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Validation of a Supplemental Reading Intervention for First-Grade Children

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Abstract

This experimental study was designed to validate a short-term supplemental reading intervention for at-risk first-grade children. Although substantial research on long-term supplemental reading interventions exists, less is known about short-term interventions. Thirty first-grade children were randomly assigned to intervention or control conditions. Students in the intervention received 16 hours of instruction. Analyses of pre- and posttest data and growth measures suggest that short-term supplemental reading intervention had a significant effect on children's reading skills; however, effects were not consistent across measures. Parent and teacher ratings moderated significant effects. Findings support the validity of a brief intervention for students at risk for reading failure that may inform Tier 2 interventions within a Response to Intervention framework.

Keywords

at risk; reading; response to intervention; parent rating; first grade

It has been nearly 10 years since the National Reading Panel (National Institute of Child Health and Human Development [NICHD], 2000) disseminated its review of reading research. This report provided researchers and educators with a blueprint of components for effective reading instruction. As a result, we know that effective primary reading programs include scientifically based instruction in phonemic awareness and phonics, fluency, vocabulary, and comprehension (NICHD, 2000). In fact, most published core reading programs used in general education classrooms focus on these skills, but they may differ in how these skills are taught and the amount of time spent on each area.

Still, although many children succeed in classrooms with effective reading instruction, there remains a subset of students who struggle. Legislation in recent years has focused on this at-risk population of learners. The No Child Left Behind Act (NCLB; 2002) served as a catalyst for school administrators to scrutinize the progress of poor readers and find instructional methods to accelerate their reading achievement. In addition, the reauthorization of the Individuals with Disabilities Education Improvement Act (IDEIA;

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2004) included Response to Intervention (RTI), a method that promotes examination of student progress as a factor in the identification of learning disabilities.

Although there is no single model of RTI, the overarching aim is to provide increasingly intensive instruction to children who do not demonstrate progress. Children who do not respond to well-designed and effectively delivered reading instruction beneficial to most students may be considered reading disabled (L. Fuchs & Fuchs, 1998). An important ingredient in RTI models is providing early, short-term interventions to differentiate children who need extra support ("responders") from children who may require more intensive intervention or possibly special education ("nonresponders"). Given the importance of short-term interventions for prevention and identification of reading problems, supplemental instruction must have validity. However, most of our knowledge on effective supplemental reading instruction is based on interventions implemented for longer periods, not the short-term interventions needed in an RTI model. The review of reading interventions by Wanzek and Vaughn (2007) included studies with a minimum of 100 hours of instruction. If the RTI model is to be viable as a vehicle for prevention and identification, evidence in support of less intense intervention is needed. The purpose of this study was to add to the literature on the design and measurement of short-term, supplemental interventions for first graders to inform the development of Tier 2 interventions within an RTI framework.

Short-Term Supplemental Reading Interventions for At-Risk Readers

To understand the current knowledge base on short-term supplemental reading interventions for at-risk readers, we reviewed studies of first-grade interventions that either (a) lasted less than or equal to 12 weeks or (b) provided less than or equal to 25 hours of instruction on average. The most relevant studies are described below, and a synthesis of the research base on short-term supplemental reading interventions follows.

The studies identified fall into two categories: (a) studies that compared supplemental intervention to regular classroom instruction using a no treatment control group and (b) studies that compared more than one type of supplemental intervention with children assigned to different intervention groups. A study by Allor and McCathren (2004) fits into this first category. These researchers conducted an experiment comparing a no treatment control group with an intervention group that consisted of two cohorts of first-grade children (n = 86 and 157, respectively) who were tutored individually by trained college students. Scores on screening measures of oral reading fluency and phonemic awareness were used in conjunction with teacher recommendations to select students for participation. The intervention included word study activities focused on phonemic awareness and the alphabetic principle and book reading activities in which students made predictions, read leveled texts, and answered simple comprehension questions. Children were tutored three to four times a week for 15 to 20 minutes per session. The intervention totaled approximately 10 to 14 hours across 44 sessions, and treatment fidelity was 86%. Compared to the control group, tutored children in both cohorts made significant gains on measures of pseudoword reading accuracy and pseudoword reading fluency. No differences were found for real word accuracy or fluency across two cohorts.

Similarly, in New Zealand, Ryder, Tunmer, and Greaney (2008) studied the effect of a phonemic awareness and decoding intervention compared to typical classroom instruction for 6- and 7-year-old struggling readers randomly assigned to condition. The 24 lowest scoring students were identified using a measure of word reading, and at-risk status was corroborated by classroom performance and teacher reports. Children in the intervention group (n = 12) received instruction in small groups for 20 to 30 minutes per day, 4 days a

week, over 12 weeks for an average of about 24 hours of instruction. Children in the control group received regular whole language classroom instruction. Treatment fidelity was not reported. Children in the intervention group outperformed children in the control group (n = 12) on measures of phonemic awareness, pseudoword decoding, and context-free word recognition. Differences on reading words in connected text and reading comprehension were not significant but yielded effect sizes of .70 and .98, respectively.

In addition, D. Fuchs, Compton, Fuchs, Bryant, and Davis (2008) implemented a randomized control trial in first-grade classrooms comparing an intervention with a no treatment control. Scores on *Word Identification Fluency* (WIF) and rapid letter naming as well as teacher recommendation were used to identify 40 low-performing readers. Twenty-four students were assigned to the intervention group whereas 16 students in the control group received regular classroom instruction. Research assistants tutored children in the intervention group in small groups or individually for 45-minute sessions, four times a week, over 9 weeks for a total of about 27 hours of instruction. The intervention focused on letter-sound recognition, decoding practice, sight-word recognition, and fluency activities. Treatment fidelity was reported as more than 96%. In addition to pre-, mid-, and posttest measures, Fuchs et al. collected progress monitoring data with WIF. Compared to the control group, children in the intervention group had greater growth on WIF and obtained higher scores on word identification, word attack, phonemic decoding fluency, and sight-word efficiency.

Among studies that have focused on the content of intervention by examining the effectiveness of more than one type of supplemental intervention is a study conducted by Berninger et al. (2000) that involved 128 first-grade students randomly assigned to eight treatment groups including a control group. The main purpose of the study was to determine the effectiveness of either isolated or combined methods of explicit whole word, letter-phoneme, and onset-rime instruction. Berninger et al. used teacher referral, scores on standardized word identification, word attack, and vocabulary assessments to identify children for the study. Instruction was delivered to groups of two students by a trained graduate student for twenty-four 20-minute lessons (for a total of about 8 hours) and treatment fidelity was high. To evaluate the relative effectiveness of the intervention groups, children were assessed on reading words used in the intervention and words that were not part of the intervention. There were no differences between the seven treatment groups on words from the intervention, but these groups scored significantly higher than the control group. Students in the whole word, letter-phoneme, and combined whole-word-letter phoneme group scored significantly higher than the other groups on reading words that were not part of the intervention.

