words learned over the course of the intervention (e.g., ranging from three to 17 words learned out of 18 total). In each study, however, it appeared that some children were experiencing challenges engaging the *Story Friends* format.

Researchers suggested that nonresponsive children might benefit from the *Story Friends* intervention if additional features were added to increase engagement and success using the automated format. Some children might benefit from more preteaching of the instructional format, perhaps in a one-to-one format, increased opportunities to respond with individual prompting and scaffolding, and corrective, response-contingent feedback. For example, the one-on-one format is an evidence-based support used to build children's engagement and attention, ranging from peer tutoring (Embry & Biglan, 2008) to individualized Tier 3 interventions (Kaminski & Powell-Smith, 2016). Making prompting explicit using puppets and

photographs have been successfully used to promote young children's active engagement, leading to improvement in targeted skills (Salmon & Sainato, 2005). Reports also support the use of response-contingent correction and confirmations in establishing new skills (Embry & Biglan, 2008). These procedures are not available in the standard *Story Friends* intervention and were used as additional supports as described below.

The current study focused on identifying effective supports for children with weak vocabulary skills who were not responsive to *Story Friends* (Greenwood et al., 2015). The purposes were twofold: (a) to examine the divergent range of response to *Story Friends* by children who were low performing in vocabulary in two classrooms and (b) to use MTSS problem solving (Tilly, 2008) to plan and evaluate the effects of additional complementary intervention components for children for whom *Story Friends* was not initially effective. Thus, we addressed the following questions:

**Research Question 1 (RQ1):** What were the range of *Story Friends* effects in Classroom A? In MTSS, it is important to examine the range of divergent intervention effects and examine the relation between children's progress and the standard intervention.

**Research Question 2 (RQ2):** Were the range of *Story Friends* effects duplicated in Classroom B? For children not responsive to *story friends* only, were additional components effective? It was important to understand the range of divergent effects in MTSS and examine the relation between children's progress and the additional intervention components.

**Research Question 3 (RQ3):** Did the rate of improvement reach educationally relevant levels with additional components? In MTSS, it is important to document variation in the range of children's rate of improvement in word learning; including the educational importance of words learned based on intraindividual and peer comparisons (Kazdin, 1977; Wolf, 1978).

## Method

### Participants

Two preschool teacher/classrooms from the same early childhood center participated sequentially with a 3-week break in between. An urban, central-city school district operated the center serving a majority low SES population inclusive of children with and without identified disabilities. The center provided children with a half-day Pre-K program, 4 days per week. The center had nine preschool classrooms serving children aged 3 to 5. Each classroom had two lead teachers and two paraprofessionals.

**Teachers/classrooms.** All four lead teachers (two per classroom) had at least a bachelor's degree in early childhood education or early childhood special education. Lead teachers in both classrooms were female. The range of the teachers' teaching experiences varied from 1 to 11 years. Both classrooms were Pre-K programs that were inclusive of children with disabilities and each served a range of 19 to 20 children. All teachers and children participating were consented based on standard institutional review board (IRB) procedures approved by the appropriate university IRB.

Teacher/classroom A's participation began prior to Classroom B and was part of a prior *Story Friends* evaluation (Greenwood et al., 2016). The Greenwood et al. (2016) study was one in a series of replications seeking to develop and validate the *Story Friends* supplemental intervention conducted by the Center for Response to Intervention in Early Childhood (Greenwood et al., 2015). This classroom served to illustrate the range of children's response to *Story Friends* by providing comparative benchmarks for both responsive and nonresponsive children. Classroom B uniquely served as an independent replication of the range of individual response to *Story Friends* and as an evaluation of the effects of additional intervention components.

**Children.** All children in each classroom were screened for oral vocabulary skills to identify those with weak vocabulary skills. We used the *Individual Growth and Development Indicators—Picture Naming* (IGDI-PN) and two standardized norm-referenced language tests (i.e., the *Peabody Picture Vocabulary Test* (PPVT) and the *Expressive One Word Picture Vocabulary Test—Spanish-Bilingual Edition* (EWOPVT-SBE). Below expectation IGDI-PN vocabulary performance was defined by a cut point of 10 words (My IGDI: Benchmarks for Early Literacy Screening, 2013). This separated children performing at or above expectation in literacy (Tier 1) from children likely to benefit from supplemental literacy instruction (Tiers 2–3).

Children's assessed IGDI-PN vocabulary skills were all below benchmark and did not differ by classroom (see Table 1). All children performed below the mean standard score of 100 on the PPVT; most were one or more standard deviations below the mean. Children's demographics in terms of age, gender, and parent and child language were relatively similar across classrooms. Both classrooms contained children whose heritage language was English and Spanish. Unique to Classroom A was a child whose heritage language was Hmong (Kate). Unique to Classroom B were children with Individualized Education Programs (Ian and Francisco, both with speech/language delays and communication disorders). The characteristics of all eight identified children (four in Classroom A and four in Classroom B) are shown in Table 1.

**Table 1.** Child Participant Characteristics.

Variables	Classroom A historic children				Classroom B new children				
	Unresponsive		Responsive		Unresponsive			Responsive	
	Kate	Diane	Aden	Oliver	Ian	Carter	Francisco	Mina	
Age (Months)	53	50	54	57	59	55	57	57	
Gender	Female	Female	Male	Male	Male	Male	Male	Female	
IGDI PN	4	3	8	6	3	0	1	7	
PPVT-IV	79	89	86	92	74	76	63	90	
EOWPVT	—	—	—	137	93	85	55	120	
Parent language	E&H	E	E	E&S	E <sup>a</sup>	E&S	S	E&S	
Child language	E&H	E	E	E&S	E&S	E&S	E&S	E&S	
IEP	No	No	No	No	Yes	No	Yes	No	
Study duration								Dropped	

Note. IGDI-PN = Individual Growth and Development Indicators–Picture Naming (Bradfield et al., 2014); PPVT = Peabody Picture Vocabulary Test (Dunn & Dunn, 2007); EOWPVT-SBE = Expressive One-Word Picture Vocabulary Test–Spanish-Bilingual Education (Brownell, 2001); E = English; H = Hmong; S = Spanish; E<sup>a</sup> = the child’s parents spoke English to him but he lived with his grandmother who spoke Spanish to him; IEP = Individualized Education Program; IGDI-PN benchmarks = 0–10 (Tier 2/3); 11–15 (Tier 1). Parent and child language = language spoken at home.

**Research staff.** Three research staff participated. All had master’s degrees in special education or psychology and received multiple training sessions from the *Story Friends* developers. One lead researcher (first author) implemented the *Story Friends* intervention with the children in both classrooms and the additional components intervention sessions in Classroom B. One experienced *Story Friends* interventionist and a research coordinator collected data for purposes of determining score reliability and the fidelity of facilitators’ implementation of *Story Friends* and additional components.

### Setting

All children received core Tier 1 early literacy instruction delivered by a general education lead preschool teacher. In both classrooms, a center for small-group/individual instruction was set up for the children to participate in *Story Friends* instruction. In Classroom B, children received the additional components in this context as well. The specific classroom location and the time for the intervention delivery differed in each classroom based on teacher preference.

### Measurement

We used the procedures reported by Spencer et al. (2013), Greenwood et al. (2016), and Kelley et al. (2015) to measure child performance with target words. These included word mastery probes before and following instruction in each storybook. Each probe assessed the two target vocabulary words taught in each of the nine storybooks and took approximately 2 min to administer. Probe items consisted of a definitional question for each word (e.g., “Tell me what

does ‘enormous’ mean?”). We used definitional word questions because they are a rigorous test of word learning in that children were asked to generate a decontextualized definition or synonym to indicate knowledge of the word.

Scoring of the mastery probes was based on guidelines in the *Story Friends* manual (Spencer et al., 2013). Scores were based on a widely used system in vocabulary intervention research (e.g., Beck & McKeown, 2007; Coyne, McCoach, Loftus, Zipoli, & Kapp, 2009) and previous *Story Friends* research. We scored children’s responses as follows: two points given for a complete and accurate response, one point for an incomplete but acceptable response that reflected partial knowledge of the word or synonym, and zero points for an incorrect response defined as unrelated, nonsensical, or inadequate. Thus, the highest score for each probe was four points: two correct words per book. Across the nine books, a total point score of 36 was possible if all 18 words were correct. This scoring procedure also was used because of its practical implications in helping teachers make distinctions between a child’s spoken vocabulary knowledge that was correct, almost correct, and incorrect—with instructional implications.

Besides target words, untaught control words also were assessed (Spencer et al., 2013) (see Table 2). These occurred during the last three books for children in Classroom A and during the last six books for children in Classroom B as a control for hearing words read in the study. Control words appeared in story but were not provided embedded instruction (see below). We scored the control words using the same definitional questions as previously described.

The vocabulary words selected from word lists identified in the literature as Tier 2 words (Beck, McKeown, & Kucan, 2002). Tier 2 words are novel and challenging for

**Table 2.** Target Vocabulary Words (Spencer et al., 2013).

Book	Title	Target words	Control words
1	Ellie's First Day (EFD)	enormous, different	
2	Leo's Brave Face (LBF)	brave, grin	
3	Jungle Friends Go to the Beach (JFB)	gorgeous, soaked	
4	Marquez Monkeys Around (MMA)	reckless, ruin	quickly
5	If Elephant Could Fly (ECF)	imagine, soar	gaze
6	Leo Loses His Roar (LHR)	ill, comfort	practice
7	Ellie Gets Stuck (EGS)	leap, pause	notice
8	A New Jungle Friend (NJF)	speedy, wise	carefully
9	Marquez's Backwards Day (MBD)	ridiculous, tumble	hard

preschoolers because they occur frequently in sophisticated spoken and written language (e.g., *speedy*, *protect*) in a number of contexts and thus have high relevance for instruction. Tier 1 words (e.g., table, barn, run) are words that are often occurring and likely familiar to most preschool children. Tier 3 words are those used rarely or are only specific to content areas, for example, the science word *evaporation*. As a result, the words were unlikely to be familiar to preschool children, particularly those with weak vocabulary skills. Additional criteria for word inclusion in the *Story Friends* series was that each could be defined with a simple, child friendly explanation, and also supported in the story content as key event or character (Spencer et al., 2013).

**Reliability.** We drew 30% of the pre- and postintervention mastery probes for reliability purposes using the random number generator in MS-Excel. We conducted the checks between observers so as to be representative of the participants and storybooks. Two staff members independently scored each probe. We calculated item-by-item interobserver agreement by dividing the total number of agreements (scoring the exact same number) by the total number of agreements plus disagreements and multiplying by 100. The percentage agreement on mastery monitoring scoring was 94% overall, ranging from 83% to 100% across individual checks. By experimental conditions, mean percentage agreement was high and stable at 96% (nine checks), 92% (five checks), and 92% (four checks) for Conditions A, B, and B + C, respectively.

### Experimental Design

The repeated acquisition design (RAD) used in prior *Story Friends* research (Spencer et al., 2013) was used. The RAD is a lesser used single-case design; however, it is appropriate for teaching nonreversible skills. RAD data may be graphed in multiple informative ways including (a) repeated unit (storybook by storybook) acquisition, (b) cumulative acquisition rates of improvement across all storybooks, and

(c) as multielements (before and after instruction time-series or elements) (Riley-Tillman & Burns, 2009). We used both the repeated unit (per storybook) and cumulative acquisition procedures.

The RAD provided an analysis of intraindividual experimental control of word mastery at the unit level or each of the nine storybooks. The cumulative acquisition rate of improvement provided intraindividual displays of improvement trajectories as well as the storybook series total word mastery (Riley-Tillman & Burns, 2009). We also included a lag in intervention onset across two children, assessed control words intermittently in the context of only listening to the words in a story (Conditions B and B+C) (Kennedy, 2005), and conducted interindividual peer comparisons (Kazdin, 1977; Wolf, 1978). Thus, it was possible to evaluate children's progress in comparisons to their own baseline performance and peers performance.

While the RAD provided instructional control of word learning through repeated replications, the staggered implementation provided an additional opportunity for replication across two different children and storybooks at two different points in time. In this case, the initial effect of adding the additional components intervention was provided to Ian beginning with Book 3 and replicated with Carter at Book 5 (see Figures 2 and 3).

### Procedures

The experimental conditions in the study design were (A) Baseline, (B) *Story Friends* Instruction, and (C) Additional Components Instruction. They were manipulated as A, B, and B + C in the RAD design.

**Baseline (A).** We assessed children's preknowledge of the targeted words in Condition (A) prior to any instruction. Preknowledge assessments occurred for each storybook.

**Story Friends Supplemental Instruction (B).** We assessed children following the embedded instruction in *Story*

*Friends* in each storybook after completing sessions (Spencer et al., 2013). The *Story Friends* series relates the adventures of a set of animal friends, organized by themes familiar to preschool children conveyed in common story grammar elements. One such theme was a visit to the dentist. *Story Friends* consists of nine storybooks, prerecorded audio files for each story's narration with embedded lessons, an mp3 player, headphones for a small group of children, and an adult facilitator. *Story Friends* teaches new vocabulary knowledge and comprehension through explicit embedded instruction delivered by a narrator and is listened to by the children with headphones. Children listen to each prerecorded story, follow along in their personal storybook, and respond when prompted by the narrator during the reading. Children received the posttest on the day that they had listened to the storybook for the third and final time.

Within each story, two embedded, explicit lessons occurred for each target word promoting active child engagement and appropriate answer models (Spencer et al., 2013). The first lesson included the following procedures (Spencer et al., 2013). When a word was first used in a story, the first lesson unfolded as follows:

1. The definition of the word was provided explicitly.
2. Children were asked to repeat the word.
3. The definition of the word was repeated again and the children were asked to produce the word in response to a prompt and question.
4. A model of the word was provided next with words of encouragement.
5. The child was prompted to answer a question to demonstrate knowledge of the word as it related to the child's experiences.
6. The child was provided with an activity related to the word to promote the child's active engagement.
7. The child was asked to say a definition of the word, and a model and encouragement also provided.