Another study comparing interventions is one by McMaster, Fuchs, Fuchs, and Compton (2005). These researchers identified 56 low performing first-grade students using a measure of rapid letter naming and monitored the progress of these students using curriculum-based measures (CBM) of nonsense word fluency and word reading. Slope and level of performance on these measures identified a group of students who were nonresponsive to 7 weeks of classroom instruction that included the research-based Peer Assisted Learning Strategies (PALS) program. Nonresponsive students were assigned to receive continued regular classroom instruction including PALS (n = 21), regular classroom instruction including a modified version of PALS (n = 15), or individualized, criterion-based tutoring (n = 20). The PALS lessons focused on decoding, sight words, and fluency skills, whereas the modified PALS introduced fewer sounds and words in each session and included a greater emphasis on phonological awareness and decoding. The one-to-one tutoring intervention included letter-sound recognition, decoding, sight words, and reading short stories. All three interventions occurred three times per week for 35-minute sessions for a total of 23 hours.

Median fidelity of implementation was 86%. Although McMaster et al. reported no significant differences among the three experimental groups, effect sizes on blending, word identification, word attack, and spelling favored students in the tutoring group.

A final study relevant to short-term supplemental intervention compared a 10-week (16.5 hours total) and a 20-week (33 hours total) intervention that consisted of the same instructional content. Hatcher et al. (2006) screened first-grade students using a group-administered spelling measure and individually administered letter identification, early word reading, and phoneme manipulation assessments. The content of both interventions included small-group instruction in phonological awareness and writing skills and individual instruction in oral reading. Although the authors reported that 4 days were devoted to teacher training and provided ongoing help during the intervention, no fidelity of treatment information was provided. The results showed that 10-week intervention was effective in the areas of phonemic awareness and word reading, but there were no significant differences between the 10-week and 20-week interventions.

The reviewed studies suggest that research has converged on certain aspects of short-term supplemental intervention for first-grade students. Most studies above included instructional focus on phonological awareness, the alphabetic principle, decoding, and fluency, and these studies suggest that supplemental instruction focusing on these skills benefits struggling readers, compared to typical and even enhanced classroom instruction (Allor & McCathren, 2004; Berninger et al., 2000; D. Fuchs et al., 2008; Hatcher et al., 2006; McMaster et al., 2005; Ryder et al., 2008). Although some studies included individual tutoring (Allor & McCathren, 2004; McMaster et al., 2005), most studies provided intervention to small groups of students (Berninger et al., 2000; D. Fuchs et al., 2008; Hatcher et al., 2006; Ryder et al., 2008), which is more practical in school settings with limited human resources. Furthermore, Hatcher et al. (2006) found that short-term supplemental instruction may be as effective as long-term supplemental intervention.

However, only two of the studies reviewed (D. Fuchs et al., 2008; McMaster et al., 2005) investigated the effect of supplemental intervention not only on pre- and posttest gains but also on growth. Determining if supplemental intervention can have an effect on slope or the rate of growth over time is important because the Response to Intervention paradigm defines responsiveness not just according to whether or not students meet certain benchmark scores but also according to whether or not they maintain an adequate rate of growth.

In addition, few studies examined moderators of responsiveness to intervention. In a follow-up to the Berninger et al. (2000) study, Stage, Abbott, Jenkins, and Berninger (2003) studied predictors of growth in a sample of first-grade children who received short-term reading interventions in the Berninger et al. study. They reported that verbal intelligence, phonological skills, orthographic skills, rapid naming, and attention ratings made significant unique contributions to word identification skills. The same measures, except orthographic skills, made unique contributions to word attack skills. Al Otaiba and Fuchs (2006) found that letter naming speed, vocabulary, problem behavior, and sentence imitation distinguished three groups of children who varied on their responsiveness to general education reading instruction in kindergarten and first grade. These studies focused primarily on child characteristics, but they also found that variables derived from teachers' perspectives (attention, problem behaviors) were significant correlates. In their review, Al Otaiba and Fuchs (2002) found that home variables (i.e., parent occupation, parent education, and child English proficiency) were important. As these studies show, there may be more to understanding responsiveness than exposure to an intervention. In this investigation, we were interested in examining further if teacher and parent perspectives were related to children's responsiveness to instruction.

Purpose of This Study

The purpose of this study was to augment the small research base on short-term supplemental reading intervention that could be used within an RTI framework. Therefore, we designed a small group reading intervention for at-risk children in first grade based on findings from reading research studies on effective supplemental reading intervention and conducted a randomized control trial to evaluate its effects. The intervention consisted of 24 lessons implemented across 11 weeks during the fall semester with instruction occurring 3 days per week for 40 minutes per session (16 hours). We assessed children on norm-referenced and researcher-developed measures of reading skills, and progress monitoring measures to assess growth. We also collected information from parents and teachers to test factors that might moderate responsiveness to supplemental intervention. We used these data to address two questions. First, can a short-term supplemental reading program implemented across 11 weeks have a significant effect on at-risk first-grade children's growth in reading and related skills (e.g., phonological processing, word decoding, and word recognition)? Second, do student factors moderate students' progress? To complement the statistical analyses, we also examined the extent to which individual children responded to instruction.

Method

Participants

First-grade children in three non-Title I public schools located in a large, suburban, mid-Atlantic school district participated in the study. The Free and Reduced-Price Meals eligibility of the schools ranged from 22% to 37%. Participants in the study came from nine classrooms taught by certified teachers with varying levels of education and teaching experience (M = 13.8 years, SD = 11.9). One teacher was a 1st-year teacher, four had between 5 and 15 years of teaching experience, and four had more than 20 years of teaching experience. Six of the nine teachers had master's degrees in education. One class had 27 students; the other classes had between 18 and 24 students.

The classroom teachers devoted a minimum of 2 hours per day to reading and language arts instruction. It consisted of whole-group phonics instruction (20–30 minutes), small-group guided reading (20 minutes), and center activities with focus on written language, word study, and spelling. Teachers selected books from the Houghton Mifflin Reader Collection as well as from other publishers' leveled books. University interns and reading assistants participated in the reading program on various days. The students in both conditions participated daily in this general classroom reading program.

To identify participating students, teachers were asked to nominate students who were reading in the bottom half of the class and/or who had received a score of 1, 2, or 3 on the kindergarten end-of-year Developmental Reading Assessment. A score of 4 or lower was considered to be below grade-level status. Students who were receiving intensive pullout services for reading (either for special education or as second language learners) and students who received Reading Recovery were excluded. These exclusions were necessary to control for extraneous effects on students' reading skills once intervention took place.