The second lesson occurred at the end of the story and included additional practice by providing an implicit definition for the word and asking the child to produce the word.

Each listening session lasted approximately 10 min, once per day, 3 days per week. *Story Friends* sessions continued for 9 to 10 weeks through to completion of the entire series. Children missing a listening session were given makeup sessions to ensure dosage. The lead researcher serving as a volunteer in the preschool classroom facilitated *Story Friends* sessions. The role of the facilitator was to set up the session and materials for the children and supervise the children's story listening. Specifically, the facilitator was expected to help children stay on the right page, provide a model of

correct response if needed, and encourage engagement in the activity. The facilitator also listened to the audiotaped narration to help supervise children's responding.

**Additional Components (C).** Based on suggestions from earlier research (Greenwood et al., 2016; Kelley et al., 2015), we assembled and tested a new package of complementary intervention components (Condition C) for use in a one-on-one session. The additional components included (a) reviewing the words taught in the storybook; (b) providing individual children with additional opportunities to listen to *Story Friends* target words used in different contexts; (c) explicit teaching of novel words without interrupting story flow; and (d) use of puppets to enhance engagement, photograph prompts for children to respond to questions, and response-contingent correction/confirmations.

These additional individual sessions (Condition C) followed the Condition B (*Story Friends*) sessions for two targeted children in Classroom B who were not making progress (Ian and Carter). These additional sessions were repeated 2 days per week per child until the last storybook was completed, between 5 and 10 weeks depending on when Condition C began for each child. Immediately following a *Story Friends* session, a target child (Ian) was asked to remain in the listening center to receive the Condition C intervention for an additional 5 to 7 min per day.

In the first session with Ian, the facilitator (lead researcher) introduced a puppet to the child as a friend who would like to join their activity. The puppet provided a game-like format that included the use of pictures of the *Story Friends* target words as context for new question asking and differentially reinforcing the child's correct responding. For example, the puppet was voiced by the facilitator who used a target word to describe a picture (e.g., "The racing car is 'speedy.'"). The child was then asked whether they knew the meaning of the target word by choosing the picture that described the word. Additional prompts were provided if needed using the least to the most prompts principle (West & Billingsley, 2005).

If the child did not respond to a question correctly, the facilitator praised the child's attempt at an answer and asked the child a binary question (e.g., "Nice try!, Does a turtle move slow or fast?"). If the child did not respond to the binary question correctly, the facilitator modeled the correct answer (e.g., "A turtle moves slowly.") and provided the meaning of the word (e.g., "Speedy means fast."). In this format, additional examples of the target words were provided beyond those used in the story. Children heard additional definitions of target words (e.g., "leap means to jump.") and engaged in new opportunities to repeat and practice words (e.g., "We can say the word, leap. 'Let's say the word together, leap (child

and puppet). Now it's your turn. What word means 'to jump?' Leap (child and puppet). Great thinking!'). Finally, the child was asked to make discriminations between various pictures depicting different vocabulary words (e.g., "Look at these pictures. Point to the animal that leaps."). This procedure was repeated for the second target child (Carter).

**Intervention Fidelity.** Intervention fidelity was evaluated for Conditions B and C using checklist assessments that tapped the essential components. We did not assess the fidelity of Condition A, children's word preknowledge. Intervention sessions were videotaped and scored by an observer. The observer was an experienced interventionist who watched the videos and completed the fidelity of implementation checklists. Approximately 30% of the Condition B and C interventions sessions were evaluated for fidelity using separate checklists. Condition A was not assessed because no intervention was provided.

The Condition B *Story Friend* checklist included six core items, three examples of which are (a) each child and a facilitator had headphones on, (b) the correct storybook narration was playing, and (c) the facilitator provided positive reinforcement for responding, but no additional instruction. The Condition C checklist contained four items indicating that the facilitator (a) used a puppet and the picture cards, (b) manipulated the puppet to provide a game for the child, (c) provided response contingent feedback, and (d) prompted if the child made an error. Fidelity reflected the percentage of items correctly implemented that was calculated by dividing the total number of correctly implemented items by the total number of items and multiplying that number by 100. Fidelity was 100% for both Conditions B and B + C.

**Data Analysis.** We analyzed individual children's pre- and post-intervention mastery probes graphically, using two of the three procedures described by Riley-Tillman and Burns (2009). Individual children's pre- and posttest point scores were graphed for each individual unit (storybook) (see Figures 1 and 2). We also graphed the cumulative rate of improvement in the number of points an individual child earned over the storybooks in the series and total words acquired through Book 9, possible 36 points or 18 words (see Figure 3).

## Results

### *What Was the Range in Children's Divergent Response to Story Friends in Classroom A?*

The range in children's divergent response to *Story Friends* is displayed in Figure 1. Kate and Diane were least responsive to the intervention (upper panel) while Aden and Oliver reflected the desired response (lower

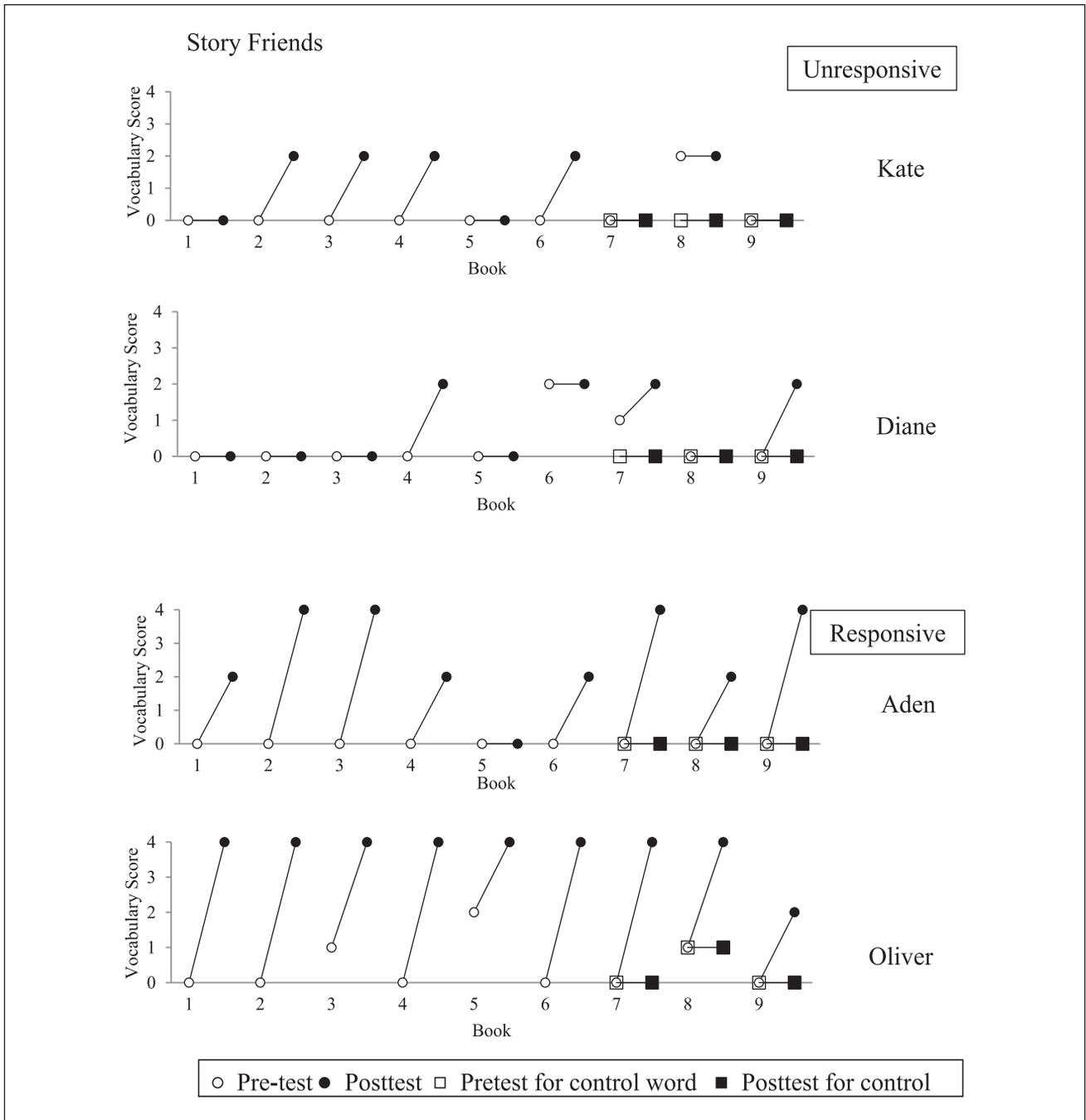
panel). Inadequate progress was defined by two or fewer points per book out of four possible on pre- and postmastery probes for two consecutive books in the *Story Friends* series (Spencer et al., 2013). With respect to baseline word knowledge (Condition A), three of the four children received at most only an occasional point or two at pretest. Overall, children did not know the words and thus were appropriate for instruction.

With respect to acquisition of the new words in *Story Friends* (posttest minus pretest), Aden and Oliver were responsive to the embedded intervention, while Kate and Diane were not. Because Aden and Oliver realized successive, replicating gains in word points in each storybook, an experimental analysis was achieved for them in the RAD. Aden's gains were typically two to four points per book, Oliver's gains were typically four points earned per book. Similar gains were not evident for the control words that measurement confirmed were unknown based on only hearing them used in the story.

It was also the case the Kate and Diane did not know the words at pretest, and neither made progress similar to that of Aden and Oliver. Kate and Diane never earned the maximum four possible points per book, receiving only two points per book at best. Of the nine storybooks, they only demonstrated improvement with *Story Friends* instruction in three (Diane) or four (Kate) storybooks. A functional relation between *Story Friends* instruction and vocabulary acquisition was not demonstrated.

### *For Children Not Responsive to Story Friends Only, Were Additional Components Effective?*

Ian, Carter, and Francisco in Classroom B were least responsive to *Story Friends* while Mina was responsive (see Figure 2). After demonstrating weak performance in two storybooks, Ian's word acquisition was vastly improved with the additional components (Condition B + C), gaining all four points throughout future storybooks (see Figure 2). Carter earned four points in the first storybook, but thereafter his acquisition was minimal in Books 2 through Book 4. Carter's acquisition vastly improved and stabilized in Books 6 through 9 following onset of the additional components (Condition B + C). In the meantime, Mina's acquisition continued on acquiring all possible word points in seven of the nine books with only *Story Friends* instruction. As in Classroom A, children demonstrated knowledge of few if any words at pretest in the absence of embedded instruction. The children did not learn control words they did not already know after only hearing them in the stories. With regard to experimental control, *Story Friends* was consistently related to improved vocabulary acquisition for Mina in the RAD.



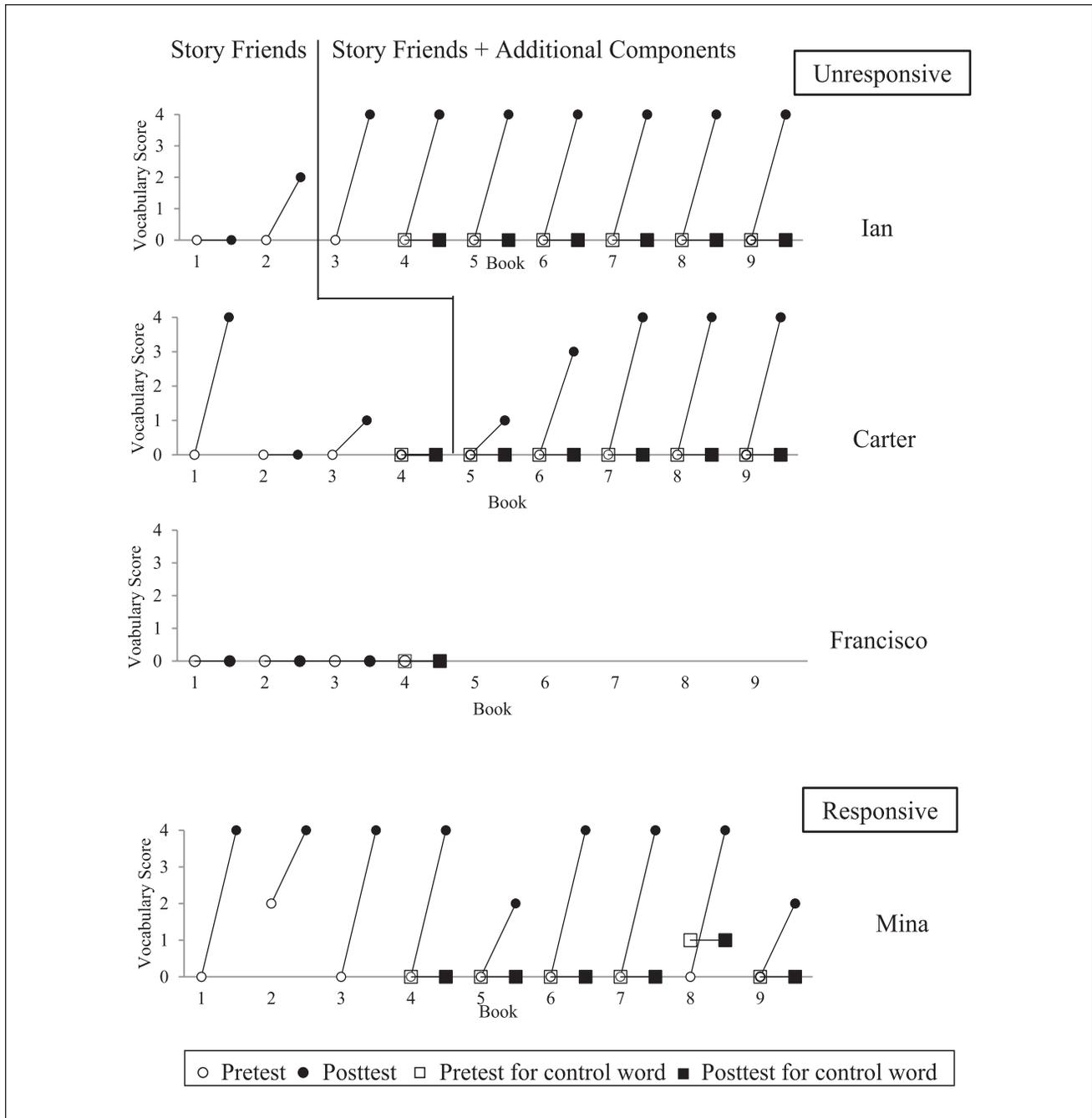
**Figure 1.** Weekly vocabulary point acquisition of children in Classroom A.