Initially, teachers identified 80 students. Seventeen of these students were involved in Reading Recovery, leaving 63 potential participants. At the beginning of the school year, we screened all children for whom we received permission (n = 60) using *Word Identification Fluency* (D. Compton, personal communication, 2003) and identified the lowest 30 participants. These students correctly identified four words or fewer in 1 minute. Compton, Fuchs, and Fuchs (2009) suggested a cutoff of fewer than 10 words per minute on a similar measure to designate risk status for first-grade children. We then paired participants within

each school based on WIF scores and randomly assigned children within pairs to the intervention or control group. The groups did not differ on the screening variable, $t(1, 28) = .74$, $p > .47$. Table 1 provides a summary of demographic information of the students in the intervention group, control group, total sample, and the screening sample. The intervention and control groups did not differ on sex, race, mother's education, or father's education as indicated by chi-square tests (all p values > .07; Fisher's exact test used for the latter three variables). Although the children who already received additional reading services did not participate, the sample we identified is similar to other studies of at-risk first-grade children. In addition to low WIF scores, the children in our sample had scores on the *Woodcock Reading Mastery Test* (Word Identification or Word Attack) that were similar to children in other studies (McMaster et al., 2005; J. Wanzek & S. Vaughn, personal communication, August 4, 2008).

Intervention

Intervention Teachers—The intervention was taught by three tutors, who were graduate research assistants (GRAs) with a range of 2 to 7 years of classroom teaching experience. The tutors participated in 25 hours of training on the assessment and instructional procedures in the month preceding the first lesson. In addition, they were observed and given feedback a minimum of three times during the study by one of the coinvestigators.

Instructional Components—Our goal was to develop a supplemental reading intervention that integrated the skills needed by struggling readers. We adapted published reading programs and researched-based instructional methods to target phonemic awareness, word attack skills, spelling, sight-word recognition, vocabulary, oral reading fluency, and comprehension. We developed 24 scripted lessons that tutors were instructed to follow closely and modify only slightly to accommodate learners' needs. Instruction was delivered to small groups of three or four children.

Each of the lessons contained three main parts. First, in a 15-minute lesson segment focused on phonemic awareness and phonics skills, letter-sound relationships were introduced and reinforced. Next, in a 10-minute lesson plan segment, sight words, decodable words, vocabulary, and prereading comprehension strategies were explicitly taught. In the final 15 minutes, students participated in reading fluency and comprehension activities with timed reading, repeated choral reading, and comprehension discussion. Every fourth lesson, this format changed. Instead of participating in choral and timed reading, students listened to an individual student read a decodable or leveled trade book and then the group read the text chorally. This gave tutors an opportunity to observe individual students' word recognition and word attack skills. Each of these lesson parts is described below.

Phonemic awareness and phonics skills—We generally followed the sequence of phonetic skills published in *Fundations* (Wilson Language Training, 2002). However, we modified the activities and the instructional delivery as well as the pacing of the program. *Fundations* is a yearlong curriculum for kindergarten and first grade. For our short-term intervention, we used techniques from *Fundations* to introduce the letter names and sounds and keywords. We also used skywriting and letter formation guidelines from *Fundations* during the first part of each lesson. To teach blending sounds, *Fundations* uses a finger-tapping technique. We used a similar procedure that we adopted from Peer Assisted Learning Strategies developed by Fuchs and colleagues (D. Fuchs et al., n.d.). Students were taught to raise a finger each time they heard or produced a sound when blending a word. This strategy also was integrated into other parts of the lesson when students were spelling or sounding out words.

Students were actively engaged in phonics activities through *Fundations* activities such as "Echo Find Word," where students first repeat or "echo" a word stated by the tutor. Then, the students use magnetic letters and boards to create the correct letter sequence. During this process, the blending strategy explained above was modeled to assist students in segmenting sounds in a word. Other simple word sort activities as well as sentence reading and dictation were used in this portion of the lesson.

Sight-word recognition and vocabulary—In the next part of the lesson, students performed skywriting and repeated spelling practice to learn sight words that were to be read in the text that was introduced in the final portion of the lesson. Procedures for these activities resembled those used in *Fundations*, as well as Responsive Reading Instruction (Denton & Hocker, 2005). The objective was to maintain engagement and improve student memory for common sight words. Words from the reading that were irregular or difficult to decode were discussed briefly. Students also worked on recognition of decodable words that appeared in the selected passage or trade book. At the end of this lesson segment, students discussed a prediction for the reading based on the title and provided picture.

Reading fluency, monitoring, and comprehension—We used the guidelines from *Read Naturally* (Ihnot, 2002) for what we called a "first" timing. This was the number of correct words that students could read in 1 minute before they practiced the passage. Following the first timing, the tutor led the group in three choral readings of the passage. The tutor set the pace slowly for the first reading and stopped the students on at least two decodable words that they practiced decoding in text. The reading rate of subsequent readings was increased to help improve fluency and prosody. At the conclusion of three repetitions, the students did a "final" timing to determine how many words they read correctly in 1 minute. Time permitting, the students graphed their scores. The final portion of the lesson was devoted to developing comprehension. The tutor returned to the children's earlier prediction, and the group discussed what they learned.

Text materials—The first series from the *Learn to Read Program* (Pro-Ed) and *Dr. Maggie's Phonics Readers: A New View* (Creative Teaching Press) contained controlled vocabulary for beginning readers as well as the Dolch Basic Words. Selected books matched the phonics skills for that day's lesson or previous lessons (e.g., short vowel sounds, digraphs).

Group Management—An important component of the intervention was keeping students engaged and focused. Tutors were required to state the lesson's objectives at the beginning of the lesson and practice effective teaching principles throughout the lessons (e.g., explicit instruction, modeled and guided instruction, and immediate feedback). Activities were introduced with clear instructions and feedback was given when appropriate. A group point system helped to keep the students motivated. Following each activity or at various times of the lesson, students had the opportunity to earn points for the group. If a predetermined number of points was obtained at the lesson's conclusion, all of the students received stickers.

Treatment Fidelity—All of the lessons were audiotaped. For each tutor, 25% of the lessons were randomly selected across the intervention period and coded by a trained graduate student rater. In addition, one of the coauthors randomly selected and independently scored four of these lessons to assess whether rater drift occurred (range = 82–96% agreement). The graduate student rater was taught the basic principles of the lesson and how to determine that each activity within a lesson component had been implemented correctly. The rater awarded a score of 0, 1, or 2 for each lesson activity. The number of

steps for activities varied, so for each rated activity, 80% or more of the steps had to be present for a rating of 2. Compliance between 65% and 79% received a rating of 1. Any procedure that had less than 65% compliance received a 0. Fidelity was calculated as the sum of the rater's scores for a lesson divided by the total possible points on a lesson multiplied by 100. In general, each lesson had about 16 lesson activities for a total possible score of 32. Interrater reliability was established when agreement between the raters was 95% on three consecutive lessons. The mean fidelity across lessons was 90% (*SD* = .07) with individual lesson ratings ranging from 79% to 100%.