With Ian and Carter, this same consistency in acquisition occurred only with the onset of the additional components (Condition B + C) (Figure 2).

**Did Rate of Improvement Reach Educationally Relevant Levels?**

All children’s rate of improvement is shown in Figure 3. Both children receiving Condition B + C increased their

rate of improvement over storybooks and total words learned. Ian’s rate of improvement was 0.8 word points per book prior to the additional components that increased to 4.0 word points per book thereafter to the end of the series. Carter’s improvement rate prior to components was 1.6 increasing to 3.7 word points per book after. Ian and Carter’s rates of improvement with exposure to B + C became similar to those of Aden (2.6), Mina (3.4), and Oliver (3.5) as a function of only *Story*

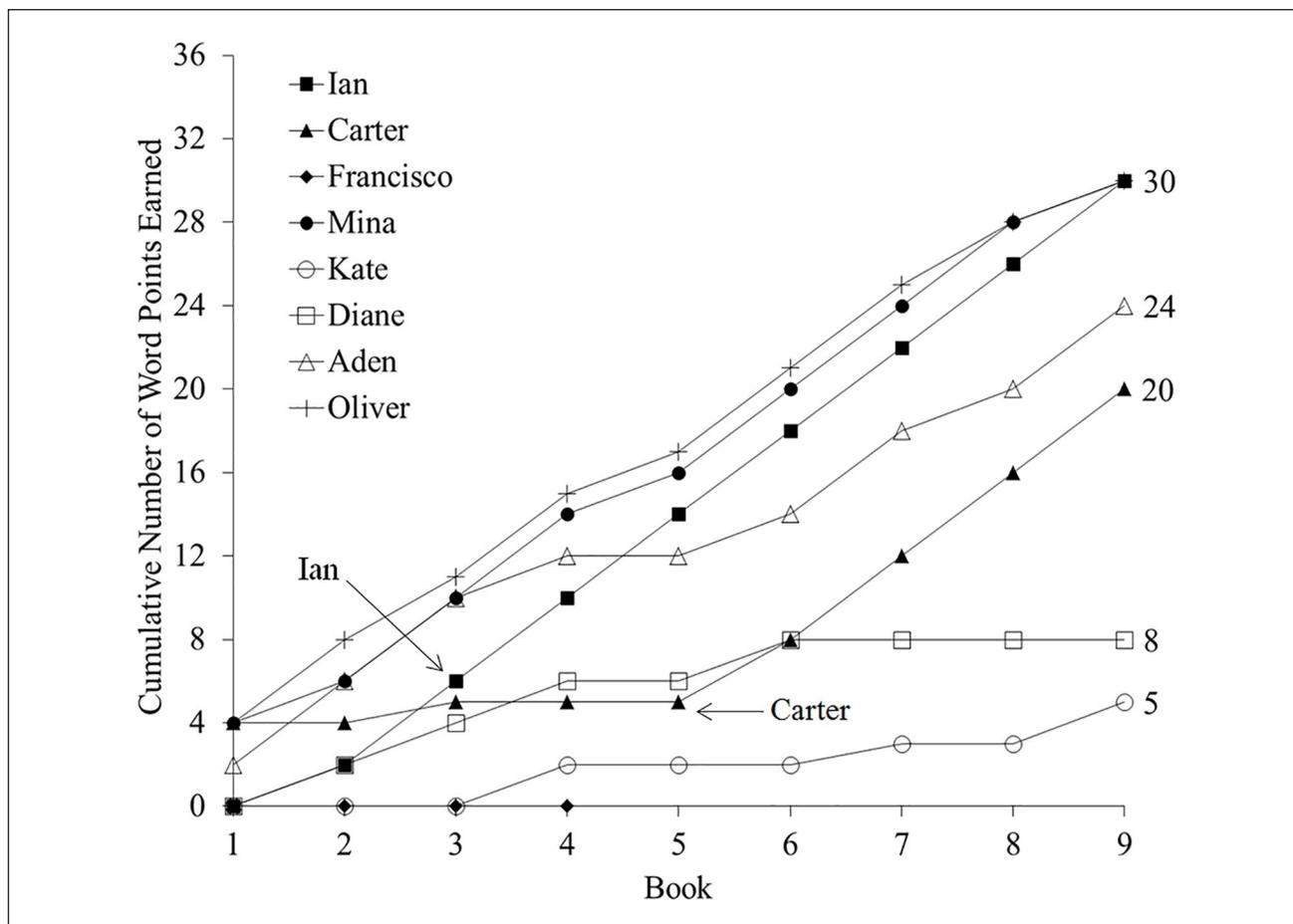


**Figure 2.** Weekly vocabulary point acquisition of children in Classroom B.

*Friends*. Their improvement rates also were better than peers, Kate (0.4) and Diane (1.1), who were not responsive to *Story Friends* and received no additional supports (see Figure 3).

While it was possible to obtain a perfect score of 36 points (all 18 words) after Book 9, the best score was 30 obtained by Mina and Oliver, 24 by Aden—all who were

responsive to *Story Friends* in both classrooms. Ian and Carter who were initially unresponsive but improved due to the additional components achieved total scores of 30 and 20, respectively. Children who were not responsive to the Tier 1 intervention (Diane, Kate, Francisco) achieved total scores of only 8 and 5, respectively. Francisco learned no words.



**Figure 3.** Cumulative number of word points earned over the storybook series.

Note. Kate, Diane, Aden, and Oliver are children in Classroom A; Ian, Carter, Francisco, and Mina are children in Class B. Aden, Oliver, and Mina are responsive; Kate, Diane, Ian, Carter, Francisco are not responsive to *Story Friends*. Ian and Carter markers indicate onset of B + C and inflection in their rate of improvement. Maximum possible after Book 9 = 36 points.

## Discussion

In this study, we examined issues in preschool response to intervention in an effort to identify effective supports for all children with weak vocabulary knowledge. This involved identify children receiving core instruction with weak vocabulary skills in two classrooms. Children with weak skills were provided *Story Friends*, an evidence-based supplemental intervention and their progress monitored. The majority of these children improved their word learning, but across children experiencing *Story Friends* in both classrooms, word learning ranged from all words taught to none at all (RQ1). In nearly all cases, children did not know the words prior to experiencing *Story Friends*, and they did not learn any of the control words (with only minor exceptions) by just hearing the words read to them in the story and in the absence of embedded storybook instruction.

Children who did not respond to *Story Friends* in one classroom were provided additional instructional components and their progress monitored. The additional components

following *Story Friends* sessions (B + C) dramatically improved the vocabulary acquisition of two children (RQ2) in Classroom B. The Condition C added more components (i.e., one-to-one format, review, prompting and scaffolding, puppet game, additional opportunities to respond, and response-contingent feedback). Ian and Carter's learning of new words was improved immediately and it maintained over each subsequent storybook. Their improved performance also was comparable to peers in both classrooms who were initially responsive to *Story Friends*, and much higher than peers who were not responsive. Not only did performance improve after each storybook, their growth in cumulative word acquisition also was improved (RQ3).

Children in the study had an opportunity to learn 18 words in nine storybooks over 9 to 10 weeks. Findings from other vocabulary intervention studies using a similar measure of requesting a child to define challenging words taught have reported that children learned only 12.5% (out of 8 words) or 56% (out of 18 words) (Kelley et al., 2015; Loftus

et al., 2010). In the current study, Carter and Ian learned 66% and 83%, given the addition of new components. Also, given that the novel “Tier 2” words taught in *Story Friends* have known usefulness in children’s future language learning, the findings were arguably important.

### Strengths of the Study

This work contributed to a growing set of evidence-based oral language curricula for use in MTSS with improved instructional designs and efficiencies. *Story Friends* design features included relevant content selection, storybooks with embedded, explicit instruction for each new word, and technology-assist for use in small groups that was facilitated by the researcher and not the classroom teacher. While individualized instruction was provided only to two selected children in Condition C, these additional evidence-based procedures focused on teaching the same *Story Friends* content. They included one-on-one review, more opportunities to respond, specific prompts (the puppet game), and immediate correction and feedback (Embry & Biglan, 2008). This approach was one that both researchers and practitioners can build on in the future.

While progress developing the MTSS approach and standard evidence-based interventions in early childhood is evident, the question of what to do about children not responding to intervention remains a major issue. This work was an important example of how MTSS problem solving was used to tailor additional components to work with, not replace, an adopted supplemental curriculum. Group and individual data were used to identify the children with divergent responses to the standard, small-group *Story Friends* intervention. The data helped inform the problem some children were having in learning in that context, while others were thriving in the same experiences. Rather than starting over completely, the approach led to an understanding of the problem and development of additional instructional components that were complementary. These components were implemented and tested for function using comparisons to individual baselines and peers’ performance. Responsive and unresponsive learners’ data were helpful evaluating the educational importance of gains children made with the additional components. This work also demonstrated an approach to intervention improvement that built on prior research findings. Greenwood and colleagues (2016) suggested that some few children’s response to *Story Friends* might be improved by providing additional components to help children establish key learning behaviors in the automated *Story Friends* intervention.

The current vocabulary learning findings replicated those of the original *Story Friends* developers (e.g., Kelley et al., 2015; Spencer et al., 2013) as well as others who have evaluated the effects of using explicit teaching

and multiple exposures to novel words in supplemental interventions (Coyne et al., 2007; Pullen et al., 2010). These studies reported that kindergarten and first-grade children learned more words when they received a supplemental intervention focusing on the two features compared with conditions when these practices were not in place. While the current study extended these results to younger prekindergarten children, additional research is needed.

The single-case design used was particularly appropriate to the instructional goal of improving vocabulary acquisition and demonstrating instructional control where the content structure involved teaching multiple content units (storybooks) over time. While most frequently used in evaluations of the effects of one-on-one, massed learning trials on word mastery, the RAD design now has proven track record of evaluating small-group embedded instruction in interactive storybooks (e.g., Greenwood et al., 2016; Kelley et al., 2015; Spencer et al., 2013).

The RAD provided up to nine opportunities to demonstrate duplicative effects (replications) of new word learning in comparisons before and following children’s exposure to embedded instruction. An additional RAD feature used was graphing the acquisition data cumulatively to reveal the rate of improvement over all storybooks in the series, including the total number of words taught and learned by the end of the series.

Graphing these data as multiple elements was another possibility that was not used (Riley-Tillman & Burns, 2009). In this approach, individual data are graphed as separate time-series (elements) for each condition. Thus, one element would be the trend in pretest baseline performance over Storybooks 1 to 9 (Condition A), the other two elements would be trends in Conditions B and B + C performance also across storybooks. Connecting the adjacent data points within each element for each individual child would visualize three important effects. The baseline level and trend would reveal very low, near zero word points earned per storybook. The next level and trend comparisons would show differential effects in word points earned by different children given the embedded *Story Friends* instruction (Condition B) and Condition B + C. This technique could be used in future research. Another advantage of the RAD design in MTSS problem solving was avoidance of long baselines wherein some children are required to wait for intervention when clearly likely to benefit immediately from an instructional change.

Two additional helpful design features included control words within children and across storybooks, and a lagged treatment onset across two children, Ian and Carter. The use of control words helped rule out alternative hypotheses of learning from just hearing the words used in a story, in contrast to words that received explicit instruction in *Story Friends* (B) and in the additional components (B + C). The

lagged treatment onset demonstrated a replication of adding Condition C with another student starting that started with a later storybook.

### *Limitations and Future Research*

This study did not afford an opportunity to examine a range of related effects. One issue was whether Ian and Carter would have continued their demonstrated success given that the additional components intervention were discontinued and the children returned to *Story Friends* only. Future research needs to examine whether the children's progress in the B + C condition can be maintained in the *Story Friends* B condition alone. This would be an excellent MTSS demonstration of returning children to a less intensive intervention. A related set of studies could examine this question proactively by adding some of the additional components to the standard *Story Friends* intervention for the first few weeks as needed by a few children with weak vocabulary skills and removing them when children are responding well.

Another issue was children's ability to retain their knowledge of the vocabulary words learned past just their immediate experiences and generalize their new skills to other interactions and situations. Future research is needed to determine the extent to which children are able to maintain and generalize knowledge acquired outside of the *Story Friends* context. Additional experiences in other contexts, such as in-depth discussions of the target words, may help maintain children's full word knowledge over time as reported in studies by Coyne and colleagues (e.g., Coyne et al., 2007; Coyne et al., 2009; Maynard, Pullen, & Coyne, 2010). Another limitation of the study was that research staff implemented the intervention, and not preschool staff. We need future research that demonstrates that program staff can implement the additional components intervention efficiently and effectively.