Measures

Ratings

Academic Competence: Classroom teachers completed the Academic Competence subtest of the *Social Skills Rating System* (SSRS; Gresham & Elliott, 1990) to provide information about student academic performance. Teachers answered nine questions concerning students' math and reading achievement, cognitive skills, motivation, and parental involvement on a 5-point scale. Gresham and Elliott report a test–retest reliability of .93 for teacher-provided Academic Competence ratings. This score was used as a moderator variable.

Reading rating: We developed the *Teacher Reading Rating Form* to capture teachers' assessment of children's reading skills. Teachers rated each participating child on a scale of 1 to 5 (i.e., Overall Score). Scores of 1 or 2 indicated below grade-level performance and scores of 3, 4, or 5 represented skill at or above grade level. For children rated 1 or 2, teachers were asked to identify the specific areas of weakness for the child. The selections were decoding, fluency, vocabulary, comprehension, and motivation; teachers could select as many problems as were applicable to the child. The number of problems was summed to produce a Reading Problems score. Validity evidence was obtained with a large unselected sample of first-grade children (n = 256) by correlating both scores with concurrently obtained reading measures (Speece, Case, Cooper, & Schatschneider, 2007). The validity coefficients for the Overall Score with the Test of Word Reading Efficiency: Sight Word Efficiency, the Woodcock Reading Mastery Test–Revised/Normative Update (WRMT) Word Attack and Word Identification subtests were .69, .61, and .69, respectively. For Reading Problems, the validity coefficients with the same reading measures were −.49, −.39, and −.50, respectively. Although these latter coefficients are lower than those of the Overall Score, validity coefficients in the range of .40 to .50 are considered acceptable (Wood, Garb, & Nezworski, 2002). The predictive validity (fall ratings, spring test scores) was higher with values of −.50 for Word Attack and −.56 for Word Identification. The Reading Rating scores were used as moderator variables in the analysis.

Parent rating of reading: All parents provided demographic information on a researcher-developed form. In addition to providing race, ethnicity, and parental education information, parents were asked to rate their child's home reading behavior from 1 (rarely or never reads for enjoyment or asks to be read to) to 4 (*reads or asks to be read to almost daily*). The variable was used as a moderator of response to intervention.

Phonological Processing

Comprehensive Tests of Phonological Processing: The Elision and Rapid Letter Naming subtests of the *Comprehensive Tests of Phonological Processing* (CTOPP; Wagner, Torgesen, & Rashotte, 1999) were administered. The Elision subtest requires students to orally delete word parts and then produce the resulting word. For example, examinees are asked to say *toothbrush* without saying *brush* or say *cup* without /*k*/. The number of correct items was the score used in analyses. The Rapid Letter Naming subtest evaluates students'

ability to name quickly an array of five letters randomly arranged on a page. Students completed two probes and the score represented the average time in seconds to complete the task. For students ages 5 to 7 years old, the test–retest reliability is .88 for Elision and .97 for Rapid Letter Naming (Wagner et al., 1999).

Letter Sound Fluency: The *Letter Sound Fluency* measure (Speece & Case, 2001) assesses how quickly and accurately students can say the letter sounds associated with 26 lower-case letters randomly arranged on a page. The examiner provided standardized directions that included practice trials and instructed the students to say as many letter sounds as they could in 1 minute. Students' answers were scored as either correct or incorrect, with incorrect answers including skipped letters, mispronunciations, or letter sounds unidentified within 3 seconds. Two probes were administered, and the average number of letter sounds read correctly in 1 minute was used in analysis. Speece and Case reported an alternate form reliability of .93 and a validity coefficient of .66 with the basic reading cluster score of the *Woodcock-Johnson Psychoeducational Battery–Revised* (Woodcock & Johnson, 1989/1990).

Decoding

Decodable Word Fluency: The *Decodable Word Fluency* (Case & Speece, 2007) task was developed by the researchers to evaluate the students' knowledge of three- and four-letter decodable words randomly selected from the intervention lessons. The words increased in difficulty, and the score was the number of words correctly read in 1 minute. Omissions, mispronunciations, and answers provided after 3 seconds were marked as errors, but self-corrections within 3 seconds were not. Students received two probes at each measurement, and the scores were averaged for analysis. Test–retest/alternate form reliability was .83 for the current sample.

Word Attack: This subtest of the WRMT was administered to evaluate decoding skill. The subtest required students to decode nonwords, such as *tat* or *op*, within 5 seconds. The raw score was the total number of nonwords identified correctly. The raw score was used for analysis. Woodcock (1998) indicated that the reliability of the word attack subtest for first-grade students is .98. Furthermore, strong evidence of concurrent validity was established with third-grade children using well-known reading measures (Woodcock, 1998).

Word Identification

Word Identification: This subtest of the WRMT is untimed and requires students to read a list of printed words. The raw score is the number of words read correctly and was used in analysis. The reliability with first-grade students is .98 (Woodcock, 1998). Similar to the word attack subtest, concurrent validity with well-known reading measures was established with third-grade children.

Word Identification Fluency: The *Word Identification Fluency* measure (D. Compton, personal communication, 2003) assesses students' ability to quickly and accurately identify printed words. The test consists of a list of 50 common first-grade-level words that increase in difficulty. Students were assessed on two WIF probes per assessment, and the score was the average number of words read correctly in 1 minute. Students' responses were scored as either correct or incorrect, with incorrect responses including mispronunciations, skipped words, or words unidentified within 3 seconds. Test–retest/alternate forms reliability is .95 and concurrent criterion-related validity with the WRMT Word Identification subtest is .85 (Speece & Ritchey, 2005).

Additional Measures

Spelling: This untimed measure requires students to spell 10 CVC words and 2 CVCC words (with a consonant blend) (Ritchey & Coker, 2008). Although the test is untimed, prompts are provided to prevent students from struggling and becoming frustrated. Scoring was conducted in two ways: correct letter sequences and correct words. Median alternate-form reliability is .89 for correct letter sequence scoring, and .85 for correct word scoring (Ritchey & Coker, 2008).

Math Calculation Fluency: In this curriculum-based measure developed by L. Fuchs, Hamlett, and Fuchs (1998), students complete up to 25 addition and subtraction problems within 2 minutes. Two probes were administered at each assessment point, and the score was the average number of Correct Digits (CD) converted to a 1-minute metric. Marston (1989) reviewed the psychometric evidence for calculation. Reliability (various types: test–retest, internal consistency, parallel forms) for mixed problem types ranged from .93 to .98. Criterion-related validity was lower than for other CBM measures, with a median value of .43. Marston suggested that the criterion measures required reading skill that may have depressed the validity coefficients. This measure was administered to determine if growth in the reading intervention was specific to reading or perhaps was a function of learning in general.