The single-case design could have been strengthened. A potential threat to internal validity was variance in target word difficulty affecting children's learning of vocabulary words (Kennedy, 2005). Beyond the criteria used to select the target vocabulary words taught in *Story Friends*, certain words might have been more familiar, interesting, or meaningful to some children than others, and word type (e.g., nouns, verbs, adjectives, etc.) could be another factor that influences word learning (Goldstein et al., 2016). However, pretesting of the words taught in each storybook appeared to rule this confound out. Nearly all the words proved to be unknown to the children. A related issue was the sequence in which target words were taught, also a possible confound because all children experienced the same sequence of target words and storybook instruction. Researchers could investigate sequence effects in future research by varying the sequence of storybooks at random for different children. This research would help rule out confounds related to

variations in word difficulty affecting children's vocabulary learning. One more issue was the lack of fidelity data collected during Condition A, the preinstruction word knowledge baseline for each child. It was not possible to document the historic instructional conditions and experiences, if any, that preceded this assessment of children's word knowledge. Procedures for doing so in word or academic skill acquisition research await future inquiry.

Attrition also was a limitation. We dropped Francisco from the study due to his refusal to attend sessions. His case illustrates another tenet of MTSS—All children will need interventions that address their unique needs, and additional behavioral procedures were needed to increase his motivation to participate. Unfortunately, these changes were beyond the scope of this work. Including three or more participants in this combined RAD/multiple-baseline design in future research would strengthen experimental control.

### *Implications for Practice*

This study illustrated a feasible MTSS approach to provide additional instructional intensity for a small group of struggling children using evidence from all children's progress to address the need. This approach is important because practitioners are increasingly required to use individual results in intervention decision making (Akers et al., 2014; Frameworks for Response to Intervention in Early Childhood: Description and Implications, 2014). When teachers acquire evidence that current instruction does not facilitate a child's vocabulary learning, they need to provide supplemental or individualized support to meet each child's needs. This study demonstrated one way that a preschool teacher might offer supplemental support to children with weak vocabulary skills and then decide to provide individualized support to those few children still struggling to learn the words taught. Provision of the individualized components in this work appeared sufficiently feasible to deliver with the additional potential of being phased-out over time, a transition from Tier 3 to Tier 2. This potential remains to be demonstrated.

### *Conclusion*

This study may be one of the first reports of an effort to improve preschool children's response to early literacy intervention in MTSS by adding more intensity to children's experiences based on response to intervention. While evidence-based MTSS interventions will be effective with most, but not all, children, we documented a successful approach to serving a few children who were not making measurable progress. This problem-solving approach could be helpful to current *Story Friends* users. In addition, these lessons learned contribute to future consideration of *Story Friends* supplemental interventions and how some children may need greater experiences to

be successful in a small-group, technology-assisted format. Preschool teachers using MTSS may consider using this approach in their early literacy instruction.

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### References

- Akers, L., Grosso, P. D., Atkins-Burnett, S., Boller, K., Carta, J. J., & Wasik, B. A. (2014). *Tailored teaching: Teachers' use of ongoing child assessment to individualize instruction: Volume I: Conceptual framework and measurement plan*. Retrieved from [http://www.acf.hhs.gov/sites/default/files/opre/40158\\_cpm\\_final\\_report\\_vol\\_i.pdf](http://www.acf.hhs.gov/sites/default/files/opre/40158_cpm_final_report_vol_i.pdf)
- Beck, I. L., & McKeown, M. G. (2007). Increasing young low-income children's oral vocabulary repertoires through rich and focused instruction. *The Elementary School Journal, 107*, 251–271. doi:10.1086/511706
- Beck, I. L., McKeown, M. G., & Kucan, L. (2002). *Bringing words to life: Robust vocabulary instruction*. New York, NY: Guilford Press.
- Biemiller, A. (2012). Vocabulary instruction: Research to practice. In E. J. Kame'enui & J. F. Baumann (Eds.), *Teaching vocabulary in the primary grades: Vocabulary instruction needed* (pp. 34–50). New York, NY: Guilford Press.
- Biemiller, A., & Slonim, N. (2001). Estimating root word vocabulary growth in normative and advantaged populations: Evidence for a common sequence of vocabulary acquisition. *Journal of Educational Psychology, 93*, 498–520. doi:10.1037/0022-0663.93.3.498
- Bradfield, T., Besner, A., Wackerle-Hollman, A., Albano, A., Rodriguez, M., & McConnell, S. (2014). Redefining individual growth and development indicators: Oral language. *Assessment for Effective Intervention, 39*, 233–244.
- Braham, E. G., & Lynch-Brown, C. (2002). Effects of teachers' reading-aloud styles on vocabulary acquisition and comprehension of students in the early elementary grades. *Journal of Educational Psychology, 94*, 465–473. doi:10.1037/0022-0663.94.3.465
- Brownell, R. (2001). *The Expressive One-Word Picture Vocabulary Test—Spanish-Bilingual Edition*. Novato, CA: Academic Therapy.
- Carta, J., & Miller Young, R. (2019). *Multi-tiered systems of support for young children: Driving change in early education*. Baltimore, MD: Paul H. Brookes.
- Catts, H. W., Hogan, T. P., & Adolf, S. M. (2005). Developmental changes in reading and reading disabilities. In H. W. Catts & A. G. Kamhi (Eds.), *The connections between language and reading disabilities* (pp. 25–40). Mahwah, NJ: Lawrence Erlbaum.
- Coyne, M. D., McCoach, D. B., & Kapp, S. (2007). Vocabulary intervention for kindergarten students: Comparing extended instruction to embedded instruction and incidental exposure. *Learning Disability Quarterly, 30*, 74–88. doi:10.2307/30035543
- Coyne, M. D., McCoach, D. B., Loftus, S., Zipoli, R., Jr., & Kapp, S. (2009). Direct vocabulary instruction in kindergarten: Teaching for breadth versus depth. *The Elementary School Journal, 110*, 1–18. doi:10.1086/598840
- Dunn, L., & Dunn, L. (2007). *Peabody Picture Vocabulary Test* (4th ed.). Bloomington, MN: Pearson Assessments.
- Embry, D. D., & Biglan, A. (2008). Evidence-based kernels: Fundamental units of behavioral influence. *Clinical Child and Family Psychology Review, 11*(3), 75–113.
- Farkas, G., & Beron, K. (2004). The detailed age trajectory of oral vocabulary knowledge: Differences by class and race. *Social Science Research, 33*, 464–497. doi:10.1016/j.ssresearch.2003.08.001
- Frameworks for Response to Intervention in Early Childhood: Description and Implications. (2014). *Communication Disorders Quarterly, 35*, 108–119. doi:10.1177/1525740113514111
- Fuchs, D. F., Mock, D., Morgan, P. L., & Young, C. L. (2003). Responsiveness-to-intervention: Definitions, evidence, and implications for the learning disabilities construct. *Learning Disabilities Research & Practice, 18*, 157–171. doi:10.1111/1540-5826.00072
- Goldstein, H., & Kelley, E. S. (2018). *Story friends*. Baltimore, MD: Paul H. Brookes.
- Goldstein, H., Kelley, E. S., Greenwood, C., McCune, L., Carta, J., Atwater, J., . . . Spencer, T. (2016). Embedded instruction improves vocabulary learning during automated storybook reading among high-risk preschoolers. *Journal of Speech, Language, and Hearing Research, 59*, 484–500. doi:10.1044/2015\_JSLHR-L-15-0227
- Goldstein, H., & Olszewski, A. (2015). Developing a phonological awareness curriculum: Reflections on an implementation science framework. *Journal of Speech, Language, and Hearing Research, 58*(6), S1837–S1850. doi:10.1044/2015\_JSLHR-L-14-0351
- Greenwood, C. R., Carta, J. J., Goldstein, H., Kaminski, R. A., McConnell, S. R., & Atwater, J. (2015). The center for response to intervention in early childhood: Developing evidence-based tools for a multi-tier approach to preschool language and early literacy instruction. *Journal of Early Intervention, 36*, 246–262. doi:10.1177/1053815115581209
- Greenwood, C. R., Carta, J. J., Schnitz, A. G., Irvin, D. W., Jia, F., & Atwater, J. (2018). Filling an information gap in preschool