Procedures

Following receipt of parent permission, children were screened on WIF. Thirty children were selected as participants based on WIF (described above). Within school, children were paired on their WIF scores and randomly assigned to either the intervention or control (usual class-room instruction) group. Prior to intervention, children were administered all norm-referenced measures (CTOPP, WRMT), *Decodable Word Fluency, Spelling,* and *Math Calculation Fluency*. We assessed all students at 3 weeks and 6 weeks after the start of the intervention to monitor progress in addition to administering these measures at pre- and posttest. The progress monitoring assessments administered included Letter Sound Fluency, Word Identification Fluency, Decodable Word Fluency, Spelling, and *Math Calculation Fluency*. After the intervention was completed, all measures administered at screening and pretests were re-administered. Four trained GRAs, three of whom were the tutors, individually administered the assessments to students. For progress monitoring and posttesting, GRAs did not administer measures in the school where they taught. Thus, tutors did not test the children they instructed. Teachers and parents provided their ratings prior to the start of intervention or shortly thereafter.

Four instructional groups were formed across the three schools. Each school had a group of four students whereas one school had an additional group with three students. Groups met outside of the classroom setting for 40 minutes, three times a week. Intervention ran for 11 weeks from the end of September to the 1st week of December. This time frame included weeks in which only one or two lessons were implemented (instead of three) due to progress monitoring or school holidays.

Data Analysis

Repeated measures analysis of variance (ANOVA) and growth curve analysis (GCA; Francis, Schatschneider, & Carlson, 2000; Singer, 1998) were used to examine differences between the intervention and control groups. For measures on which we collected only pre- and posttest data, we used repeated measures ANOVA. For measures on which we collected progress monitoring data, we used GCA to identify the best fitting unconditional model to describe children's growth across time for each progress monitoring variable, independent of any predictors (e.g., group assignment). Because we had four measurement points for the

progress monitoring variables, with the exception of *Math Calculation Fluency* for which we had three points, we could examine the intercept, slope, and quadratic parameters. The intercept was centered at the last measurement point. Then, if the parameters were determined to be random, that meant there was sufficient variance to test predictors of that variance in a conditional model. In these conditional analyses, the predictor of interest was group assignment. In both the repeated measures and growth curve analyses, we focused on the results for the Group × Time interaction. A significant interaction would indicate that the groups demonstrated differential progress over time.

To further assess responsiveness, we examined children's pre- and posttest scores on the variables that best discriminated the groups. Within group, we determined the number of children who scored below the sample mean at pretest and who then scored above the sample mean at posttest.

Our second question addressed moderators of growth for those progress monitoring variables that had a significant Group × Time interaction. The selected correlates (Reading Ratings, Academic Competence, and Parent Rating of Reading) were entered in a conditional model as described above for group assignment.

Results

Table 2 presents the descriptive statistics for pretest and posttest variables by group. Effect sizes were calculated via Glass's *d* statistic, which uses the control group's standard deviation in the denominator. This table also presents standard scores for norm-referenced measures for descriptive purposes, but these scores were not used in analyses. Table 3 includes the descriptive statistics for the progress monitoring measures across time points, and Table 4 presents descriptive statistics for the measures used as moderators. Correlations between the pretest and posttest measures and between the moderators and posttest measures are in Table 5.

Differences on Pre–Post Measures

Table 6 presents the Group × Time results for repeated measures ANOVA on the following measures: WRMT Word Attack and Word Identification, CTOPP Elision and Rapid Letter Naming. In all cases, the interaction was not significant, indicating that the intervention did not result in higher scores for the Intervention group. WRMT Word Attack and Word Identification Group × Time interactions were marginal with $p < .10$ with $d = .855$ and .491, respectively.

Differences on Progress Monitoring Measures

Unconditional models—The analyses focused on the following variables: Letter Sound Fluency, Decodable Word Fluency, Word Identification Fluency, Spelling–Words, Spelling–Correct Letter Sequences, and Math Calculation Fluency–Correct Digits. Analyses of Letter Sound Fluency and Decodable Word Fluency supported Random Intercepts, Random Slopes parameters indicating significant variance in each parameter. For Decodable Word Fluency, the quadratic term was fixed as it did not carry any independent variance. Analyses of Word Identification Fluency, Spelling–Words, and Spelling–Correct Letter sequences suggested Random Intercepts, Fixed Slopes models. The model for Math Calculation Fluency–Correct Digits was a Fixed Intercepts model, which indicated that there was not enough variance to model group effects. Thus, we concluded that the groups did not differ on math calculation. Table 7 contains the results for unconditional models associated with Decodable Word Fluency and Spelling–Words. As explained next, these were the two

models for which significant effects were found, so they are the only ones presented in the table.

Conditional models—The effect of interest was the Group × Time interactions. Significant interactions were found for Decodable Word Fluency, $F(1, 59) = 8.57$, $p = .005$, and- Spelling–Words, $F(1, 88) = 5.85$, $p = .02$. In both cases, the results favored the intervention group. Recall that the unconditional model for Spelling–Words had a fixed effect for slope. The significant Group × Time interaction indicates that the slope does not vary by child but by group; all children within a group have the same slope but the group slopes are different (nonrandomly varying slope; Bryk & Raudenbush, 1992).

Individual responsiveness—The percentage of children who scored below the sample mean at pretest and above the sample mean at posttest were examined by group for WRMT Word Attack (sample pretest $M = 90.0$ [$SD = 10.46$]; sample posttest $M = 102.8$ [$SD = 12.50$]), Decodable Word Fluency (sample pretest $M = 3.42$ [$SD = 2.13$]; sample posttest $M = 11.63$ [$SD = 6.65$]), and Spelling–Words (sample pretest $M = 2.90$ [$SD = 2.25$]; sample posttest $M = 7.33$ [$SD = 3.04$]. For Word Attack, 37% of the control group (4/11) and 75% (6/8) of the intervention group were considered responders. The respective percentages for Decodable Word Fluency were 25.0% (2/8) and 81.8% (9/11) and for Spelling–Words, 16.7% (1/6) and 71.4% (5/7). The median percentage difference between the groups was 54.7% favoring children who received the intervention.

Moderators of Growth

Several correlates were investigated to determine if they captured variance beyond that accounted for by group membership for Decodable Word Fluency and Spelling-Words. Table 4 presents the descriptive statistics for these variables by group, and Tables 8 and 9 present the results for the complete conditional models, respectively.

Parents' ratings of their child's home reading behavior had a significant relationship with Decodable Word Fluency, $F(1, 89) = 7.97$, $p = .006$. Figure 1 displays the relationship by graphing parent ratings of 2, 3, and 4. The figure indicates that for children in the intervention group, ratings of 3 or 4 (child reads or asks to be read to one or two times per week or *almost daily*, respectively) were associated with significantly better response to intervention than either (a) intervention children who were rated 1 or 2 or (b) control children regardless of rating.

The other significant finding was that teachers' ratings of Academic Competence significantly predicted growth in Spelling–Words, $F(1, 89) = 3.95$, $p = .05$, beyond that accounted for by group membership. The interaction is depicted in Figure 2 by graphing high, middle, and low Academic Competence ratings (+1 *SD*, *M*, and −1 *SD*). Intervention children who had higher Academic Competence ratings grew faster on spelling in the intervention than did intervention children with lower ratings. Academic Competence ratings did not appear to affect the children in the control group. The Teacher Reading Ratings did not explain growth beyond what was accounted for by the group variable.

Discussion

The purpose of this study was to test the validity of a short-term, supplemental reading intervention for first-grade children at risk for reading failure. This intervention was investigated to inform possible Tier 2 interventions with an RTI framework. Despite the interest in RTI models of assessment and instruction, there are relatively few studies that examine reading interventions that are implemented for less than half a school year. A critical component of RTI is early identification of children with academic problems. Early

identification within RTI requires short-term interventions to discriminate between children who need supplemental instruction to catch up with their peers from those who require more intensive instruction. Our results suggest cautious optimism.

Group Differences

We found that our intervention significantly affected growth in Decodable Word Fluency and spelling. The word fluency task was based on words randomly selected from the intervention. The results for spelling represent far transfer as the words assessed were not taught in intervention but required the skills taught in intervention. Effects for real and pseudoword reading were not statistically significant but were encouraging with effect sizes of .491 and .855, respectively. The lack of variability in the intercept and slope for Math Calculation Fluency demonstrates that the findings for reading were not due to a general growth in learning but rather were specific to the intervention.

In the studies we reviewed, spelling skills were not typically measured, so this finding adds to the list of possible effects of supplemental reading interventions for beginning at-risk readers. The significant effects for a fluency measure are in line with Allor and McCathren (2004) and D. Fuchs et al. (2008). However, our results are not as broad as these two studies as we did not find significant differences for untimed real and pseudoword reading. Both studies had larger samples and began intervention later in the year, which may explain differences.

In the current investigation, there were no significant effects for the norm-referenced measures of early reading. Similar to the reviewed studies, the largest effects were found for skills that were taught as part of the intervention using measures that were sensitive to small amounts of growth. In fact, only one study (D. Fuchs et al., 2008) reported statistically significant findings on word identification and word attack measures. It may be that short-term interventions lack the intensity to produce significant effects on broader norm-referenced measures and that solely using norm-referenced achievement measures to determine responsiveness may be insufficient to determine whether young at-risk readers are responding to an intervention. On the other hand, improvement in these areas may require additional instructional emphasis while maintaining the strengths of the phonological components.

With respect to individual intervention responsiveness, a higher percentage of children in the intervention group who received the lowest scores at pretest scored above the sample mean at posttest compared to children with the same scores in the control group. Given our sample size, the absolute number of intervention children who responded was small but provides an indication that the intervention can identify children who do and do not require more intensive reading instruction.

Moderators of Group Differences

We found that parents' rating of children's home reading behavior and teachers' ratings of Academic Competence moderated our significant intervention effects for Decodable Word Fluency and Spelling-Words, respectively. The parent rating may reflect a motivational component in that we asked parents to rate the extent to which their child either reads or asks to be read to at home. It is remarkable that this one item accounted for differences in responsiveness within the intervention group. Intervention children whose parents rated them as more interested in reading outperformed intervention children who were rated as less interested. Parent ratings did not explain the control children's performance. Our finding suggests that children who show more interest in reading will reap greater benefits from a focused intervention. Moreover, at-risk children (in the control group) who

demonstrate similar high interest in reading at home will not progress in general education classrooms to the extent that intervention children will. There is a small but growing literature on the role of parents, motivation, and reading achievement (Baker, Scher, & Mackler, 1997). Morgan and Fuchs (2007) reviewed 15 studies on the relationship between motivation and reading skill and found a reliable but modest relationship that increased over the elementary school years. None of the studies reviewed used parental reports. Morgan and Fuchs called for experimental studies that evaluated the effects of intervention on motivation. We did not explore whether there were posttest motivational differences attributable to the intervention. However, we did establish that higher pre-intervention levels of parent-rated home reading behavior were related to better word fluency scores for intervention children.

Teacher ratings of behavior have a strong empirical history of predicting child achievement. Ratings of children's attention to task- and work-related behaviors consistently predict achievement and response to intervention (e.g., McKinney, Mason, Perkerson, & Clifford, 1975; Stage et al., 2003; Torgesen et al., 1999). Speece and Ritchey (2005) reported that ratings of Academic Competence (the measure used in this study) uniquely predicted end of year reading skill in a multivariate model that included reading and reading-related variables. Similarly, Chard et al. (2008), using the same measure, found that Academic Competence interacted with first-grade children's alphabetic skills in predicting oral reading fluency at the end of first grade. They found, as did we, that children with higher Academic Competence had stronger skills. Academic Competence as measured by the SSRS (Gresham & Elliott, 1990) is an amalgam of teacher-rated skills: reading, math, motivation, parental support, and cognitive ability. Thus, it is difficult to pinpoint the "active ingredient" in the interaction predicting spelling skills. The finding suggests, at the least, that further examination of the construct may assist our understanding of who may respond to intervention and factors that may serve to enhance children's acquisition of early reading skills.

Intervention Components

The effectiveness of extensive long-term reading interventions is well documented (e.g., Wanzek & Vaughn, 2007). Far fewer studies have examined the efficacy of short-term reading interventions. The duration and intensity of our intervention was similar to other short-term reading interventions that we reviewed. Our intervention provided 16 hours of total instruction over 11 weeks. Of the studies we reviewed, two interventions were completed in 10 or fewer weeks (D. Fuchs et al., 2008; Hatcher et al., 2006), three were completed in fewer than 14 weeks (Allor & McCathren, 2004; McMaster et al., 2005; Ryder et al., 2008), and one spanned 16 weeks (Berninger et al., 2000). Intensity of the interventions varied as well, ranging from 8 to 28 hours, with a mean of 21.25 hours of instruction across the six studies we identified. Our intervention falls at the short end on both number of weeks and total number of hours of instruction, which, given significant findings, makes our results promising. Brief interventions may provide greater utility, in that some significant effects can be seen in as few as 11 weeks. In turn, decisions concerning responsiveness, and the need for further intervention, could be made in a relatively short amount of time.