- MTSS and RTI decision making. *Exceptional Children*, 85, 271-290.
- Greenwood, C. R., Carta, J. J., Spencer, E., Guerrero, G., Kong, N. Y., Atwater, J., & Goldstein, H. (2016). Systematic replication of the effects of a supplementary, technology-assisted, storybook intervention for preschool children with weak vocabulary and comprehension skills. *The Elementary School Journal*, 116, 574-599.
- Griffiths, A., VanDerHeyden, A. M., Parson, L. B., & Burns, M. K. (2006). Practical applications of response-to-intervention research. *Assessment for Effective Intervention*, 32, 50-57. doi:10.1177/15345084060320010701
- Hart, B., & Risley, T. (1995). *Meaningful differences in the everyday experiences of young American children*. Baltimore, MD: Brookes.
- Hoff, E. (2003). The specificity of environmental influence: Socioeconomic status affects early vocabulary development via maternal speech. *Child Development*, 74, 1368-1378. doi:10.1111/1467-8624.00612
- Juel, C. (2006). The impact of early school experiences on initial reading. In D. K. Dickinson & S. B. Neuman (Eds.), *Handbook of early literacy research* (pp. 410-426). New York, NY: Guilford Press.
- Justice, L. M., & McGinty, A. S. (2009). *Read it again Pre-K! A preschool curriculum supplement to promote language and literacy foundations*. Columbus, OH: The Children's Learning Research Collaborative.
- Kaminski, R. A., & Powell-Smith, K. A. (2016). Early literacy intervention for preschoolers who need Tier 3 support. *Topics in Early Childhood Special Education*, 36, 205-217. doi:10.1177/0271121416642454
- Kazdin, A. E. (1977). Assessing the clinical or applied importance of behavior change through social validation. *Behavior Modification*, 1, 427-452. doi:10.1177/014544557714001
- Kelley, E. S., Goldstein, H., Spencer, T. D., & Sherman, A. (2015). Effects of automated Tier 2 storybook intervention on vocabulary and comprehension learning in preschool children with limited oral language skills. *Early Childhood Research Quarterly*, 31, 47-61. doi:10.1016/j.ecresq.2014.12.004
- Kennedy, C. H. (2005). *Single-case designs for educational research*. Boston, MA: Pearson.
- Lofthus, S. M., Coyne, M. D., McCoach, B., Zipoli, R., & Pullen, P. C. (2010). Effects of a supplemental vocabulary intervention on the word knowledge of kindergarten students at risk for language and literacy difficulties. *Learning Disabilities Research & Practice*, 25, 124-136. doi:10.1111/j.1540-5826.2010.00310.x
- Marulis, L. M., & Neuman, S. B. (2010). The effects of vocabulary intervention on young children's word learning: A meta-analysis. *Review of Educational Research*, 80, 300-335.
- Maynard, K. L., Pullen, P. C., & Coyne, M. D. (2010). Teaching vocabulary to first-grade students through repeated shared storybook reading: A comparison of rich and basic instruction to incidental exposure. *Literacy Research and Instruction*, 49, 209-242. doi:10.1080/19388070902943245
- My IGDIs: Benchmarks for Early Literacy Screening. (2013). Retrieved from <http://www.myigdis.com/wp-content/uploads/2015/05/myIGDIs.EarlyLiteracy-Benchmarks.pdf>
- Pullen, P. C., Tuckwiller, E. D., Konold, T. R., Maynard, K. L., & Coyne, M. D. (2010). A tiered intervention model for early vocabulary instruction: The effects of tiered instruction for young students at risk for reading disability. *Learning Disabilities Research & Practice*, 25, 110-123. doi:10.1111/j.1540-5826.2010.00309.x
- Riley-Tillman, T. C., & Burns, M. K. (2009). *Evaluating educational interventions: Single-case design for measuring response to intervention*. New York, NY: Guilford Press.
- Salmon, M. D., & Sainato, D. M. (2005). Beyond Pinocchio: Puppets as teaching tools in inclusive early childhood classrooms. *Young Exceptional Children*, 8, 12-19. doi:10.1177/109625060500800303
- Spencer, E. J., Goldstein, H., Sherman, A., Noe, S., Tabbah, R., Ziolkowski, R., & Schneider, N. (2013). Effects of an automated vocabulary and comprehension intervention: An early efficacy study. *Journal of Early Intervention*, 34, 195-221. doi:10.1177/1053815112471990
- Stoiber, K. C., & Gettinger, M. (2016). Multi-tiered systems of support and evidence-based practices. In S. Jimerson, M. Burns, & A. VanDerHeyden (Eds.), *Handbook of response to intervention: The science and practice of multi-tiered systems of support* (pp. 121-142). New York, NY: Springer.
- Tilly, W. D. (2008). The evolution of school psychology to science-based practice: Problem solving and the three-tiered model. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology* (Vol. 1, pp. 17-36). Washington, DC: National Association of School Psychologists.
- Tuckwiller, E. D., Pullen, P. C., & Coyne, M. D. (2010). The use of the regression discontinuity design in tiered intervention research: A pilot study exploring vocabulary instruction for at-risk kindergarteners. *Learning Disabilities Research & Practice*, 25, 137-150. doi:10.1111/j.1540-5826.2010.00311.x
- Walker, D., Greenwood, C., Hart, B., & Carta, J. (1994). Prediction of school outcomes based on early language production and socioeconomic factors. *Child Development*, 65, 606-621.
- Walsh, B. A., & Blewitt, P. (2006). The effect of questioning style during storybook reading on novel vocabulary acquisition of preschoolers. *Early Childhood Education Journal*, 33, 273-278. doi:10.1007/s10643-005-0052-0
- West, E. A., & Billingsley, F. (2005). Improving the system of least prompts: A comparison of procedural variations. *Education and Training in Developmental Disabilities*, 40, 131-144.
- Wolf, M. M. (1978). Social validity: The case for subjective measurement or how Applied Behavior Analysis is finding its heart. *Journal of Applied Behavior Analysis*, 11, 203-214.
- Zucker, T. A., Solari, E. J., Landry, S. H., & Swank, P. R. (2013). Effects of a brief tiered language intervention for prekindergartners at risk. *Early Education and Development*, 24, 366-392.