Half of the studies we reviewed had trained research assistants implement the interventions, whereas two used teacher assistants and one relied on undergraduate college students. Training ranged from 3 hours to 4 days. Our tutors were experienced teachers who received 25 hours of training before intervention began. Further research should examine if similar results can be found with the same number of weeks and hours of intervention using tutors with less training. Given the scarcity of time and resources within schools, it would be

valuable to discover the minimum amount of training necessary for tutors to implement interventions with fidelity and achieve positive student outcomes.

Limitations

These findings need to be considered in the context of design limitations. Although analysis of moderators is a unique feature of our design, validity information for the parent report of home reading is limited to its significant interaction with Decodable Word Fluency. Further analysis of what this variable represents is warranted. Our design had limited power to detect statistical significance with only 30 participants. From this perspective, the findings are robust for Decodable Word Fluency and spelling, but a larger sample is needed to determine if the intervention can affect other transfer measures of fluency and accuracy. A post hoc power analysis with power set at .80 revealed that 23 children per group would be required to detect a large effect (e.g., .855, word attack) and that 64 children per group would be required to detect a medium effect (e.g., .49, word identification). Another issue is that the fall implementation of the intervention prior to examining response to general education reading instruction obviates direct parallels to RTI models (e.g., McMaster et al., 2005). Our goal was to validate a short-term reading intervention within the broad umbrella of RTI; we cannot say whether it would be effective for a group of children identified differently or who received intervention later in the year. However, because we used an experimental design, we can point to the medium to large effect size estimates to suggest that the control children, although making growth, were not able to match the intervention children's responsiveness. For example, the intervention group gained one standard deviation in word attack skills whereas the control group gained two thirds of a standard deviation. We also did not measure the extent to which the intervention children maintained gains. Evidence of this type would bolster validity claims.

Implications and Future Directions

The interactions with parent and teacher ratings provide important considerations for future work. There are few studies that investigate the link between home reading behavior and reading achievement in young children and none that investigate the relationship experimentally (Morgan & Fuchs, 2007). There are now several studies that link teacher ratings of academic competence with early reading achievement. This construct is complex and it is instructive to note that, in this study, the bivariate correlations with the posttest measures were small, with all but two being less than .30. It is tempting to speculate that the measure is tapping constructs such as motivation or intelligence. A broader selection of predictors would be needed to understand the relationship with growth in reading.

The evidence provided suggests that our short-term reading intervention is valid in that we found differential responsiveness at both the group and individual levels of analysis. This conclusion is tempered by the fact that several important reading variables did not differentiate the groups. Whether this is due to the small sample, brief intervention duration, or the intervention components requires further study. It is critical to gain more insight on the effectiveness of potential Tier 2 interventions that have short durations.

If these interventions are not effective in discriminating between children who do and do not need intensive intervention, it would suggest that short-term Tier 2 instruction may not function as intended in the identification of children in need of more specialized instruction. If Tier 2 instruction needs to be implemented over longer periods, then the prospect of early identification is diminished. This study provides tentative evidence that briefer interventions may be helpful in an RTI framework focused on early identification.

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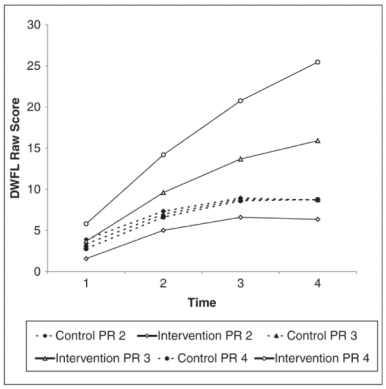

Figure 1.
Interaction of group, time, and parent rating of home reading behavior (PR) for Decodable Word Fluency predicted scores

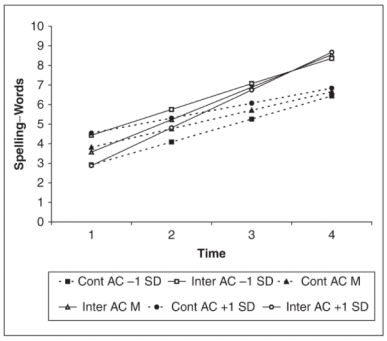

Figure 2.
Interaction of group, time, and Academic Competence (AC) for spelling predicted scores Cont = control ; Inter = intervention; M = mean; SD = standard deviation.

Table 1

Demographic Data for Students

Variable	Intervention *n* = 15	Control *n* = 15	Participants *n* = 30	Screened *n* = 60
% female	33	60	47	43.3
Age *M (SD)*	6.7 (.34)	6.6 (.27)	6.6 (.31)	6.6 (.33)
Race %				
African American	53.3	46.6	50	46
Asian	0	6.6	3	2
Caucasian	13.3	20	17	23
More than 1 race	13.3	6.6	10	12
Did not report	20	20	20	17
Mother's education %				
High school graduate or less	33	40	37	38
Some college/vocational training	47	33	40	20
College degree	7	27	17	13
Graduate degree	13	0	6	2

Table 2

Descriptive Statistics for Pretest and Posttest Only Measures

	Pretest		Posttest		
	Intervention	Control	Intervention	Control	
Variable	M (SD)	M (SD)	M (SD)	M (SD)	ES
CTOPP Elision[a]	4.47 (2.5)	3.36 (2.0)	6.07 (3.2)	4.80 (3.1)	.407
CTOPP Elision SS	8.60 (2.44)	7.86 (2.25)	9.13 (2.47)	8.40 (2.82)	
CTOPP RAN Letters	40.90 (11.83)	43.93 (13.72)	28.90 (4.68)	33.97 (6.72)	−.754
WRMT Word Attack[a]	1.20 (1.70)	0.93 (2.1)	8.80 (4.8)	5.13 (4.3)	.855
WRMT Word Attack SS (grade)	92.07 (10.92)	87.93 (9.92)	108.13 (7.47)	97.47 (14.39)	
WRMT Word Identification[a]	9.33 (4.27)	10.47 (3.7)	24.33 (4.9)	21.20 (6.4)	.491
WRMT Word Identification SS (grade)	101.80 (5.87)	103.20 (5.10)	107.07 (2.99)	104.93 (5.95)	

CTOPP = *Comprehensive Test of Phonological Awareness*; WRMT = *Woodcock Reading Mastery Test*; SS = standard score; ES = effect size.

[a]Raw scores used in analysis.

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Table 3

Descriptive Statistics for Progress Monitoring Measures

	Time					
	1	2	3	4	5	
Variable	**M (SD)**	**M (SD)**	**M (SD)**	**M (SD)**	**M (SD)**	**ES**
Letter Sound Fluency						0.431
Intervention	18.57 (10.52)	–	33.08 (13.45)	40.75 (16.03)	47.09 (11.63)	
Control	17.67 (13.69)	–	28.43 (14.28)	30.75 (16.46)	38.66 (19.45)	
Decodable Word Fluency						1.47[a]
Intervention	–	3.27 (1.90)	9.53 (8.07)	12.53 (5.87)	14.60 (7.52)	
Control	–	3.57 (2.39)	6.17 (4.30)	9.30 (5.40)	8.67 (4.02)	
Word Identification Fluency						0.457
Intervention	2.40 (0.095)	–	8.93 (9.84)	6.97 (3.17)	9.33 (2.93)	
Control	2.67 (1.03)	–	6.07 (2.75)	6.37 (3.22)	7.73 (3.50)	
Spelling–Words						0.788[a]
Intervention	–	2.87 (2.29)	6.13 (2.92)	6.73 (3.75)	8.33 (3.29)	
Control	–	2.93 (2.28)	5.73 (3.31)	5.47 (2.59)	6.33 (2.50)	
Spelling–CLS						0.612
Intervention	–	23.93 (8.92)	34.73 (9.28)	35.67 (11.09)	39.80 (9.87)	
Control	–	23.60 (10.84)	32.47 (10.61)	32.73 (8.27)	35.33 (7.30)	
Math–Correct Digits						0
Intervention	–	2.13 (2.36)	9.40 (3.44)	–	7.00 (2.90)	
Control	–	3.07 (2.79)	9.27 (3.45)	–	7.00 (3.44)	

CLS = correct letter sequence; ES = effect size calculated at Time 5 (posttest).

[a]Variables were involved in significant interactions and effect sizes are presented for comparison to other studies.

Table 4

Descriptive Statistics for Rating Measures

	Intervention	Control
Variable	**M (SD)**	**M (SD)**
Academic Competence	28.60 (5.50)	26.93 (5.27)
Overall Reading	2.20 (0.77)	1.87 (0.83)
Reading Problems	2.07 (1.67)	2.13 (1.77)
Parent Ratings of Reading	2.87 (0.64)	2.93 (0.80)

Table 5

Correlations Between Pretest–Posttest Measures and Moderator–Posttest Measures

Measure	1	2	3	4	5	6	7	8	9	10
1. CTOPP Elision	.776	−.373	.196	.389	.455	.307	.317	.558	.549	−.019
2. CTOPP RAN Letters	−.268	.589	−.469	−.471	−.413	−.437	−.396	−.382	−.233	−.308
3. Letter Sound Fluency	.473	−.298	.587	.392	.551	.329	.372	−.307	.416	−.017
4. Decodable Word Fluency	.134	.004	.321	.294	.407	.405	.509	.368	.445	.129
5. WRMT Word Attack	.533	−.164	.320	.210	.386	.114	.367	.421	.549	.082
6. Word ID Fluency	.218	−.064	.152	.295	.217	.345	.453	.267	.529	.006
7. WRMT Word ID	.092	−.021	−.121	.153	.078	.319	.568	.031	.492	.285
8. Spelling–Words	.537	−.203	.295	.350	.495	.422	.484	.599	.676	.034
9. Spelling–CLS	.598	−.249	.310	.329	.405	.242	.028	.627	.705	.278
10. Math Calculation Fluency	−.008	.112	.099	.156	.263	.222	.243	.233	−.068	.397
11. Overall Reading	.130	−.450	.341	.333	.132	.416	.374	.051	.017	−.164
12. Reading Problems	−.041	.333	−.189	−.312	−.050	−.312	−.267	.101	.091	.196
13. Parent Ratings of Reading	.362	−.134	.169	.312	.220	.084	.230	.344	.333	−.184
14. Academic Competence	−.039	−.324	.158	.227	.042	.308	.203	.104	.118	.125

CTOPP = *Comprehensive Test of Phonological Processing*; WRMT = *Woodcock Reading Mastery Test*; CLS = correct letter sequence. Correlations ≥ .36, $p < .05$.

Table 6

Results for Repeated Measures Analyses of Variance on Pretest–Posttest Only Measures

	df	F	p
CTOPP Elision	1, 55		
Group		2.76	.102
Time		4.53	.038
Group × Time		0.01	.913
CTOPP RAN Letters	1, 56		
Group		2.49	.120
Time		18.31	<.0001
Group × Time		0.16	.694
WRMT Word Attack	1, 56		
Group		4.73	.034
Time		42.53	<.0001
Group × Time		3.53	.065
WRMT Word ID	1, 56		
Group		0.62	.436
Time		101.89	<.0001
Group × Time		2.80	.099

CTOPP = *Comprehensive Test of Phonological Processing*; WRMT = *Woodcock Reading Mastery Test.*

Table 7

Unconditional Models for Decodable Word Fluency and Spelling–Words

	Fixed Effect			Random Effect		
	Coefficient	**SE**	**t**	**Estimate**	**SE**	**z**
Decodable Word Fluency						
Intercept	11.68	1.32	8.85*	44.18	13.22	3.34*
Slope	−0.003	0.22	−0.02	0.13	0.66	2.01*
Quadratic	−0.06	0.02	−3.48*			
Residual				8.53	1.57	5.43*
Spelling–Words						
Intercept	7.57	0.51	14.79*	5.53	1.68	3.29*
Slope	0.34	0.38	8.98*			
Residual				3.38	0.51	6.67*

* $p < .05$.

Table 8

Complete Conditional Model for Decodable Word Fluency With Group and Parent Rating of Home Reading

Variable	Estimate	SE	df	t
Fixed effects				
Intercept	−12.75	6.48	26	−1.97
Group	21.38	8.41	89	2.54*
Time	−1.53	0.49	26	−3.11*
Time × Time	−0.06	0.01	26	−4.30
Group × Time	1.14	0.60	89	1.90
PR	9.56	2.21	89	4.33*
PR × Group	−9.52	2.83	89	−3.37
PR × Time	0.62	0.16	89	3.93*
PR × Group × Time	−0.57	0.20	89	−2.82*

PR = Parent Ratings of Home Reading.

*$p < .05$.

Table 9

Complete Conditional Model for Spelling–Words

Variable	Estimate	SE	df	t
Intercept	7.64	4.00	26	1.91
Group	−2.25	5.61	86	−0.40
Time	−0.06	0.28	86	−0.23
Group × Time	0.61	0.39	86	1.57
AC	0.03	0.14	86	0.24
AC × Group	0.01	0.20	86	0.07
AC × Time	0.02	0.01	86	1.78
AC × Group × Time	−0.03	0.01	86	−2.04*

AC = Academic Competence.

*p < .05.

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